



C123 – Intermediate Shafts

Limmo Peninsula Shaft Site Specific Written Scheme of Investigation

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Definitions

ADS	Archaeology Data Service
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
CPFR	Crossrail Project Functional Requirements
CRL	Crossrail Ltd
dB	Decibel
dB(A)	Decibel (ambient)
DDA	Disability Discrimination Act
DDBA	Detailed Desk Based Assessment
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
EH	English Heritage
EWMA	Enabling Works Managing Agent
GLAAS	Greater London Archaeological Advisory Service
GLHER	Greater London Historic Environment Record
HER	Historic Environment Record
HF	Human Factors
HMRI	Her Majesty's Railway Inspectorate
IDC	Inter-disciplinary Design Check
IDR	Inter-disciplinary Design Review
IfA	Institute for Archaeologists
IRD	Initial Reference Design
km	Kilometre
km/h	kilometres per hour

LBN	London Borough of Newham
LBTH	London Borough of Tower Hamlets
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	Metres
M&E	Mechanical and Electrical
MDC	Multi-Disciplinary Consultant
MDC4	Multi-Disciplinary Consultant 4, Halcrow
MoL	Museum of London
MoLAS	Museum of London Archaeology Service
NLL	North London Line
NLBH	Non-Listed Built Heritage
NR	Network Rail
OD	Ordnance Datum
O&M	Operations and Maintenance
OHLE	Overhead Line Equipment
OSBM	Ordnance Survey Bench Mark
OSD	Over Site Development
OSL	Optically Stimulated Luminescence
PDP	Project Delivery Partner
RM	Requirements Management
RMP	Requirements Management Plan
RSPG	Railway Safety Principles and Guidance
SI	Systems Integration/Site Investigation
SMR	Sites and Monuments Record
SRA	Strategic Rail Authority
SRC	Systems and Rolling Stock Consultants
SRS	Systems Requirements Specification
TWB	Targeted Watching Brief
TBM	Tunnel Boring Machine
TfL	Transport for London
TOC	Train Operating Company
VE	Value Engineering



VM Value Management
SSWSI Site Specific Written Scheme of Investigation

1 Executive Summary

C123 has updated this Site Specific archaeological Written Scheme of Investigation (SSWSI) following archaeological investigations (evaluation and watching brief) at Limmo Peninsula shaft, London Borough of Newham (LBN), as part of the Crossrail development. This document has been compiled using the information on the Crossrail works available at the RIBA Stage F design stage.

The Limmo Peninsula shaft site lies east of the lower part of the River Lea, and west of Victoria Dock Road/Silvertown Way/Dock Road. It consists of two main areas, a storage/treatment compound for excavated material from tunnelling from the Limmo Peninsula shaft, and a conveyor for excavated material leading south to a barge loading facility at Instone Wharf at the mouth of the Lea.

The archaeological investigations that were undertaken to assess the archaeological resource and mitigate the effect of the scheme were trial trenching, geoarchaeological assessment and watching brief.

The geoarchaeological assessment identified late Pleistocene (Allerod interstadial deposits) and Holocene geoarchaeological sequences, but no activity between prehistoric alluvial deposits and the nineteenth century by the Thames Iron Works and Ship Building Company. The development of the area in the nineteenth to early twentieth century is shown on Figures 4-8.

The evaluation identified elements of the Thames Ironworks and Ship Building Company Ltd that was located on the site between 1846 and 1912. The earliest activity at the site was represented by a build up of material in the form of iron concretions and slag that may have been used to consolidate the marshland to create a surface suitable to build on. This was followed by evidence for at least two phases of activity dating to the use of the ironworks including brick structures, footings for machinery and working surfaces (Crossrail 2011).

Based on the results of the archaeological investigations, a Targeted Watching Brief (TWB) is recommended during the excavation of the shaft during the removal of the alluvial and Thames Iron Works layers; the specification for this is provided in Section 8.

Please note that contaminant concentrations exceeding human screening values have been identified in the ash material; see Contamination Assessment of the Gas Main Diversion at Limmo Peninsula Shaft (Document No. C123-JUL-T1-RST-CR144_SH011_Z-00001).

2 Project Background

2.1 Project Background and Site Location

C123 has been appointed to undertake a Site Specific Written Scheme of Investigation (SSWSI) covering the proposed Limmo Peninsula shaft worksite as part of the C123 Intermediate Shafts contract of the Crossrail project.

Crossrail is a new rail link project which will provide a transport route in the south-east and across London. The line will provide a range of both new and improved rail journeys across London and its immediate surroundings. The proposed development will include the construction of seven stations within central London which will have interchange with other public transport modes including the London Underground, National Rail and the London Bus service; the development will also include the renewal and/or upgrade of existing stations outside central London. The route itself will link Maidenhead and Heathrow in the west with Shenfield in the north-east and Abbey Wood in the south-east.

The Limmo Peninsula shaft site lies east of the lower part of the River Lea, and west of Victoria Dock Road/Silvertown Way/Dock Road, National Grid Reference 539,480/180,980. It consists of two main areas, a storage/treatment compound for excavated material from tunnelling from the Limmo Peninsula shaft, and a conveyor for excavated material leading south to a possible barge loading facility at Instone Wharf at the mouth of the Lea.

Due to its former industrial use, the Crossrail Environmental Statement identifies the Limmo Peninsula shaft as a site of potentially significantly contaminated land. More recently the ground level on the Limmo Peninsula shaft was raised by c. 5m with excavated materials arising from the construction of the DLR.

2.1.1 Summary of previous Crossrail studies

The principal studies are as follows:

- Crossrail, Environmental Statement, February 2005;
- Crossrail, Assessment of Archaeology Impacts, Technical Report. Part 4 of 6, South-East Route Section, 1E0318-E2E00-00001, February 2005 [Specialist Technical Report (STR)];
- Crossrail, Amendment of Provisions 1, January 2006;
- Crossrail, Amendment of Provisions 3, November 2006;
- Crossrail, Archaeology Programming Assessment, November 2006;
- *Crossrail, MDC4 Archaeology Updated Baseline Assessment, January 2008; and*
- *Crossrail, Archaeological Monitoring of Ground Investigations, Borehole Package 11, Limehouse to North Woolwich, January 2008.*

2.2 Summary of Previous Assessment Work and Archaeological Investigation

The Crossrail Generic WSI (Document No. 14022008-44ES-P2Z1) outlines how the arrangements and controls for managing archaeology will be met in designing and constructing Crossrail. It also provides a framework for archaeology which will ensure that the works conform to a common project standard.

The Environmental Statement and supporting Specialist Technical Report (STR): 'Assessment of Archaeology Impacts' (Document No. 1E0318-E200-00001) presents the outcomes of the archaeological studies undertaken as part of the Environmental Impact Assessment. The assessment included the likelihood of archaeological resources being present in land affected

by the project, their importance and the extent to which they will be physically affected by the construction and operation of Crossrail.

A Detailed Desk Based Assessments (DDBA) was not produced for the Limmo Peninsula shaft due to what was considered to be 'the relatively low impact of the proposed worksites'. The SSWSI is a live document and is updated at each activity stage that provides further information about the archaeological resource. This SSWSI includes additional archaeological information, in particular on geology/topography and deposit survival.

A Non-Listed Built Heritage (NLBH) survey was undertaken by MDC4 in 2009, however, the survey was inconclusive as vegetation prevented identification of surface remains. The results of the work did not identify any NLBH, however, the site was not accessed and further surveys were suggested. C123's Archaeologist viewed the site after site clearance on 5th May 2010; this was done from the A1020 fly-over. No evidence of NLBH was identified in the gas main diversion area.

Archaeological monitoring of ground investigations was undertaken by C261 between 16/09/2009 and 17/11/2009; Ground Investigation Package 19A (Figure 3). The report on the works was issued on 13/04/2010. The report provided the following summary:

'The watching brief provided the first evidence of survival of a structure from the Thames Ironworks, part of a furnace or similar at the northern tip of the Crossrail site, at 1.86m OD (101.86 ATD). The deep modern dumping further south may have prevented the other test pits from reaching similar remains, which are unlikely to be identified in boreholes.'

More extensive deposits of ash and other foundry waste have been recorded across the site at levels varying between 1.74 and 5.40m OD (101.74-105.40 ATD). These appear to represent levelling of the site with waste materials following its closure in 1911, although some may well be redeposited in later dumping (particularly at higher levels).

Re-deposited building material and waste were identified in the trial pits within the modern dumping which overlay the ironworks deposits (where present). This included granite setts, industrial slag/waste, and fire bricks and tiles from furnaces or related industrial structures. This modern Made Ground varied between 1.2m and to 8.0m deep.'

Limmo Peninsula	
Deposit	Level (top of deposit)
Modern Made Ground	4.9–11.1m OD (104 - 11.10m ATD)
Ash and other foundry waste	1.7–5.4m OD (101.70 – 105.40m ATD)
Thames Ironworks furnace or similar structure	1.86m OD (101.86m ATD)

Table 2.2.1 Summary of deposit heights

These observations provide an initial impression of the levels at which foundry remains might be found. However, given that there is only one identification of structural remains (from the northern tip of the site where there is less modern overburden), and that some of the waste seen elsewhere could be re-deposited, these figures should be treated with caution as they may not be representative of levels of survival in other parts of the site. (Taken from Crossrail 2010).

An archaeological watching brief was undertaken on two stopple connection pits, as part of the gas main diversion, in August 2010. The work identified nineteenth century deposits associated with the land reclamation process prior to the construction of the Thames Ironworks.

A combination of geoarchaeological assessment, trial trench evaluation and watching brief was undertaken in November and December 2010.

The geoarchaeological assessment consisted of two window samples within Trench 1; references AH1 and AH2. The lowest natural deposits were Pleistocene gravels located at 99m ATD. These were overlain by organic silt deposits interpreted as possible Allerod deposits, which were sealed by Holocene deposits in the form of fine to medium sands with granular flint and gravel. Historic alluvial layers were identified at 97.8m to 102.35 ATD.

An archaeological evaluation, comprising two trial trenches, was undertaken in November 2010. The earliest material identified in Trench 1 comprised clinker material used as a consolidation layer. A north-west – south-east orientated building was identified at the eastern end of the trench. The function of the structure is uncertain, however, it corresponds to a building identified on the 1869 Ordnance Survey map. Other features included a series of concrete pads, interpreted as footings for machinery, and associated timbers and floor surfaces. The structure was sealed by a series of deposits associated with the abandonment of the area.

Clinker material similar to that identified in Trench 1 was the primary deposit identified dating to the nineteenth century in Trench 2. A rectangular brick structure, with two parallel horseshoe shaped flues was identified in Trench 2 (Plate 1); referred to as Structure 31. It comprised two barrel vaulted brick flues. The function of the feature is uncertain, but the flues exhibit evidence of exposure to extreme heat. The structure appears to correlate with buildings identified on the Ordnance Survey maps of 1846 and 1869, but not on the later 1912 map (Crossrail 2011).



Plate 1 Structure 31 in Trench 2.

2.3 Geology and Topographic Setting

The site lies within the alluvial floodplain of the River Lea and within the wider alluvial floodplain of the River Thames.

Five Crossrail boreholes have been monitored archaeologically within the southern part of the Limmo Peninsula shaft site, c.50 to 70m north of the Lower Lea Crossing (Crossrail 2008b). Of particular geoarchaeological interest were late Pleistocene/Glacial Allerod channel deposits and peat, sealed at c. 94.5 to 96m ATD beneath the Holocene gravels; the base of these deposits lay at c. 94 to 95.5m ATD.

The early prehistoric alluvial sequence was previously thought to have been removed across the site by river scour from later meandering of the River Lea. The Holocene Floodplain/Shepperton gravels lay at c. -4m - -3m OD (96 to 97m ATD), above which lay alluvial deposits, most or all of which are thought to represent late prehistoric infilling of channels of the River Lea. More recent boreholes suggest that areas of intact prehistoric sequences, e.g. in situ peat, survive towards the eastern margins of area, but their extent is not known; no peat was identified in boreholes taken across the current site as part of the earlier ground investigation works (Crossrail 2010). The surface of the Alluvium in Crossrail boreholes at the Limmo Peninsula shaft was generally consistent at 2 – 2.50m OD (102m to 102.5m ATD).

Two window samples collected as part of the evaluation at Limmo identified Pleistocene gravels at 94.92-94.45 ATD that were overlain by possible Allerod deposits at 97.2m to 97.38m ATD. These were overlain by Holocene gravels and historic Alluvium to a maximum height of 101.2m ATD (Crossrail 2011).

It should be noted that Instone Wharf to the south currently lies at 5-5.40m OD (105.0 to 105.4m ATD). This suggests that the river frontage has been raised above the general ground level of c. 2m OD (102m ATD) seen further to the east of both parts of the site. It is therefore possible that the Ironworks also had raised areas along the river frontage.

Modern ground level varies across the site with the depth of modern land raising. Considerable modern land raising has occurred on the Limmo Peninsula shaft part of the site, and it is understood that this is mainly excavated material from DLR tunnelling. However, a 1952 Ordnance Survey map shows a combination of some mounding with extensive cleared areas. This suggests that some of the Made Ground may represent clearance of bombed buildings etc after the Second World War.

The Crossrail boreholes as part of Package 19A recorded Made Ground varying from c. 8 to 9.5m deep, below ground levels of c. 110.4 to 110.7m ATD; however, as the elevated Lower Lea Crossing lies at only c. 106m ATD, it is possible that the borehole records may be misleading.

2.4 Archaeological and Historical Development of the Site

The following summary is drawn mainly from Technical Report 'Assessment of Archaeology Impacts, Part 4 South-East Route Section, February 2005', which should be consulted as it contains extensive further details. In the 'Crossrail MDC4 Archaeology Updated Baseline Assessment, January 2008, there were no changes in designation or new baseline data.

The site lies within an Archaeological Priority Area designated by the LBN. It does not include any Scheduled Monuments, Listed Buildings or other designations.

2.4.1 Prehistoric Period — c. 500,000BP to AD50

Following the end of the last glaciation, c. 15,000 to 10,000 BP the Thames and the Lower Lea formed a landscape of braided channels. These would have deposited organic sediments as they fell into disuse, c. 11,000 to 9,000BP. The local environment would have consisted of marshlands and shallow watercourses flowing around higher islands of sands and gravels.

Mesolithic hunter-gatherers would have exploited the area for food and other resources. The water levels gradually rose through the Neolithic and Bronze Ages and this formed marshes along the Thames and Lower Lea valley. Permanent settlement was centred upon the higher ground on the gravel terraces to the north of the site. Movement around the wetlands was difficult, although timber track ways were used during the Neolithic and Bronze Age to access areas of high ground.

2.4.2 Floodplain gravels (13,000 to 7,000 BC)

Sands and gravels identified during geotechnical works were deposited under a braided river environment during the final phases of the last (Devensian) glaciation (c 15,000 to 10,000 years ago). These sediments represent the Shepperton Gravel formation. The monitored works show the surface of these gravels between -4.52 and -2.65m OD (95.48 – 97.35 ATD) at Limmo Peninsula, and slightly higher at Victoria Dock Portal (VDP) between -1.57 and -2.6m OD (98.43 – 97.40 ATD). Undulations in this surface likely reflect preferential scouring of softer underlying beds of Tertiary sedimentary units. Downcutting events occur at the end of cold stage episodes (stadials) and were initiated by the great volume of meltwater introduced into the system during the initial thawing of ground ice. This is coupled by very low sea-levels during these periods which ultimately led to an incision/downcutting event. These sediments provide the base upon which Holocene and later archaeological deposits develop. However, it is as yet uncertain whether the fluvial sands and channel marginal deposits identified across much of the site are of Late Devensian or Holocene date and their date would affect the archaeological potential of the lower part of the site sequence. At the Limmo Peninsula site, within CH62, an organic silty clay deposit was recorded at -3.35m OD (96.65 m ATD). This unit is recorded in the logs as possible backfill but may relate to deposits from the Allerod interstadial (c 15,000–13,000 BP) found in this area previously (Crossrail 2008a). Window Sample AH2 identified possible Allerod deposits in the form of dark brown organic silts at 97.2m to 97.38m ATD.

2.4.3 Fluvial margins and vegetated sand bars (10,000 to 4,000 BC)

Overlying the floodplain gravels, sands and sandy silts were recorded, between -1.2 and -4.02m OD (98.80 – 95.98 ATD) at Limmo Peninsula, and between -1.13 and -2.5m OD (98.87 – 97.50m ATD) at Victoria Dock Portal (VDP). These deposits probably formed during the early Holocene when high water flux evident at the end of the Devensian glaciations had abated to an extent and lead to a reduction in the size of the particles which the river could entrain. However, medium to coarse sand, still available in the fluvial system, was still being transported along the river and was being deposited and banked up against gravel highs, or forming point and mid-channel bars within the network of anastomising (braided) channels. The deposits are thinner at the VDP site indicating less fluvial influence here.

These sediments most likely accreted over long periods of time and would have most likely been subject to occasional hiatuses in deposition, allowing soil formation (pedogenesis) to occur, forming light soils which would have been appealing to Mesolithic populations roaming the landscape along channel margins in search of resources. The potential for finds of Mesolithic age, such as flint scatters, is therefore higher within sand units, especially where possible palaeosols (buried soils) have formed within these deposits. Sand bodies such as these have been observed at West Silvertown Urban Village (Wilkinson et al 1996; 2000) and Fort Street (Wessex 2000). Optically Stimulated Luminescence (OSL) dating would be useful in confirming an Early Holocene date for these sediments (if required). In addition, the environmental evidence potential of these deposits is very low, as sands commonly show poor preservation of such remains.

2.4.4 Wooded marshland (4,000 – 700 BC)

Previous work from the Canning Town area records a woody peat overlying the gravels between –1.94 and –2.94m OD (98.06 – 97.06 ATD). The dating evidence suggests that the development of peat was Late Neolithic to Late Bronze Age (Yendell 2009). This is a period of eustatic sea level rise (global changes in sea level relating to water mass as opposed to other factors) and rapidly developing woodland.

No evidence of this peat layer has been found within the works monitored at the Limmo Peninsula. The absence of this layer is probably a result of river scour in later prehistory and during the historic period, which eroded much of this evidence from areas closer to the modern river. In addition, thick estuarine mud deposits representing extensive historic mudflats and creeks that developed at the confluence of the Thames and the Lea have been recorded on the Limmo peninsula and nearby areas, directly overlying the truncated / eroded prehistoric sequence.

2.4.5 Roman Period — AD50 to 450

The area remained marshy during the Roman period and there would have been little settlement activity as a result. However, there may have been Roman flood defences constructed along the river margins. Roman flood defences along this stretch of river, continued through later periods. Assessment of the borehole/window sample data indicates that there is no direct evidence of Roman activity in the alluvial deposits.

2.4.6 Medieval Period — 450 to 1540

The site was once again part of the marshy areas of the Thames floodplain after water levels rose. The medieval manors of West and East Ham were located to the north on the higher, drier ground. The medieval manor of Covelees, GLHER 061808, is thought to be located at the mouth of the River Lea although its precise location is not known; no evidence for the manor was identified during the evaluation and it may be possible that if it was on the site that later activity has truncated any remains. In addition there have been isolated medieval artefacts discovered including a lance head and a spur, GLHER 061767, 081780 and 061780.

2.4.7 Post-medieval Period — 1540 to Present

By the early seventeenth century much of the extensive marshland had been drained and reclaimed this process continued into the nineteenth century when the site was open grazing and farmland protected by dykes and embankments.

The site was occupied between 1846 and 1912 by the Thames Ironworks and Shipbuilding Company, who built HMS Warrior, the first steam powered iron hulled armoured warship; launched in 1860 but obsolete within a short period. The 1920 Ordnance Survey (OS) map shows that the site remained occupied by large ship repair yards, including extensive buildings, a dock and slipways and an internal railway system. The plans of the buildings shown in 1920 are the same as those shown on the 1867, 1894, 1914, and 1916 OS maps, suggesting that there were not extensive alterations to the buildings and docks during the period immediately following their closure.

2.4.8 The Thames Ironworks and Shipbuilding Company Ltd (Figures 4-8).

The former site of the Thames Ironworks and Ship Building Company began its existence as Ditchburn and Mare in 1838/39. The company was founded by Thomas Ditchburn, a shipwright, and Charles Mare, a naval architect. The company began building small iron paddle steamers of 50-100 tonnes, but after Ditchburn's retirement Mare began an ambitious programme of

expansion under the new company name C J Mare and Company. The original site started on the south side of the River Lea, north of Trinity Road (Figure 7). Mare bought land on the Essex side of the River Lea (north) and established a yard that was capable of building ships weighing between 2000 to 4000 tonnes. Mare nearly became bankrupt and it was his Father-in-Law, Peter Rolt MP (a timber merchant), who purchased the firm's assets in 1856. In 1857 he then assigned them to a new company, with limited liability, that was called the Thames Iron Works and Ship Building Company Ltd. The objective of the company was *'the building of ships, forging, casting and rolling of iron, the construction of wrought and cast ironwork generally, and all such works and business as may be incident thereto'*.

The majority of the work was undertaken on the eastern bank of the River Lea, which expanded from 4ha in 1856 to 12ha by 1891. With the expansion to the north on the opposing river bank, the Thames Iron Works and Ship Building Company became the largest and most important ship building company on the River Thames. One of its first contracts was in 1860 for *HMS Warrior*, the largest ironclad warship in the world. In 1861 the *Mechanics Magazine* dubbed it as *'Leviathan Workshopsof a truly cyclopean type'*. The company also produced ironwork for civil engineering projects including ribs for the domes of the International Exhibition Building (1862), the roof for the Royal Aquarium in Westminster, Blackfriars Railway Bridge in 1860-69 and Hammersmith Suspension bridge (1883-87). The company eventually went into decline in part due to its reliance on building warships; the Admiralty preferred the northern shipyards with their cheaper prices due to access to coal. The invention of dreadnoughts created a brief resurgence in 1909-11, but after the launch of *HMS Thunder* in 1911 the banks refused loans and the site closed in 1912. The Thames Ironworks Football Club was founded in 1895 by the then owner of the works Arnold Hills; the club would later become West Ham United (Porter 1994, 672-75).

An account of the site published in 1863 describes the works.

'To the right of the farthest down slip stands the mould loft, and along the heads of the lower slips stand the angle iron binding shop, and some press sheds. Between the lower and the upper slips the great workshops are situated. These comprise the foundry of rolled and hammered iron, a range of smithies, a copper-foundry, and an iron rolling-mills shop; behind which are the forge and forge shop, the tool shop, and another press shed. To the rear again of these workshops there are the engineers' shop, the boiler-makers' shop, the angle iron shop, and the pattern shop range of buildings. In the extreme rear and skirting the first bend of Bowcreek are the saw-pits, saw-mills, joiners' shops, and foundries' (Berry 1863, 211).

Towards the northern end of the Limmo Peninsula, TP558 revealed an in situ brick structure consisting of an east-west wall and associated floor, recorded at 1.86m OD/3.10m bGL (101.86m ATD). The wall and floor were constructed of fire bricks which showed evidence of in situ exposure to high temperatures, and appear to have been part of a furnace or other foundry structure. A hand annotated drawing dating to 1992 indicates that the buildings in this area were producing iron and galvanised iron. These buildings are identified on Bacon's map of 1900 as the buildings belonging to the Thames Ironworks that occupied the site (Figure 7).

The evaluation identified at least three phases of activity relating to the development of the Thames Ironworks and Ship Building Company. The earliest activity was a rectangular brick structure identified on the 1869 Ordnance Survey map (Figure 8); as noted above its function is uncertain. Timber beams found within rammed clinker floor surfaces and concrete platforms are likely to have been footing for machinery. Structure 31 was used for an industrial process, but the specification function has not been identified (Crossrail 2011).

Overlying the structures was a layer of demolition rubble, over which was a layer of ashy gravel and sand that may represent foundry waste used as a post-demolition levelling deposit, at 2.56m OD/2.40m bGL (102.56m ATD). To the south, in TP557, a 0.40m thick layer of ash may also represent levelling with foundry waste, and lay at 1.74m OD/3.20m bGL (101.74m ATD).

Similar deposits were recorded in boreholes CH57R at 5.40m OD/5.5m bGL (105.40m ATD), CH58R at 3.74m OD/7.00m bGL (103.74m ATD), CH59 at 3.08m OD/8.00m bGL (103.80m ATD), CH60 at 4.66m OD/1.22m bGL (104.66m ATD), CH61R at 3.78m OD/7.00m bGL (103.78m ATD), CH64 at 3.82m OD/7.00m bGL (103.82m ATD), CH85R at 2.77m OD/7.50m bGL (102.77m ATD).

Two boreholes (CH60 and CH61R) recorded the lowest levels on natural Alluvium and truncated sediments, at $-0.64\text{m OD}/6.5\text{m bGL}$ (99.36m ATD) and $-2.12\text{m OD}/2.9\text{m bGL}$ (97.88m ATD) respectively. The sequence within these boreholes may indicate the truncation of natural deposits within the dock shown in the south-western corner of the Thames Ironworks on Bacon's map of 1900 (see below). Borehole CH74, in the south-east of the Limmo Peninsula site, encountered a large timber at 1.8m OD (101.80m ATD), that may be part of a revetment or other structure related to this ironworks and shipyard. The Thames Ironworks closed in 1912. Ordnance Survey maps show the buildings standing in 1920, but removed by 1952. After the demolition of the Thames Ironworks buildings, the ground level of the area had been raised considerably, particularly in the south-eastern part of the site. In the centre of the site in TP555, these levelling deposits (modern Made Ground) were more than 4m deep, and to the east of this, in TP556, more than 4.60m.

2.5 Deposit Survival

The Crossrail boreholes indicate that deposits of mainly geoarchaeological interest lie between c. 94m ATD, base and 102.5m ATD, surface.

The deepest, Pleistocene, deposits are not likely to be present across the whole site, and levels on the base of the Holocene Alluvium and gravels, elsewhere are likely to differ considerably across the site. In the limited area of the Crossrail boreholes they varied between c. 95 and 97.5m ATD.

At the Limmo Peninsula shaft, the Alluvium is probably overlain by remains of the Thames Ironworks, estimated to lie between 102.5 to 103.5m ATD. These are sealed by the DLR excavated material etc to levels up to c. 110 to 111m ATD.

Construction of the nineteenth century docks, slipways and wharves etc will have truncated any earlier archaeological remains within their footprints. The survival of the nineteenth to twentieth century Thames Ironworks is variable; some of the large solid brick structures and other more insubstantial structures such as those visible on Plate 2 may survive. Elements such as the railway tracks (Plate 2) appear to have disappeared, possibly salvaged when the site went out of use. However, there are likely to be greater levels of survival of the ground plan of the more substantial buildings (Plate 3).

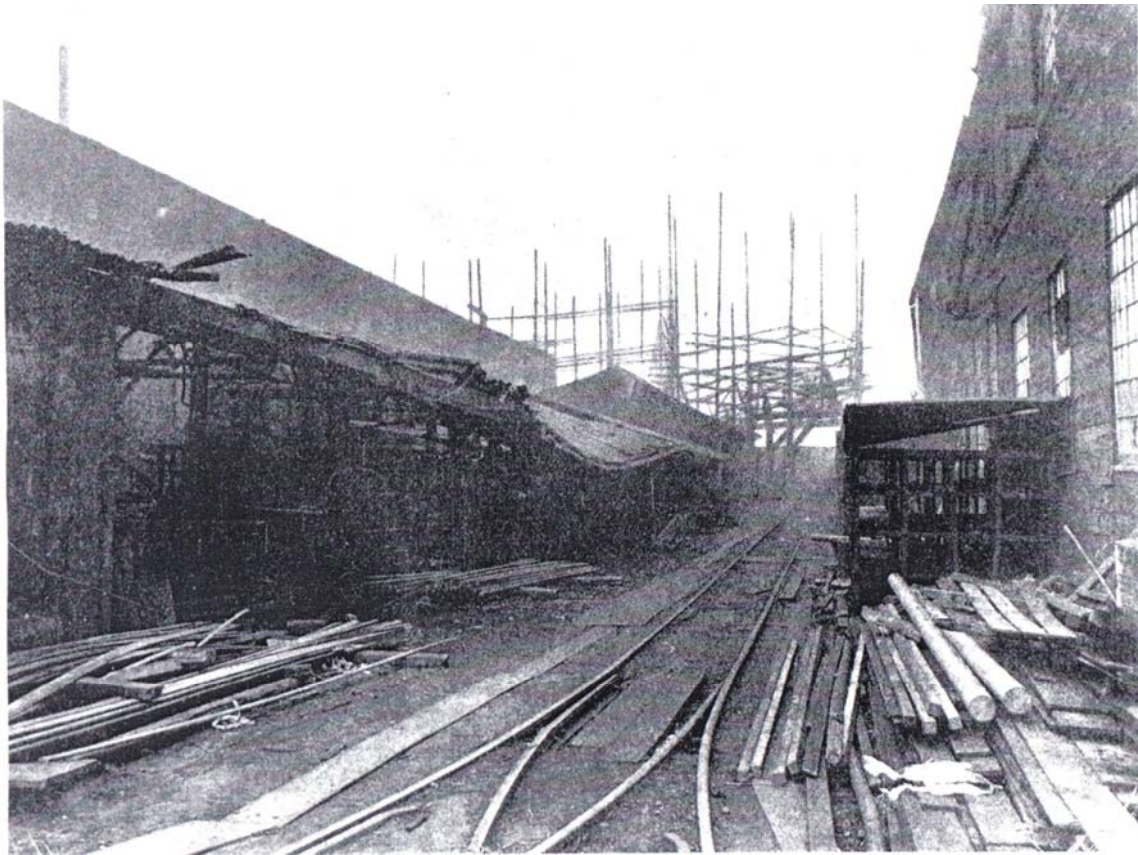


Plate 2 The ironworks in 1896



Plate 3 One of the buildings in use in 1904 with prop shaft of HMS 'Black Prince'

Outside the area of the DLR excavated material, Instone Wharf worksite and most of the conveyor route; it is assumed that in general there is approximately 0.5m of modern disturbance overlying any nineteenth century below-ground remains. However, some historic features might survive at ground level.

2.6 Archaeological Potential

The evaluation has identified that there are potential Allerod (late Upper Pleistocene) deposits within the shaft footprint. The potential for further archaeological remains dating from the prehistoric to medieval periods is considered to be minimal. The area was marshland for much of this period and there appears to have been no attempt at reclamation of the ground until the ironworks expanded northwards in the mid-nineteenth century. The archaeological remains within the two trenches that cover part of the scheme footprint have been excavated and recorded. There is the possibility that archaeological remains exist within the section of baulk (inter-trench soil block) that was not excavated, however, this is considered to be of low potential.

2.7 Importance

Any well-preserved structures associated with the Thames Ironworks Shipbuilding Company are likely to be of medium to high importance. The remains of any part of the former works within the scheme footprint would be preserved by record.

If present in any areas outside the river scour, any well-preserved prehistoric structures such as track ways might also be of high importance, but preservation by record is considered appropriate mitigation (consultation meeting with EH and GLAAS, 28 July 2004).

The majority of other archaeological remains. i.e. geoarchaeological evidence, palaeoenvironmental evidence, evidence for Roman and later river management and land reclamation, evidence of a medieval manor and nineteenth/twentieth century industrial archaeology, are likely to be of moderate importance if present.

Less well-preserved or less extensive remains are likely to be of low importance.

3 Construction Impact Summary and Outline Mitigation Design

3.1 Construction Summary

For a detailed description of shaft worksite construction methods, reference should be made to the report 'Stage 1 — Limmo Peninsula Shaft Arrangement and Worksite Layout Study' (Document No. CR-SD-CTS-X-SR-00001), submitted in August 2008 and the Limmo Peninsula Shaft Constructability Report for the Gate 2 Submission, Grip 4 Design (Document No. CR-DD-LIP-X-RT-00001).

3.2 Predicted Impacts

The area has been subject to an archaeological watching brief and evaluation and the historic structures have been identified and recorded. Based on historic map regression and the archaeological investigations, no major structural elements of the former Thames Ironworks are predicted to be within the footprint of the shaft (Figures 9 and 10). There is the potential that smaller structural elements such as sections of light railway or machine stands may be within the shaft footprint. These would be in the section of earth that was not removed during the evaluation. Geoarchaeological assessment identified the presence of potential Allerod deposits within the footprint of the shaft. The excavation of the shaft would have a direct physical impact on these.

3.3 Outline Mitigation

It is recommended that a Targeted Watching Brief (TWB) is undertaken during the excavation of the shaft through the layers associated with the Thames Ironworks and Alluvium/Allerod deposits. The work would be undertaken by C261 with C305 as the Principal Contractor. General standards for archaeological mitigation are presented in Section 7 and the specification for a watching brief is provided in Section 8 of this document.

4 Research Design Objectives of the Investigation and Research Aims

4.1 Aims of Proposed Investigation

The aim of the watching brief will be to record the presence of any archaeological activity identified during the excavation of the temporary shaft.

4.2 Site Specific Research Aims

The following site specific research aims can be outlined for the investigations at the Limmo Peninsula shaft:

- Where possible, characterise the sedimentary sequence at the site in terms of lithology, agents of deposition, preservational environment and age of deposition;
- Where possible, sample and characterise the preservational environment within bodies of sediment for the recovery of palaeoenvironmental remains;
- Where possible, develop from the boreholes and previous geotechnical work, a first order sedimentary model for the site;
- Where possible, on the basis of assessment of palaeoenvironmental remains, if recovered, develop a first order model for palaeoenvironmental development at the site;
- What is the development of the local landscape and topography of the junction of the Lea and Thames floodplains from prehistory to the medieval period? Are any peat deposits present? If so, at what level(s) and at what date did they form? Is there evidence for river scour removing prehistoric alluvial deposits, or conversely, do they survive?
- Is there any evidence for prehistoric activity that has survived later river scouring? If prehistoric remains are present, what is their character and what can be learned about the exploitation of the floodplain by prehistoric groups? In particular, is there any evidence for Mesolithic activity at the base of the Alluvium/surface of the sands? Is there any evidence for timber track ways or other structures of later prehistoric date?
- Is there any evidence for Roman activity, in particular for reclamation or flood defences, and marine transgression and regression?
- What can be learned about the process of land reclamation and management of the area from the medieval period until the construction of the shipyards and wharves in the mid nineteenth Century?
- What is the evidence for the development of the area in connection with the Thames Ironworks and other shipyards and wharves during the nineteenth century?
- Is there any below-ground or above-ground evidence for the nineteenth century Thames Ironworks, and other shipyards and wharves? In particular, is there evidence for the internal railway systems, dock structures, or slipways?

4.3 Relevant Regional Research Aims

In addition to the site specific research aims, the site has potential to address several regional research aims identified in the regional research agenda: 'A Research Framework for London Archaeology', Museum of London, 2002. The regional research themes considered relevant to achieving an understanding are as follows (page numbers in brackets):

- The significance of geomorphology, ecology, ecosystems and climate, hydrology, and vegetation and faunal development, on human lives (p. 79);
- London's hydrology, river systems and tributaries particularly the role of the River Thames, as boundary, communication route, resource, ritual focus etc, in shaping London's history, and the relationships between rivers and floodplains (p. 79);
- The relationship between landscape, river and settlement, and the influences of the River Thames in particular on communications and social interaction (p. 79); and
- The development of London's Docklands and Waterways (p. 82).

5 Scope of the Investigation

A programme of archaeological investigations has been undertaken at the Limmo Peninsula Shaft site. The work identified elements of the former Thames Ironworks and Ship Building Company and a possible sequence of Allerod deposits overlying Pleistocene gravels. The structural elements of the Thames Ironworks identified in the trenches were subsequently removed before backfilling the area.

GLAAS visited site during the evaluation and were in agreement with the approach being undertaken to mitigate for the scheme at Limmo Peninsula Shaft. Further telephone discussions were undertaken and GLAAS were in agreement with the proposal to undertake a watching brief during the excavation of the shaft footprint. It is recommended that a TWB is undertaken on the excavation of the shaft through the Thames Ironworks and Alluvial/possible Allerod material onto the gravel horizon.

Mitigation methods required for the Limmo Peninsula shaft site are listed below, but will need to be revised if C305 change the current design for the works associated with the shaft. Mitigation for any changes will be agreed with Crossrail prior to the start of works.

5.1 Site code

The site code has been allocated from the PDP Archaeological Requirements Master List. The work at Limmo is to be completed under the code: **XRW 10**.

5.2 Limmo Peninsula Shaft

The remains of the Thames ironworks and Shipbuilding Company were identified at between 102.75-103.50m ATD. It is recommended that a TWB is undertaken during the excavation of the shaft as it cuts through deposits associated with the Thames Ironworks and Alluvium/Allerod deposits, stopping where the excavation reaches the gravel horizon.

The aim of this work will be to record any archaeological remains identified during the excavation of the shaft. An industrial specialist will be on hand to give advice on structural remains in relation to the Thames Ironworks. A suitably qualified geoarchaeologist will be available during the excavation of the Alluvial/Allerod deposits to give advice and/or undertake, environmental sampling.

The standards for archaeological mitigation are provided in Section 7 of this document; the scope for a TWB is provided in Section 8 of the document.

5.3 Conveyor Route, Instone Wharf and Access Roads

The NLBH survey, undertaken by MDC4 in January 2009, was used to identify and assess the importance of any NLBH features present on the site, e.g. bollards, in order to determine the appropriate level of recording, and whether preservation in situ is appropriate and practical, during the detailed design stage. No further NLBH surveys are recommended.

Localised works for the conveyor, barge loading facility, and possibly access roads which are deep enough to have a possible impact on below-ground archaeological remains will require general or targeted archaeological watching briefs, to be determined at the detailed design stage. In the areas of the wharf and nineteenth century shipyards etc, sub-surface industrial archaeological remains may be present up to c. 0.5m from existing ground level. Elsewhere, archaeological remains may be present up to c. 1m from existing ground level. Mitigation measures would include a TWB to mitigate any impacts here. The works here are dependant on the final design by C305; the mitigation for these works is to be agreed with Crossrail.


Image	Description	Significance	Impact	Mitigation/ Further Investigation
 <p data-bbox="107 826 846 890">Limmo Peninsula undergoing removal of DLR excavated material</p>	<p data-bbox="981 384 1205 448">No NLBH significance</p>	<p data-bbox="1232 384 1294 408">N/A</p>	<p data-bbox="1489 384 1736 512">Archaeological implications as set out in WSI Section 5.1</p>	<p data-bbox="1800 384 2011 448">No further work recommended</p>



Image	Description	Significance	Impact	Mitigation/ Further Investigation
 <p>View of worksite area, thick undergrowth and tree cover</p>	No NLBH significance	N/A	None	No further work recommended
 <p>View of worksite area, thick undergrowth and tree cover</p>	No NLBH significance	N/A	None	No further work recommended


Image	Description	Significance	Impact	Mitigation/ Further Investigation
 <p>View of worksite area, thick undergrowth and tree cover</p>	<p>No NLBH significance</p>	<p>N/A</p>	<p>None</p>	<p>No further work recommended</p>

Table 5.1 Views of Key Locations at Limmo Peninsula Worksite

5.4 Specific Requirements for the Principal Contractor (C305)

5.4.1 Archaeological Watching Brief

A TWB will be undertaken from the upper levels associated with the demolition of the Thames Ironworks and Ship Building Company levels at approximately 105m ATD. The TWB will continue through the Alluvial/possible Allerod layers to the exposure of the gravel horizon.

In summary, a TWB is a programme of observation, investigation and recording of archaeological remains during construction. The main contractor's preferred working method would be controlled as necessary to allow archaeological recording to take place to the required standard.

Refer to generic WSI (CR-LWS-EN-SY-00001) for definitions of General and Targeted Watching Briefs.

Archaeological Targeted Watching Brief Procedure

During the removal of the made ground/overburden the following procedure is to be incorporated into the *Main Contractor (C305)* methods of work:

- Allow for archaeological deposits to be excavated and recorded;
- Allow safe access to the working area;
- Make allowance for two to three archaeologists on site to monitor and record;
- Use of plant in the working area only to be undertaken with the agreement of, and under the constant supervision the *Archaeological Contractor (C261)*; and
- Provide technical advice to the *Archaeological Contractor (C261)* as may be required to safely complete the work.
-

Site Accommodation and Facilities

The *Main Contractor (C305)* shall provide the following site accommodation facilities for the use of archaeological personnel, inclusive of hardstanding and services required:

- Secure storage for tools and equipment for a team of three archaeologists;
- Toilets with washing and drying facilities;
- Temporary office facilities for use by *C261* (one Senior Archaeologist) complete with suitable furniture and provision of drying areas for work clothing; and
- First Aid facilities and fire stations.

5.5 Instructions to Archaeological Contractor (C261) and Specification

5.5.1 Archaeological Watching Brief

It is proposed that a TWB is undertaken at Limmo Peninsula Shaft (see Section 8 of this document). The *Archaeological Contractor (C261)* shall:

- Provide a team of suitably qualified and experienced archaeologists to cover the range of archaeological investigation to be undertaken;
- Provide specialist advice on industrial archaeology during the excavation of the material associated with the Thames Ironworks;
- Provide a geoarchaeologist and specialist advice during the excavation of the Alluvial/Allerod deposits and any required technical support;
- Provide a method statement for carrying out the works; and
- Provide a risk assessment and health and safety plan.

6 Programme for the Investigation

6.1 Main Construction

If the ventilation shaft is included in the scheme, the main construction works are currently programmed between June 2010 and February 2015. Programme PCSO4 identifies that the shaft is due to be excavated on 21st September 2011 at a rate of 1m in depth per day.

It is recommended a TWB is undertaken during the excavation of the shaft deposits associated with the Thames Ironworks and Alluvium/Allerod deposits, stopping where the excavation reaches the gravel horizon.

7 Specification for Evaluation & Mitigation (including Watching Brief)

7.1 Generic Standards

7.1.1 The archaeological evaluation and mitigation works and scope of any archaeological scientific methods shall be designed and undertaken in accordance with the Generic WSI and relevant best practise guidance (and any subsequent revisions) i.e. the following 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 (1994); and
- English Heritage - Understanding Historic Buildings - A guide to good recording practice, 2006.

7.2 Potentially nationally important remains

7.2.1 Where unexpected, potentially nationally important archaeological remains (as defined in the Crossrail Environmental Minimum Requirements and Generic WSI) are identified during the works, the Archaeology Contractor shall undertake works in accordance with the Environmental Requirements (Archaeology) section of the relevant package Works Information and shall adhere to procedures as set out in the SSWSI.

7.2.2 The Archaeology Contractor shall submit details of their procedure for excavating and recording potentially nationally important remains in the Archaeology Contractor's Method Statement.

7.2.3 Details shall be in accordance with Crossrail procedures and include how relevant parties are to be informed of such discoveries, the criteria to be utilised by the Archaeology Contractor in the assessment of the significance of such discoveries, and the timescales to be adhered to.

7.2.4 As a result of the discovery of unexpected, potentially nationally important archaeological remains, the SSWSI will be updated by the Design Archaeologist and reissued by the Project Archaeologist to incorporate any additional specific primary fieldwork event aims.

7.3 Human Remains

7.3.1 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.

- 7.3.2 Where human remains are identified, 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.
- 7.3.3 Crossrail procedures for dealing with discoveries of human remains shall identify any specific individual roles or actions that are relevant to the works. Details shall include how relevant parties are to be informed of such discoveries, the criteria to be utilised in the assessment of the significance of such discoveries, the application process for licences and the timescales to be adhered to.
- 7.3.4 The Archaeology Contractor shall confirm how the requirements set out in the SSWSI will be implemented as part of their procedure for excavating and recording human remains in the Archaeology Contractor's Method Statement. This should incorporate best practice guidance, e.g. Council for the Care of Churches (1999) and English Heritage guidance on environmental archaeology and human remains (2002 and 2002a).
- 7.3.5 Should human remains be discovered, the Archaeology 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.
- 7.3.6 The Principal Contractor will be required to cease all works at that location until further instruction is provided by the Project Archaeologist. The Archaeology 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.
- 7.3.7 Lifting of human skeletal remains shall be kept to the minimum which is 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.
- 7.3.8 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 Archaeology 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.
- 7.3.9 As a result of the discovery of unexpected, potentially nationally important archaeological remains, the SSWSI will be updated by the Project Archaeologist to incorporate any additional specific primary fieldwork event aims.

7.4 Treasure Act

7.4.1 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.
- 7.4.2 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.
- 7.4.3 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.
- 7.4.4 Crossrail procedures for dealing with Treasure finds shall identify any specific individual roles or actions that are relevant to the works. Details shall include how relevant parties are to be informed of such discoveries, the criteria to be utilised in the assessment of the significance of such discoveries and the timescales to be adhered to.
- 7.4.5 To protect the finds from theft, the Archaeology 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 Archaeology Contractor shall ensure, on liaison with the Project Archaeologist that adequate site security is provided by the *Principal Contractor (C305)*.
- 7.4.6 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.
- 7.4.7 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.

7.5 Health and safety

- 7.5.1 The Archaeology Contractor shall undertake the works in accordance with the Employer's Health and Safety requirements and the Principal Contractor's Health and Safety Plan. Where specific health and safety constraints or requirements for the Archaeology Contractor's method of work are required, these are set out below and shall be addressed in the Archaeology Contractor's Method Statement (in the Health and Safety Plan).
- 7.5.2 No ground intervention or other survey shall be made prior to approval of the Archaeology Contractor's Health and Safety Plan, Method Statement and Risk Assessment by the CDM co-ordinator and/or Principal Contractor responsible for the works.
- 7.5.3 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 Archaeology 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.

7.6 Location and ground elevation of interventions and survey grids

- 7.6.1 The spatial extent of the investigation(s) shall be set out by the Principal Contractor or Archaeological Contractor (as required by works information) 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.
- 7.6.2 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 Archaeology Contractor by the Project Archaeologist. The positions of the trenches and survey points shall be verified by the Archaeology Contractor taking additional check measurements to additional known-location points of detail.
- 7.6.3 Surface heights and heights for all deposits shall be recorded and related to Permanent Ground Markers (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 Archaeology Contractor by the Project Archaeologist. Levelling accuracy between OSBMs/PGMs and site temporary bench marks shall be within 10 mm k: where 'k' is the total distance levelled in kilometres. Each temporary bench mark shall be levelled as part of a closed loop starting and finishing on approved OSBMs or Crossrail PGMs. Where more than one temporary bench mark is required per site the Archaeology Contractor shall establish the temporary bench marks as part of the same closed loop.
- 7.6.4 The Archaeology 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.
- 7.6.5 The Archaeology 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 Specification for Watching Brief

8.1 Scope of Watching Brief

- 8.1.1 Watching brief, as defined in the Generic WSI, 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.
- 8.1.2 The Archaeology Contractor shall undertake the watching brief for all areas of ground disturbance which may potentially contain archaeological remains as set out in the SSWSI. This shall include any activities (including those associated with site set-up and demolition) undertaken by the Principal Contractor that involve the removal of modern material, Made Ground and topsoil, subsoils, and superficial geological deposits such as Alluvium and Colluvium.
- 8.1.3 Areas that have been previously subject to archaeological excavation and which are known not to contain significant deposits (for example tunnels, cuttings, and areas of known large-scale modern disturbance) shall be excluded from the scope of the watching brief, unless stated otherwise in the SSWSI. Areas that have been subject to previous assessment and evaluation (e.g. geophysical survey, surface artefact collection, geotechnical survey, trial trenching etc.) shall be included within the watching brief, as appropriate.
- 8.1.4 Two classes of watching brief are set out in the Generic WSI:
- i) A general watching brief shall comprise observation and recording of the Principal Contractor's works without constraint on their working methods.
 - ii) 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 Archaeology Contractor. Under targeted watching brief, the Archaeology 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.
- 8.1.5 Targeted watching brief shall be used for areas of known occasional, dispersed features which are either not considered to be of sufficient significance to warrant archaeological investigation in advance of construction, or where access prior to construction has not been possible and where, as a result, there is a possibility of unexpected discoveries
- 8.1.6 Except in cases where unexpected, potentially nationally important, archaeological remains are discovered, the targeted watching brief shall be designed and implemented so as to avoid adverse impact on the construction programme, wherever practicable.
- 8.1.7 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.
- 8.1.8 The specification for watching briefs (general and targeted) are set out below:

Scope of Targeted Watching Brief - Constraints on Principal Contractor's Methodology

- 8.1.9 In archaeologically sensitive areas, where the need for a targeted watching brief has been identified in the SSWSI, the Principal Contractor will strip soils (which may include modern Made Ground, topsoil, subsoil, Alluvium and Colluvium) using their preferred method as stated in the Generic Written Scheme of Investigation (CR_PR-LWS-EN-SY-00001 version 2.0). The Principal Contractor will limit their tracking of vehicles and plant within areas specified in the SSWSI and/or as instructed by the Project Archaeologist. The Principal Contractor will facilitate mapping and sampling of deposits by the Archaeology Contractor through use of agreed plant, a site share agreement and careful liaison between the Archaeology Contractor's supervising archaeologist and the Principal Contractor's site supervisor.
- 8.1.10 A geoarchaeologist will be on site during the excavation of the shaft through the Alluvial/Allerod deposits. Where suitable deposits are identified samples will be taken for further analysis. A geoarchaeologist will provide technical advice on what materials are to be collected.

Specification for watching brief

- 8.1.11 The Archaeology Contractor shall undertake a Targeted Watching Brief during the excavation of the shaft through the deposits associated with the Thames Ironworks to the Pleistocene gravels. . The Archaeology Contractor shall undertake a general watching brief during localised works at Limmo Peninsula Shaft, such as footings for plant if the design for the localised works is changed by C305; a mitigation strategy to cover these changes would be agreed with Crossrail.
- 8.1.12 The Archaeology Contractor shall undertake a general or targeted watching brief (to be determined once C305 has submitted the design for the work; the mitigation would be agreed with Crossrail) at the Conveyor Route, Instone Wharf, and Access Roads on localised works for the conveyor, barge loading facility, and possibly access roads which are deep enough to have a possible impact on below-ground archaeological remains.
- 8.1.13 The Works to be carried out by the Archaeology Contractor shall consist of two parts:
- a) Watching brief ('observation') following, and without interruption to, the progress of the Principal Contractor by a core team of archaeologists.
 - b) Investigation of archaeology and remains of quaternary geological importance undertaken either:
 - by the core team, following the progress of the Principal Contractor; or
 - by additional archaeologists (the 'support team'), to be deployed to investigate unanticipated archaeological remains, where appropriate.
- 8.1.14 The Archaeology Contractor's core team shall consist of the Archaeology Contractor's key person (the Field Director) and other appropriately experienced archaeologists commensurate with the scale and nature of the Principal Contractor's works.
- 8.1.15 The core team shall undertake the observation and any required investigation such as they may reasonably be able to undertake.
- 8.1.16 The Archaeology Contractor's support team shall consist of additional experienced archaeologist. The size of the support team shall be commensurate with the scale and programme of the Principal Contractor's works. The Archaeology Contractor shall be

required to supply teams of 5 and 10 persons within 24 and 48 hours notice respectively.

8.1.17 The Archaeology Contractor's core and support teams shall be advised where necessary by specialists, as appropriate and as agreed with the Project Archaeologist.

8.1.18 The Archaeology 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 or remains of Quaternary geological importance 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;
- Location and description of any modern remains; and
- Investigation undertaken during watching brief.

8.1.19 An appropriate sample shall be excavated from cut features and other archaeological remains of importance. Sampling of cut features shall include feature inter-sections to establish relative chronologies. The extent of sampling shall be determined by the Archaeology Contractor in liaison with the Project Archaeologist (and as discussed with the Greater London Archaeological Advisory Service/English Heritage, and a quaternary specialist, if necessary) but may, for instance, include the sample excavation of a selected number of deposits (both layers and negative, cut features), recording of structural remains, drawn sections and profiles, and/or be aimed at recovering sufficient information to determine function, form, and date. Any specific variations from this specification shall be indicated in The Archaeology Contractor's Method Statement.

8.1.20 The Archaeology Contractor shall prepare a record of their surveying methodology for inclusion in the archive. Heights for all deposits shall be related to approved Permanent Ground Markers (PGMs) or approved Ordnance Survey Bench Marks (OSBM), where reasonably accessible. Levelling accuracy between OSBMs/PGMs and site temporary bench marks shall be within 10 mm k: where 'k' is the total distance levelled in kilometres. Each temporary benchmark shall be levelled as part of a closed loop starting and finishing on approved OSBMs or URL PGMs. Where more than one temporary bench mark is required per site, the Archaeology Contractor shall establish the temporary bench marks as part of the same closed loop.

8.1.21 It may not be possible to clean and record the archaeological profile of geotechnical test pits, due to health and safety or access constraints. Every effort shall be made to establish the presence or absence of archaeological deposits by establishing the ordnance datum for the height of significant deposits, including the depth of modern intrusions, key stratigraphic components and natural deposits.

8.2 Recording standards

8.2.1 The 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.

8.2.2 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.); and
- 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 Archaeology 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 Archaeology Contractor shall take appropriate record photographs to illustrate work in progress.

8.3 Specification for archaeological investigation

8.3.1 A sufficient sample of the archaeological features and deposits revealed must be sampled/or fully excavated to allow the resolution of the aims and objectives of the work. Structures, features, or finds which might reasonably be considered to merit preservation in situ shall not be unduly damaged.

8.3.2 Where modern foundations are likely to be present, the SSWSI shall identify whether they should be left in situ for the purposes of the evaluation or removed. Where it is clear that modern foundations have truncated certain archaeological levels they should be removed to assess lower archaeological levels. The Archaeology Contractor shall take all reasonable care to ensure that any damage is limited as far as practicable. If significant damage is likely to occur the work shall be suspended and the Project Archaeologist informed so that a technical solution can be agreed with the Project Manager.

8.3.3 The location and objectives of the trial excavations set out in Section 5 of the SSWSIs have been established in consultation with the projects' statutory consultees.

8.3.4 Each trial excavation has been assigned a unique ID number by the Project Archaeologist. The Archaeology Contractor shall not vary this number unless agreed by the Project Archaeologist in writing.

8.3.5 The dimensions of each trial excavation in plan, inclusive of the trench support system employed (if required) to secure personnel entry to the excavation, shall be set out in the SSWSI. Trial excavations shall be excavated to the base of the alluvial sequence or to a

depth specified in the SSWSI (Section 5). This shall be dependent on the agreed objectives of the excavation.

- 8.3.6 Temporary works and any required hand investigation to address below ground hazards shall be carried out by the Principal Contractor under supervision by the Archaeology Contractor in accordance with their approved Method Statement and Risk Assessment. All subsequent trial excavations shall be excavated by the Principal Contractor under supervision by the Archaeology Contractor using a mechanical excavator with toothless ditching bucket, except where the nature of the Made Ground or surface of the pits is such that an alternative bucket or means of breaking out prior to excavation is required (and the Project Archaeologist has agreed an alternative method).
- 8.3.7 All machine work and demolition of below-ground obstructions (e.g. removal of basement slabs) shall be carried out by the Principal Contractor under supervision by the Archaeology Contractor. The Principal Contractor shall cease work when archaeological evidence is revealed and allow the Archaeology Contractor to undertake investigation, as appropriate. An excavator shall not be used to cut arbitrary trial trenches down to natural deposits without regard to the archaeological stratification.
- 8.3.8 All undifferentiated topsoil, or overburden of recent origin, shall be removed down to the first archaeological layer. An exception to this would be where a focused soil-sampling strategy is proposed to record and collect data from reworked soil contexts above recognisable stratified archaeological contexts. If a mechanical excavator is to be used to remove modern overburden, such as floor slabs or recent levelling layers, this shall be undertaken in spits of 0.20m-0.5m depth (dependant on specific site conditions), moving along the length of the trench or area. The Archaeology Contractor's supervising archaeologist 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.
- 8.3.9 Each spit shall be examined carefully to assist the recovery of any archaeologically significant artefacts and thus to determine when to cease machining.
- 8.3.10 The archaeological level shall be cleaned in plan by the Principal Contractor using a wide blade, ditching bucket or similar, with no teeth. If the machine has to re-enter the trench care will need to be taken to ensure that it does not damage underlying remains.
- 8.3.11 The Archaeology Contractor shall undertake hand excavation and cleaning of any archaeologically significant horizons, to fulfil the aims of the work. Within alluvial sequences the Archaeology Contractor shall pay particular attention to establishing the vertical extent of layers of archaeological potential and shall be aware that horizons of cultural activity may be interdigitated with horizons of sterile Alluvium. The Archaeology Contractor shall supervise the excavation of each test pit in such a manner so as to allow a cumulative or continuous section to be recorded.
- 8.3.12 The Archaeology Contractor's excavation, sampling and recording policy shall be included in the Archaeology Contractor's Method Statement. This is to include, as a minimum:
- The recording of individual contexts on appropriate pro-formas;
 - Excavation plans at 1:50 scale; planning and section drawing of appropriate single contexts and features (usually at 1:20 scale for plans and 1:10 scale for inhumations and sections);
 - Photographs; and other appropriate drawn and written records; and

- Permanent Ground Markers (PGM's), any temporary benchmarks and approved OS benchmarks shall be indicated on the relevant plans.

8.3.13 The Archaeology 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;
- All trial pit locations shall be electronically surveyed with reference to the London Grid and Crossrail PGM's upon the completion of fieldwork by the Archaeology Contractor;
- The locations of trial pits 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.

8.3.14 In alluvial sequences, each trial excavation shall be excavated to the base of the alluvial sequence, and shall be appropriately shored and kept free of water by the Principal Contractor to allow 'person entry' to the excavations, i.e. to allow the Archaeology Contractor to undertake investigation and recording to fulfil the aims of the work.

8.3.15 The Archaeology Contractor shall identify any temporary works and dewatering requirements associated with the archaeological investigation in the Archaeology Contractor's Method Statement and shall agree the detailed arrangements for such with the Principal Contractor. The Archaeology 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 Archaeology Contractor's Method Statement.

8.3.16 Where areas of extensive archaeological stratification are encountered, trial trenches shall not be fully excavated. However, the horizontal and vertical extent of archaeological stratification shall be assessed by the Archaeology Contractor through implementation of an appropriate strategy including, either the excavation of features cut into horizontal stratification, limited test pitting or auguring. The aim shall be to recover suitable stratigraphic, finds and environmental samples from the full, intended depth of the trench, as far as is practicable. The exact methodology may need to be determined by the Archaeology Contractor during the excavation of individual trenches and agreed with the Project Archaeologist.

8.3.17 A sufficient sample shall be excavated from cut features and other archaeological deposits to fulfil the aims of the work. Sampling of cut features shall include feature intersections to establish relative chronologies.

8.4 Recording systems

8.4.1 The archaeological remains 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).

8.4.2 The recording is to include, as a minimum:

- At least one representative section at (1:10 or 1:20 scale) of each trial excavation from ground level to the base of the excavation;
- The written record of individual context descriptions on appropriate pro-forma;

- Plans at appropriate scales (1:10 or 1:20);
 - Single context planning if appropriate;
 - Photographs and other appropriate drawn and written records; and
 - Other sections, including the half-sections, of individual layers or features, shall be drawn as appropriate to 1:10 or 1:20.
- 8.4.3 Site plans shall identify both London Grid and OS co-ordinates. A 'site location plan', indicating site north shall be prepared at 1:1250. Individual 'trench plans' or 'excavation area plans' at 1:200 (or 1:100) shall be prepared which show the location of archaeology investigated in relation to the investigation area.
- 8.4.4 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 temporary bench mark shall also be indicated.
- 8.4.5 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 GLSMR will accept Autocad DXF or .DWG format of extent of site and location of major features with the completed Sites and Monuments Report Form.
- 8.4.6 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.
- 8.4.7 Recording of structural evidence revealed below ground level will vary according to the level of special interest of the structure and its relationship to below-ground archaeology. Structures of little or no significance shall be noted on a site plan. Detailed element detail drawings of important features revealed in investigations may be required in accordance with the aims and objectives of the investigation.
- 8.4.8 The Archaeology Contractor shall agree the appropriate level of recording and analysis for discovered standing structures with the Project Archaeologist, in accordance with the Crossrail procedure for non-listed built heritage recording (Document No. CR-PN-PRW-EN-PD-00010). The Archaeology Contractor shall revise the Archaeological Contractor's Method Statement to reflect any additional requirements for built heritage recording.
- 8.4.9 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 Archaeology 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, 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 Archaeology Contractor shall take appropriate record photographs to illustrate work in progress.
- 8.4.10 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 Archaeology Contractor shall set out proposals for such recording in the Archaeology Contractor's Method Statement for approval by the Project Archaeologist.

- 8.4.11 Where appropriate a photogrammetric record or laser scan record shall be made of complex structures, features and horizons, liable to be damaged in the course of the investigation, such as buildings or parts of buildings. Appropriate technical specification and scales shall be specified in the SSWSI and addressed in the Archaeology Contractor's Method Statement.

8.5 Archaeological science

- 8.5.1 The strategy for sampling archaeological and palaeo-environmental 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 English Heritage Regional Science Advisor and the Design Archaeologist. On-site work and off-site analysis of the processed samples and remains will be undertaken by the Archaeology Contractor's environmental archaeologist as specified in the Archaeology Contractor's Method Statement.
- 8.5.2 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 Archaeology 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).
- 8.5.3 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.
- 8.5.4 Where appropriate, samples shall be taken for scientific dating (for example radiocarbon dating, Optical Stimulated Luminescence, thermoluminescence at the evaluation stage). This may apply where dating by artefacts is insecure or absent, and where dating is necessary for development of the SSWSI for subsequent mitigation strategies. Procedures and specifications shall follow English Heritage guidance (English Heritage 2008b).
- 8.5.5 Buried soils and sediment sequences shall be inspected and recorded on site by the Archaeology Contractor's geoarchaeologist, since field inspection may provide sufficient data for understanding site formation processes. 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 where appropriate, following agreement with the Project Archaeologist.
- 8.5.6 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).
- 8.5.7 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.
- 8.5.8 Assessment of finds assemblages shall include x-radiography of all iron objects (after initial screening to exclude obviously recent debris) and, where appropriate, non-ferrous artefacts (including all coins). Where necessary, active stabilisation /consolidation shall be carried out to ensure long-term survival of the material, but with due consideration to possible future investigations.
- 8.5.9 Once assessed, all material shall be packed and stored in optimum conditions, as described in First Aid for Finds (Watkinson and Neal 1998). Waterlogged organic materials shall be processed in accordance with: Guidelines for the care of waterlogged archaeological leather (English Heritage/Archaeology Leather Group 1995) and Waterlogged wood: the recording, sampling, conservation and curation of structural wood (Brunning 1996).
- 8.5.10 Samples for absolute dating 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 development of specifications for subsequent mitigation strategies in the SSWSI. Where it is proposed to date human remains, the time limits for reburial imposed by Schedule 15 of the Crossrail Act (for remains removed from burial grounds) or set out in the relevant burial licence under the Burial Act 1857 (in all other cases) shall be adhered to.
- 8.5.11 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.
- 8.5.12 Samples collected for geoarchaeological assessment 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).
- 8.5.13 Animal bone assemblages, or sub-samples of them, shall be assessed by the Archaeology Contractor's specialist with reference to English Heritage guidance (English Heritage 2002).
- 8.5.14 The results from any specific investigations in Archaeological Science shall be included in the Site Archive and presented in the evaluation report or final fieldwork report. Reports shall include sufficient detail to permit assessment of potential for analysis. They shall

include tabulations of data in relation to site phasing and contexts, and include non-technical summaries. The objective presentation of data shall be clearly separated from interpretation, i.e. recommendations for further investigations, (both on samples already collected, and at future excavations), shall be clearly separated from the results and interpretation.

8.6 Generic specification for Environmental Sampling

- 8.6.1 Appropriate features and deposits shall be sampled to retrieve palaeo-environmental and economic indicators. The Archaeology Contractor shall make provision for the sampling of a wide range of contexts for potential assessment and analysis for plant and animal micro/macro fossils and soils/sediments in order to fulfil the aims set out in the SSWSI.
- 8.6.2 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.
- 8.6.3 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).
- 8.6.4 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.
- 8.6.5 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. The residue of soil left in the bottom of any inhumations after the removal of human remains shall be retrieved for bulk processing. Vessel or pit fills containing human remains shall be processed as bulk samples to ensure the maximum retrieval of cremated bone. Cremation vessels and deposits of placed human bone within cut features may require excavation in spits. The fill residues from the excavation of these features shall be bulk sampled to ensure maximum retrieval of cremated bone, associated small finds and floral and faunal remains. All work shall be undertaken in compliance with the generic Crossrail standards for Human Remains which may require the reburial of human remains within a specific timeframe.
- 8.6.6 For 'bulk disturbed' samples the limits of the sample zone shall be recorded and identified on plan.
- 8.6.7 The Archaeology Contractor shall use appropriately sized monolith or kubiena boxes for the recovery of 'undisturbed' monolith samples for geoarchaeological 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.

- 8.6.8 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.
- 8.6.9 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.
- 8.6.10 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 sub-samples 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 Deliverables

9.1 Archaeological Contractors Method Statement

9.1.1 The Archaeology Contractor shall provide a detailed Method Statement for the works for the Project Archaeologist's approval. The Method Statement 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 Method Statement shall include, as appropriate:

- a) A resource plan and programme and CV's;
- b) The Archaeology Contractor's IT capability and proposed IT plan (including specific survey methods for on-site recording of stratigraphic profiles and sub-surface topographic modelling;
- c) The Archaeology Contractor's approach to Archaeological Science;
- d) The methods for survey and setting out works;
- e) The methods to address the specific event types required (trial trench, area excavation etc);
- f) The safe method of working whilst excavating trenches or pits including any temporary works required;
- g) The method for disposing of water from trenches and test pits in waterlogged ground;
- h) Site management plan to include details of the method for preparing safe access route to the working areas, the proposed site accommodation, services and welfare;
- i) The retention and disposal policies for samples and artefacts recovered during the work;
- j) The method for excavating and recording inhumations and cremations in compliance with the generic Crossrail standards for Human Remains (see Section 7.1);
- k) The method for preparation of the required reports, archive and all associated deliverables;
- l) The procedures for assessment of potential for analysis (post excavation assessment); analysis and publication proposals;
- m) The method for preparation of the digital dataset, digital drawings, and digital report deliverables;
- n) The Archaeology Contractor's methods and approach for undertaking the site based works and off site processes to completion.
- o) The Health and Safety Plan and Site-Specific Risk Assessment (including unexploded ordnance);
- p) The Quality Assurance Plan;

- q) The procedures for on- and off- site security and emergency response plan (including environmental incidents);
- r) The method for complying with project generic and site specific environmental and consent requirements; and
- s) The Archaeology 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, or where outside the greater London area, 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 MOLA. Sample recording sheets, sample registers, finds recording sheets, registered finds catalogues and photographic record cards shall also follow the MOLA equivalents.
- 9.2.3 Archives shall be prepared to conform with current best practice (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 Archaeology Contractor shall complete the site archive and submit to the Project Archaeologist within 8 weeks of completion of a fieldwork event.
- 9.2.4 The site archive shall be deposited by at a museum to be confirmed by the Project Archaeologist.

9.3 Digital Data

- 9.3.1 The Archaeology 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 Archaeology 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 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; and

- 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 Archaeology 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 Archaeology 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 Archaeology Contractor. The Archaeology Contractor shall ensure that data originating from different sources within the Archaeology Contractor's organisation is compatible with the project requirements. The Archaeology 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 Archaeology 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 Archaeology Contractor shall record the date of the change and the name of the person carrying out the change. The Archaeology Contractor shall ensure that each data amendment is carried out correctly.
- 9.3.10 The Archaeology Contractor shall make two identical copies of the digital archive. The first copy shall be retained by the Archaeology 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 7 days of completion of a Critical Phase or Phase 1 fieldwork event, or as otherwise instructed to do so, the Archaeology 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, 20\$\$

9.4.8 Copies of the Interim Statement shall be provided by the Project Archaeologist to Rob Whitehead (English Heritage) and the LBN.

9.5 Survey Report

9.5.1 The Archaeology 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 temporary bench marks. The survey report shall be submitted by the Archaeology Contractor to the Project Archaeologist within 2 weeks of the completion of fieldwork.

9.5.2 The Archaeology 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 evaluation, excavation and watching brief reports shall be prepared by the Archaeology Contractor within 6 weeks of the completion of the fieldwork (unless this is varied by the Project Archaeologist). The Fieldwork Report shall follow the standard structure set out in City of London Planning Advice Note 3 and IfA standards 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

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
 15. Sites & Monuments Record form
 16. A3 plans
- 9.6.2 The Fieldwork Report 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 Fieldwork Report shall utilise information collected during archaeological fieldwork and from any other appropriate sources agreed with the Project Archaeologist.
- 9.6.3 The Fieldwork Report 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); a trench summary table indicating depths of all major stratigraphic units, and their boundaries. Photographs shall be included where appropriate.
- 9.6.6 The Archaeology Contractor shall produce a subsurface model(s) and profiles to illustrate the extent, character and depth of the major stratigraphic topology identified. The model shall be correlated with previous works within the survey area in order to inform the mitigation design. The processing software and presentation format of the data shall be included in the Archaeology Contractor's Method Statement for approval by the Project Archaeologist.
- 9.6.7 The assessment of results and statement of potential shall include the Archaeology 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, to establish importance.
- 9.6.8 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 Archaeology 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.
- 9.6.9 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.

9.6.10 When submitted at evaluation stage, the report shall set out an outline recommendation for mitigation. This may include preservation in situ and/or further investigation and recording of the remains and/or watching brief. The development of a detailed mitigation strategy shall be progressed by the Project Archaeologist in liaison with the Project Manager's engineering design team, the Archaeology Contractor, and the English Heritage Regional Science Advisor (and other statutory authority), as appropriate.

9.6.11 Copies of the Fieldwork Report shall be provided by the Project Archaeologist to GLAAS/English Heritage and LBN.

9.6.12 The following shall appear in the footer or header of each Fieldwork Report:

CRL Ltd, 20\$\$

9.7 SMR/HER Summary Sheet

9.7.1 The Archaeology Contractor shall complete a GLSMR Summary Sheet for the works (i.e. one per fieldwork event). The Summary Sheet shall be included in the Fieldwork Reports.

9.8 Summary Report

9.8.1 A short summary report of no more than 500 words (the Summary Report) for the works shall be prepared by the Archaeology Contractor for submission to the Project Archaeologist for subsequent publication within London Archaeologist or another local (county) journal or publication outlet specified by the Project Archaeologist.

9.8.2 The Archaeology Contractor shall submit the draft Summary Report to the Project Archaeologist for approval within 8 weeks of the completion date of the fieldwork event. The Archaeology Contractor shall allow two weeks in the programme of works for the Project Archaeologist to provide comments. The Archaeology Contractor shall include any amendments required by the Project Archaeologist in the final Summary Report which shall be submitted within one week of receiving the Project Archaeologist's comments on the draft report.

9.8.3 The Summary Report shall be submitted as an MS Word *.document in accordance with the Employer's information management standards and procedures.

9.9 Post excavation assessment

9.9.1 If instructed by the Project Archaeologist, the Archaeology 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 Archaeology Contractor shall provide details of its current post excavation assessment procedures with their Method Statement.

10 Site Monitoring & Progress Reports

- 10.1.1 Prior to commencing the works the Archaeology Contractor shall agree a programme of weekly written progress reports and periodic progress meetings with the Project Archaeologist an/or Project Manager and shall be represented at such meetings to the satisfaction of the Project Archaeologist. The Archaeology Contractor shall provide information describing progress on-site to date, the processing of samples and artefacts and feedback from any initial assessment.
- 10.1.2 The LBN, GLAAS officer and, if required the English Heritage Inspector for Works affecting a Scheduled Monument (collectively the 'external consultees') shall be informed in writing at least one week in advance of commencement of fieldwork by the Project Archaeologist.
- 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 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.
- 10.1.5 The Archaeology Contractor may propose that archaeological excavation be carried out as an extension to evaluation works, if the scope of such work is readily incorporated into the SWSI. The detailed method for this work shall be agreed between the Archaeology Contractor and the Project Archaeologist at a site meeting and subsequently in writing between the Project Archaeologist and the relevant external consultees.

11 Personnel requirements

- 11.1.1 The Archaeology Contractor shall provide project personnel of experience 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 Archaeology 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 tender process.
- 11.1.3 The works shall be managed, directed and staffed by appropriately qualified and experienced personnel. The Archaeology Contractor's Project Manager shall possess at least ten years directly relevant experience of similar projects.
- 11.1.4 The excavation, sampling and recording of the works shall be directed in the field by a Fieldwork Director (Supervising Archaeologist) who is a Member of the Institute of Field Archaeologists (MIFA) The Supervising Archaeologist shall be on site throughout the fieldwork stages.
- 11.1.5 The Archaeology Contractor's project team shall include a historic buildings specialist and an environmental archaeologist suitably qualified in archaeological science and geo-archaeological sediment description methods, and on site sample processing and assessment techniques.
- 11.1.6 The Archaeology 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 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 and Maps

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Maps

Ordnance Survey Drawing Stratford - Le Bow 1799

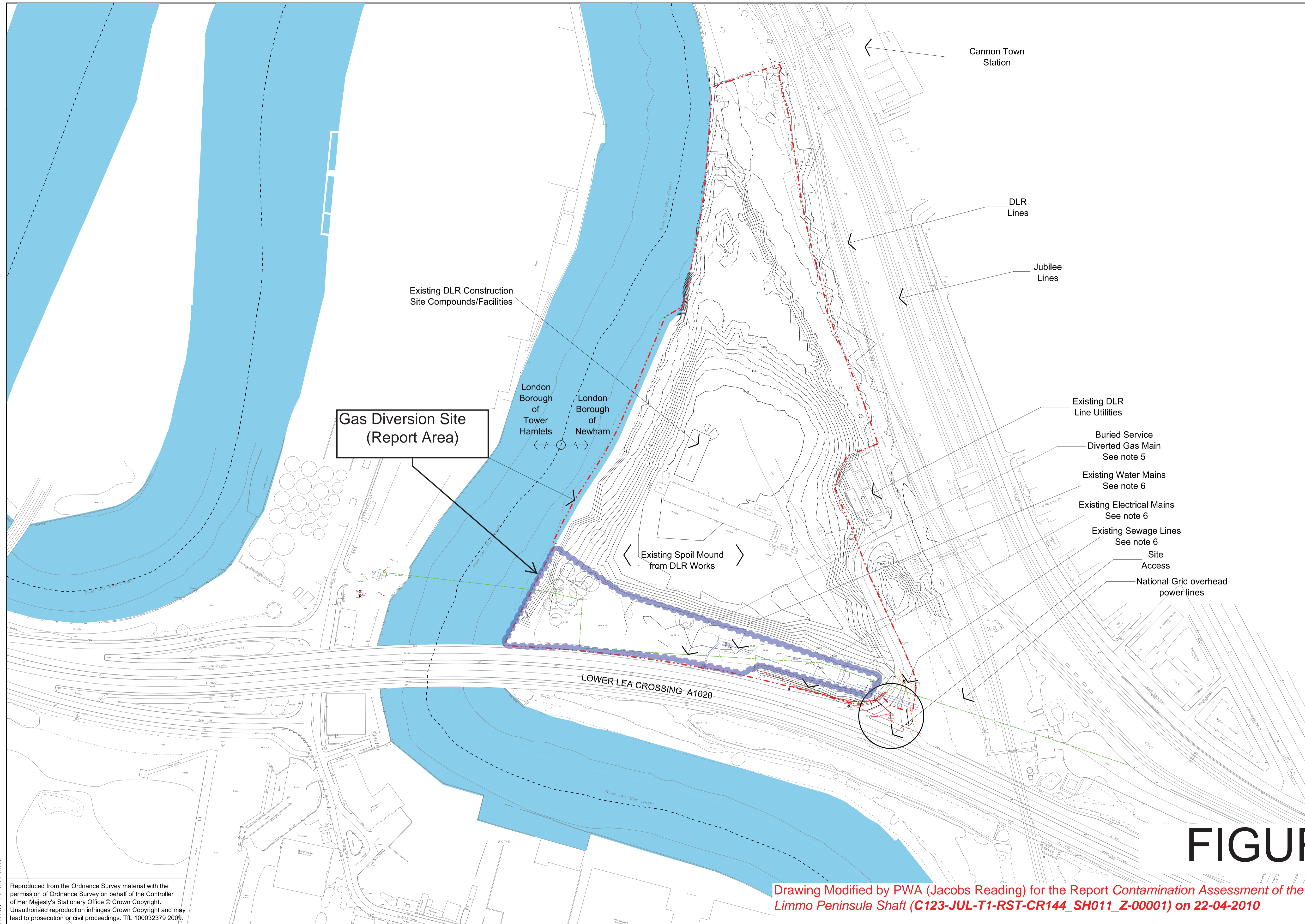
<http://www.bl.uk/onlinegallery/onlineex/ordsurvdraw/s/002osd000000006u00387000.html>

City of London - City of London: 047 *Ordnance Survey 1:2,500 - Epoch 1* (1869)

Bacon's Waistcoat Pocket Map c. 1900 (after Crossrail 2010)

Appendix A — Figures

Drawing Title	Drawing Number	Revision
Works Location Plan		
Figure 1 Existing Site Plan	C123-JUL-A-DDL- CR144_SH011_1-00101	P02
Figure 2 Crossrail Limmo Shaft Diversion Detail Drawing	RCS/LIMMO/P/001	07
Figure 3 Proposed borehole location plan Crossrail Ground Investigation Package 19A Sheet 1 of 2	P40401-C1M00-G00-D-05025	A01
Figure 4 1799 OS Drawing (Limmo site indicated in circle)	Not allocated	0
Figure 5 1799 OS Drawing (Limmo site indicated in circle)	Not allocated	0
Figure 6 1869 OS Drawing (marked site area and road indicative only, not to scale)	Not allocated	0
Figure 7 Bacon's Waistcoat Pocket Map – Plan of London 1900	Not allocated	0
Figure 8 1869 OS map with trenches overlaid	Not allocated	0
Figure 9 1869 OS map showing shaft footprint (blue hachure is unexcavated area)	Not allocated	0
Figure 10 1916 OS map with shaft footprint overlaid	Not allocated	0



Safety, Health and Environmental Information
 Notes below are additional to hazards/risks normally associated with this type of work:

Construction
 Ci.
 Cii.
 Ciii.
Operations
 Oi.
 Oii.
 Oiii.
Maintenance
 Mi.
 Mii.
 Miii.
Dismantling/Demolition (Future)
 Di.
 Dii.
 Diii.

These notes are based on the use of experienced and competent contractors carrying out the work using an approved safe method of working.

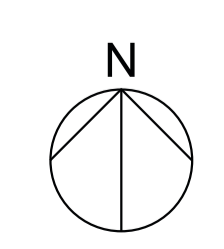
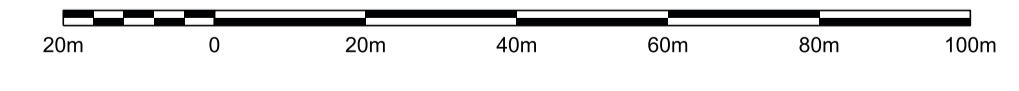
FIGURE 1

Drawing Modified by PWA (Jacobs Reading) for the Report *Contamination Assessment of the Gas Main Diversion at Limmo Peninsula Shaft (C123-JUL-T1-RST-CR144_SH011_Z-00001) on 22-04-2010*

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Rev.	Date	Description	By	Chkd	App
P01	19/01/2010	First Issue	HS	KS	CL
P02	26/01/2010	---	HS	KS	CL

- Notes**
- Confirmation of all survey data must be obtained from the Crossrail survey team.
 - Coordinates to the London Survey Grid, heights to the London height datum which is 100 metres below Ordnance Datum Newlyn. See Crossrail standard CR-STD-010.
 - All dimensions are in metres unless specified otherwise.
 - Refer to Final Land Acquisition Boundaries drawings 110801-C1G00-Y00-F-50066 & 50196 for site Boundary information.
 - Diverted Gas Main route unconfirmed. Reference files required from Enabling Works Team.
 - Existing Services from Crossrail 'Utilities Survey Oct 2009' Drawing No. 1W0100-G0G00-U00-P-50051



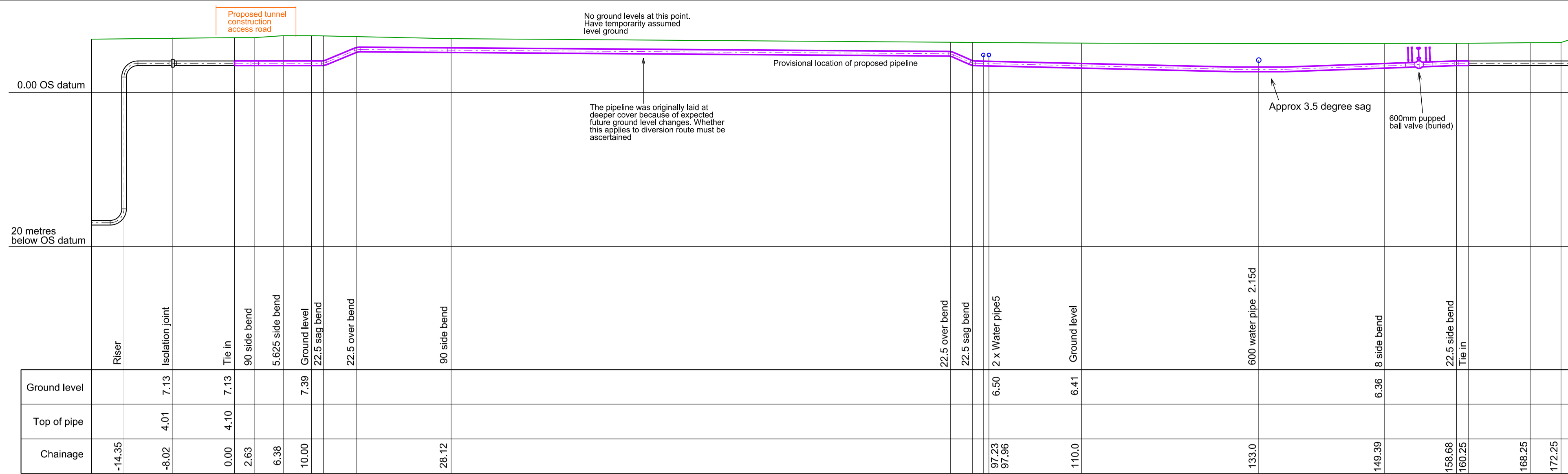
Contract: Intermediate Shaft Design		By: H.SMITH	
Originator: Jacobs UK Limited		Chk: K.SCHULTHEIS	
Location: Limmo Peninsula Shaft		App: C.LEE	
Title: Existing Site Plan		Rev: P02	
Scale: 1:1000@A1	Drawing and CAD file No: C123-JUL-A-DDL-CR144_SH011_1-00101	Suitability: S4	

Copy Approved for Design - Created: 26-JAN-2010

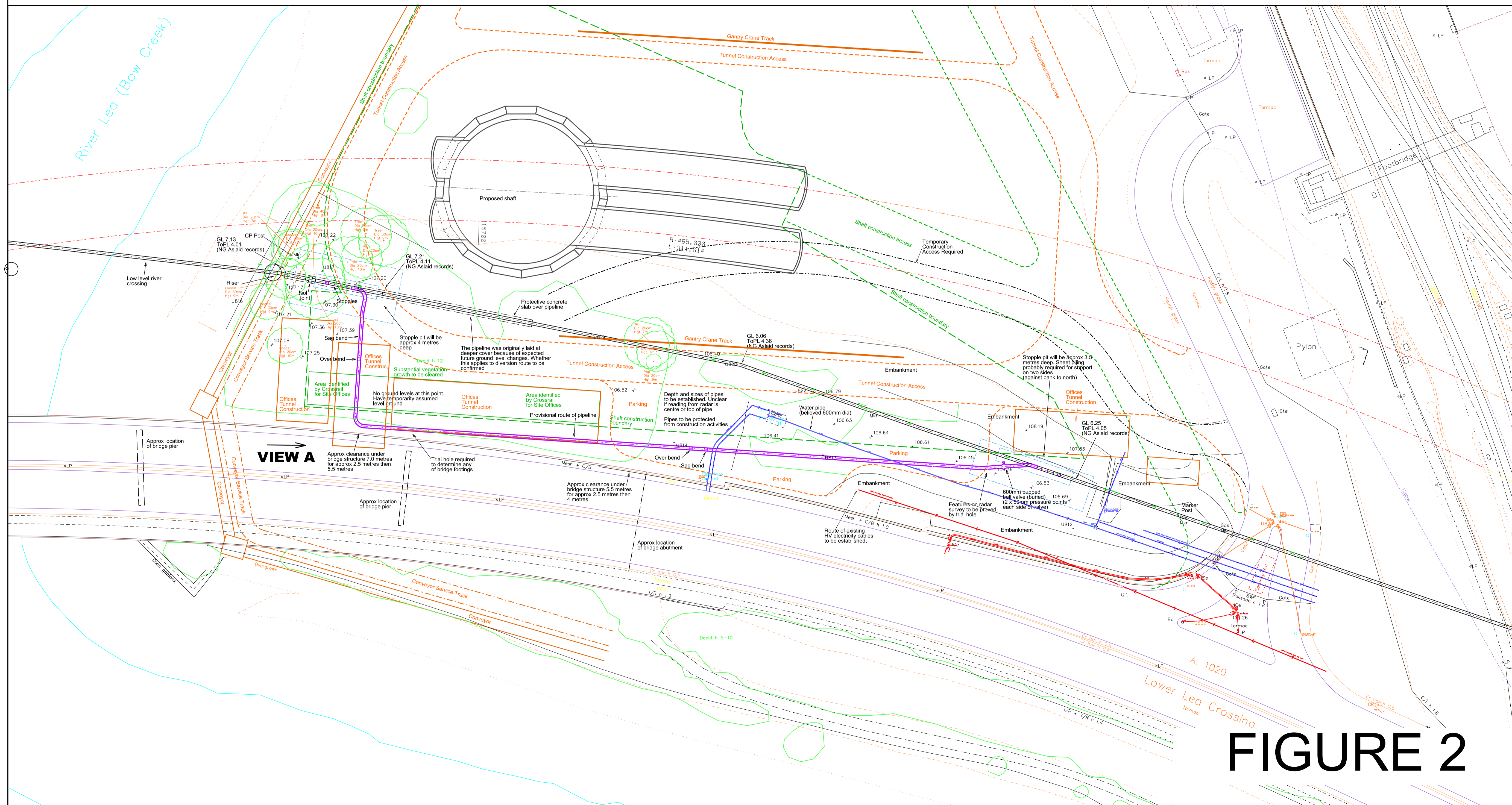
RESTRICTED



VIEW ON A



CROSS SECTION ALONG PROPOSED PIPELINE
1:400 @ A1 PLEASE CHECK SCALE BAR



VIEW A

FIGURE 2

SPECIFIC NOTES
Information Required
Details of ground remodelling for shaft construction (levels etc)
Details of ground remodelling for tunnel construction (levels etc)
Details of future plans for site (if any)
Present ground levels beside elevated road
Extent of bridge footings (Trial hole)
Clarification of features shown on radar survey near eastern tie-in (Trial Hole)
Confirmation that gas cooled HV electric cable terminates as shown along side elevated road (Crossrail investigating)
Details of ground conditions (Trial holes)

Services shown on this drawing are as supplied by the Radar Survey. Others may exist

- Proposed NG pipeline diversion
- Existing NG 600mm steel pipeline
- Existing water pipes
- Existing electric cables
- Stoppie pit area
- Access for shaft construction
- Site boundary (Shaft cons)
- Access for tunnel construction
- Access for gas diversion

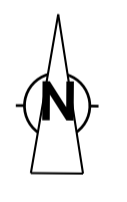
GENERAL NOTES
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards risks normally associated with the type of works detailed on this drawing please note the following:

Work to be carried out by a competent contractor working to an approved method statement

This plan is indicative only and provided as a guide. Other services may exist and should be expected. Services shown are taken from small scale records so locations are approximate. All services to be located on site before works commence.

All dimensions are in metres unless stated.
No scaling from this drawing
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OS Sheet TQ3980

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07	STOPPLES REVISED	NRJ	22/12/09
06	ISSUED FOR G17	NRJ	15/10/09
05	BALL VALVE ADDED	NRJ	23/11/08
04	TUNNEL CONSTRUCTION DETS.	NRJ	15/07/09
03	ISSUED FOR G17	NRJ	26/06/09
02	REVISED	NRJ	16/06/09
01	PROGRESS ISSUE	NRJ	03/06/09



Client
nationalgrid

Title
**CROSSRAIL
LIMMO SHAFT DIVERSION
DETAIL DRAWING**

Scale
1:400 @ A1
PLEASE CHECK SCALE BAR

Drawing No.
RCS / LIMMO / P / 001

Status
FOR G17

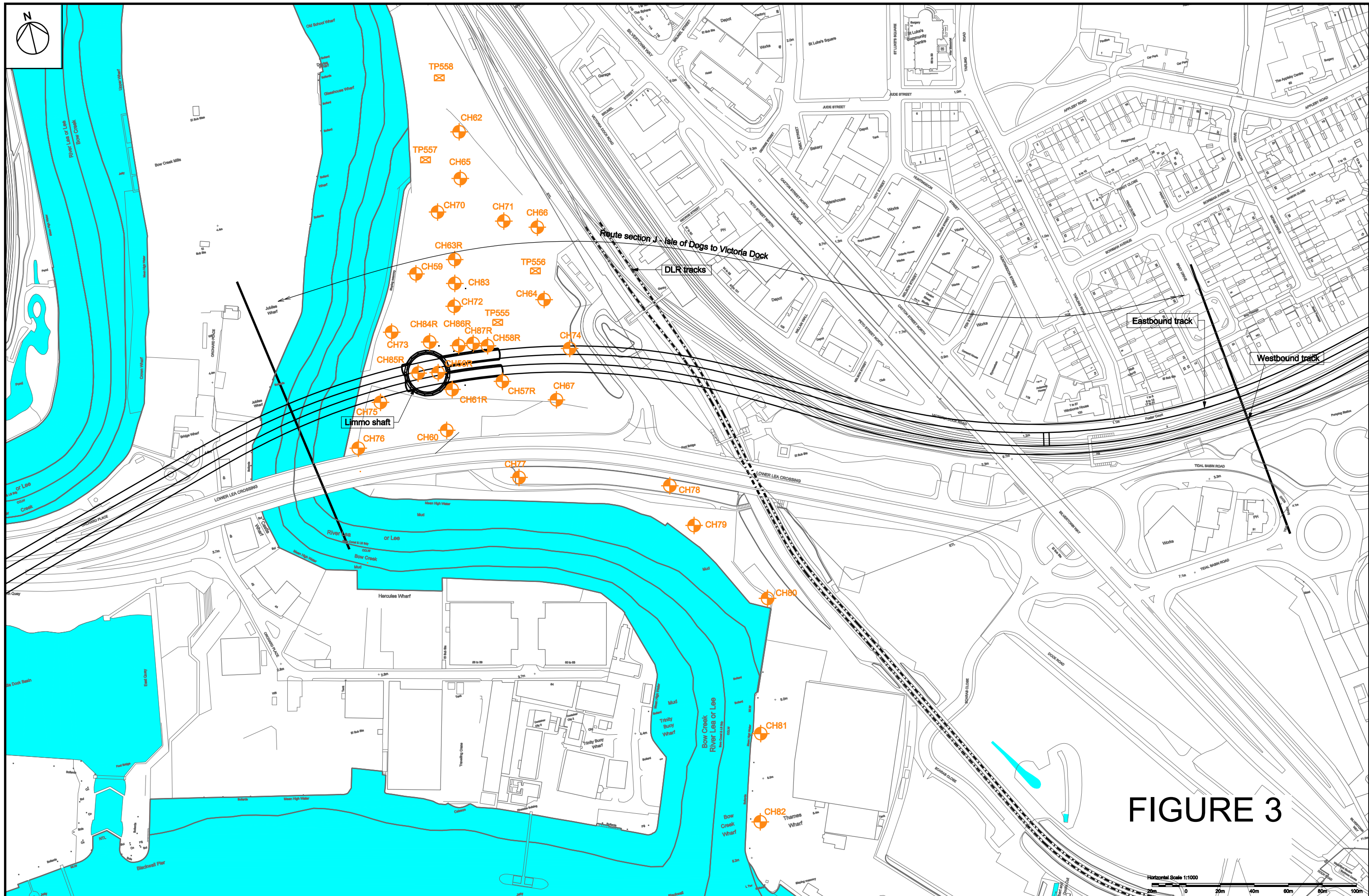


FIGURE 3

REV	DATE	FOR ISSUE	DESCRIPTION	NM	\$\$\$a	\$\$\$v
BY	CHKD	APP	CAD	ACC		

Key

- Existing Boreholes

Package 19a

- Proposed boreholes
- Proposed trial pit

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 28 CANADA SQUARE
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 LONDON E14 5LQ
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 www.crossrail.co.uk
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CONTRACT No. / CONSULTANT:
C122 ATKINS ARUP DESIGN TEAM

TITLE:
**PROPOSED BOREHOLE LOCATION PLAN
 CROSSRAIL GROUND INVESTIGATION
 PACKAGE 19A SHEET 1 OF 2**

SCALE: 1:1250 @ A1
 DRAWING AND CAD FILE No: P40401-C1M00-G00-D-05025
 REV: A01

1. Confirmation of all survey data must be obtained from the Crossrail survey team.
 2. Coordinates to the London Survey Grid, heights to the London height datum which is 100 metres below Ordnance Datum Newlyn. See Crossrail standard CR-STD-010.

RESTRICTED



Figure 4 Detail of Ordnance Survey Drawing 1799 (Limmo site indicated in circle)



Figure 5 Detail of Ordnance Survey Drawing 1799 (Limmo site indicated in circle)

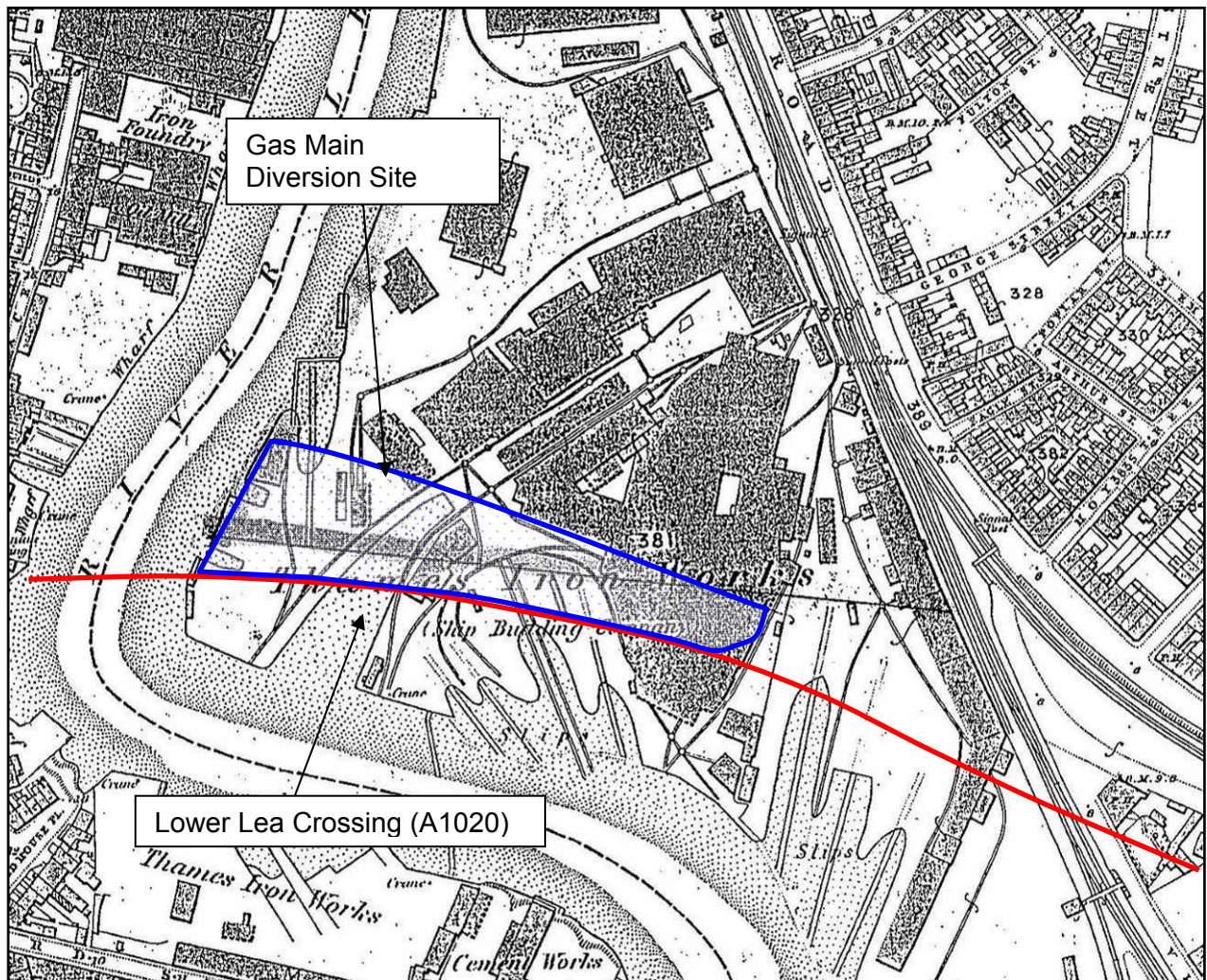


Figure 6 Detail of Ordnance Survey Drawing 1869 (marked site area and road indicative only, not to scale)

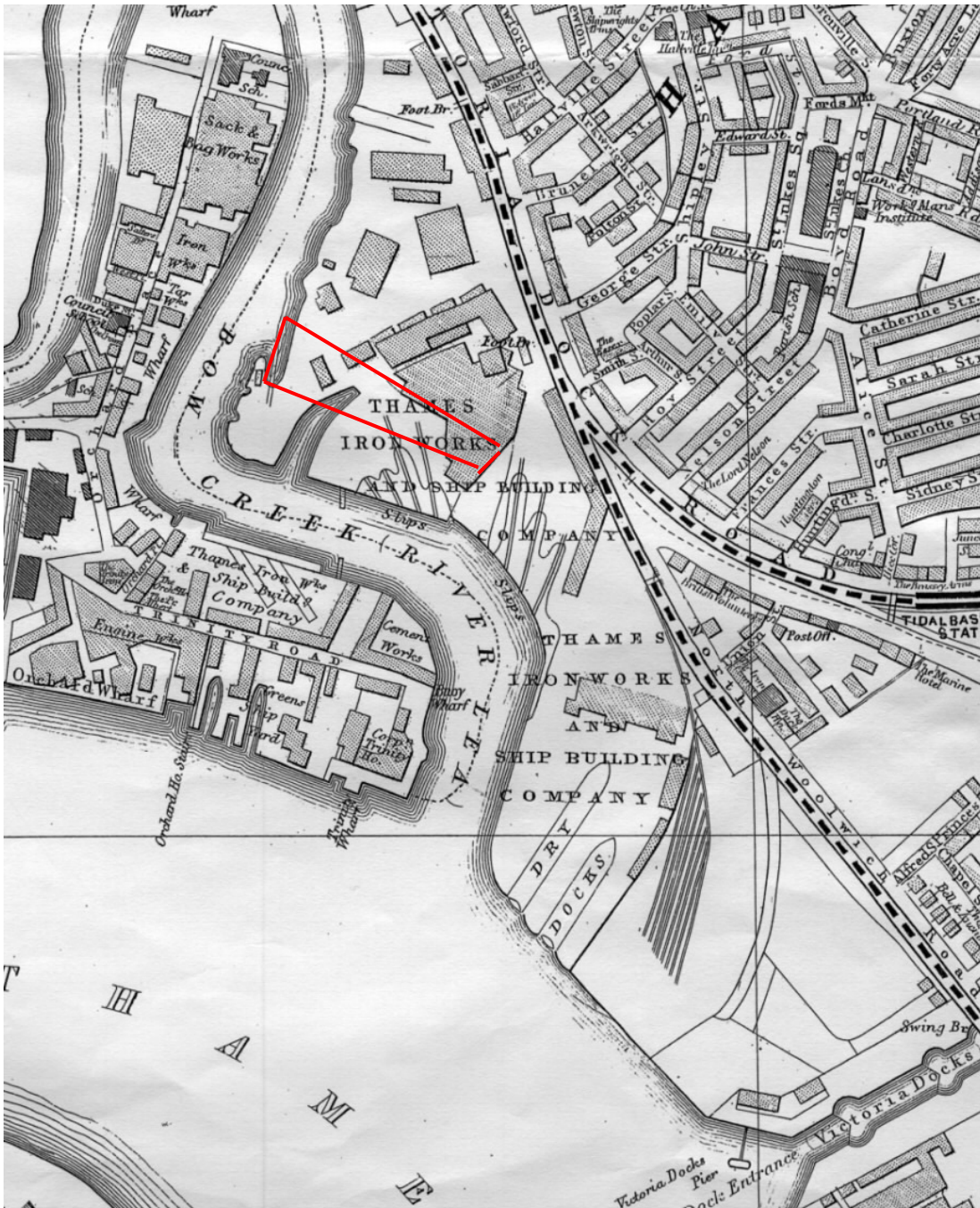


Figure 7 Bacon's Waistcoat Pocket Map of London c. 1900 (approximate site area shown in red)

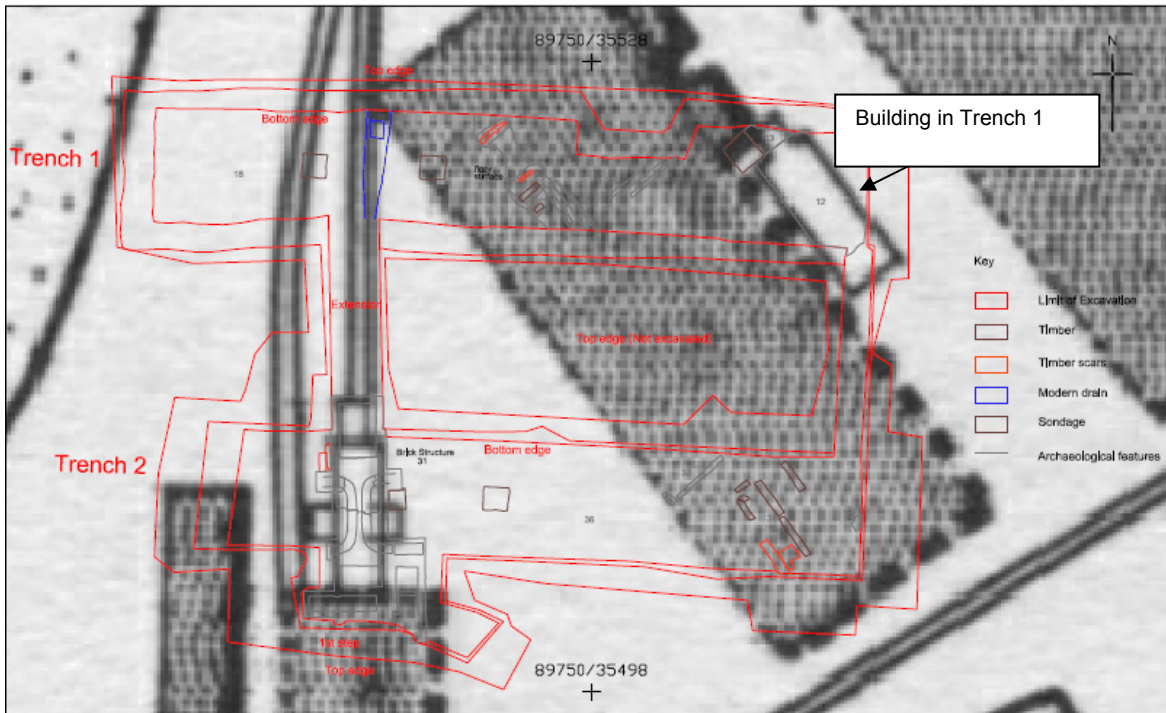


Figure 8 1869 Ordnance Survey map with trenches overlaid

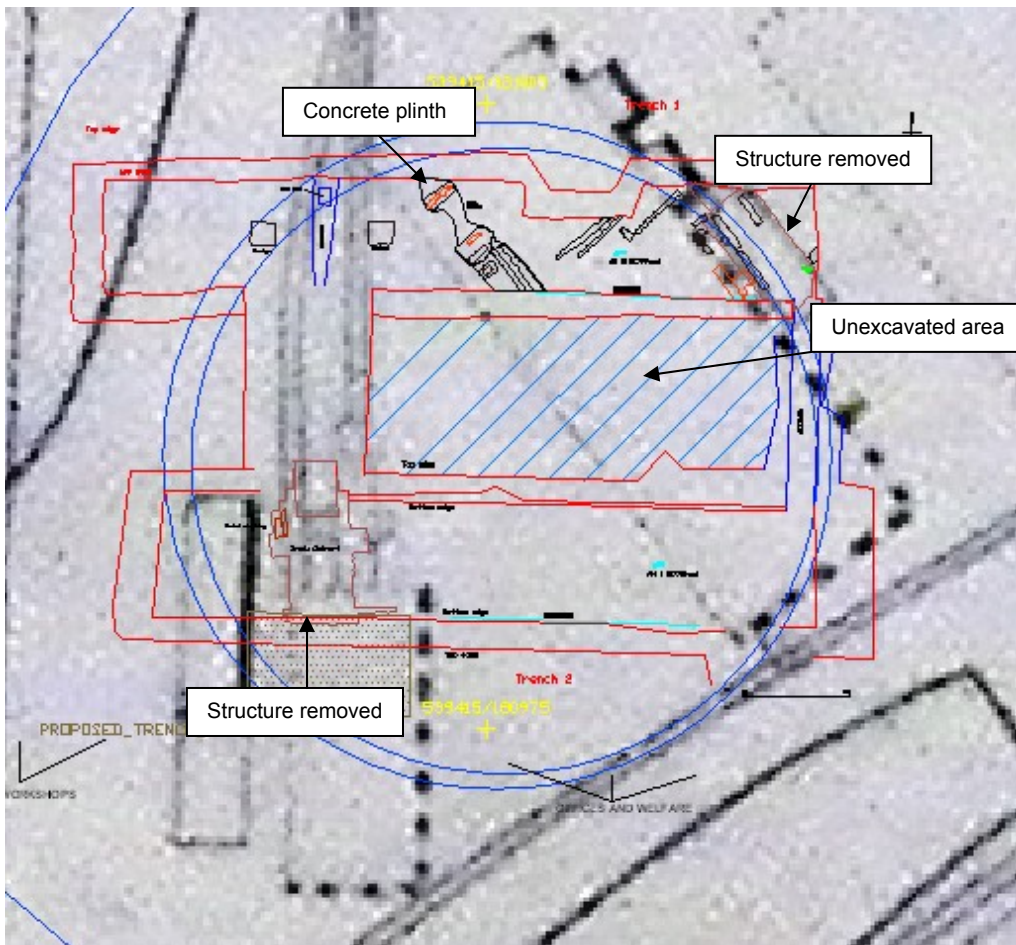


Figure 9 1869 OS showing shaft footprint (blue hachure is unexcavated area)

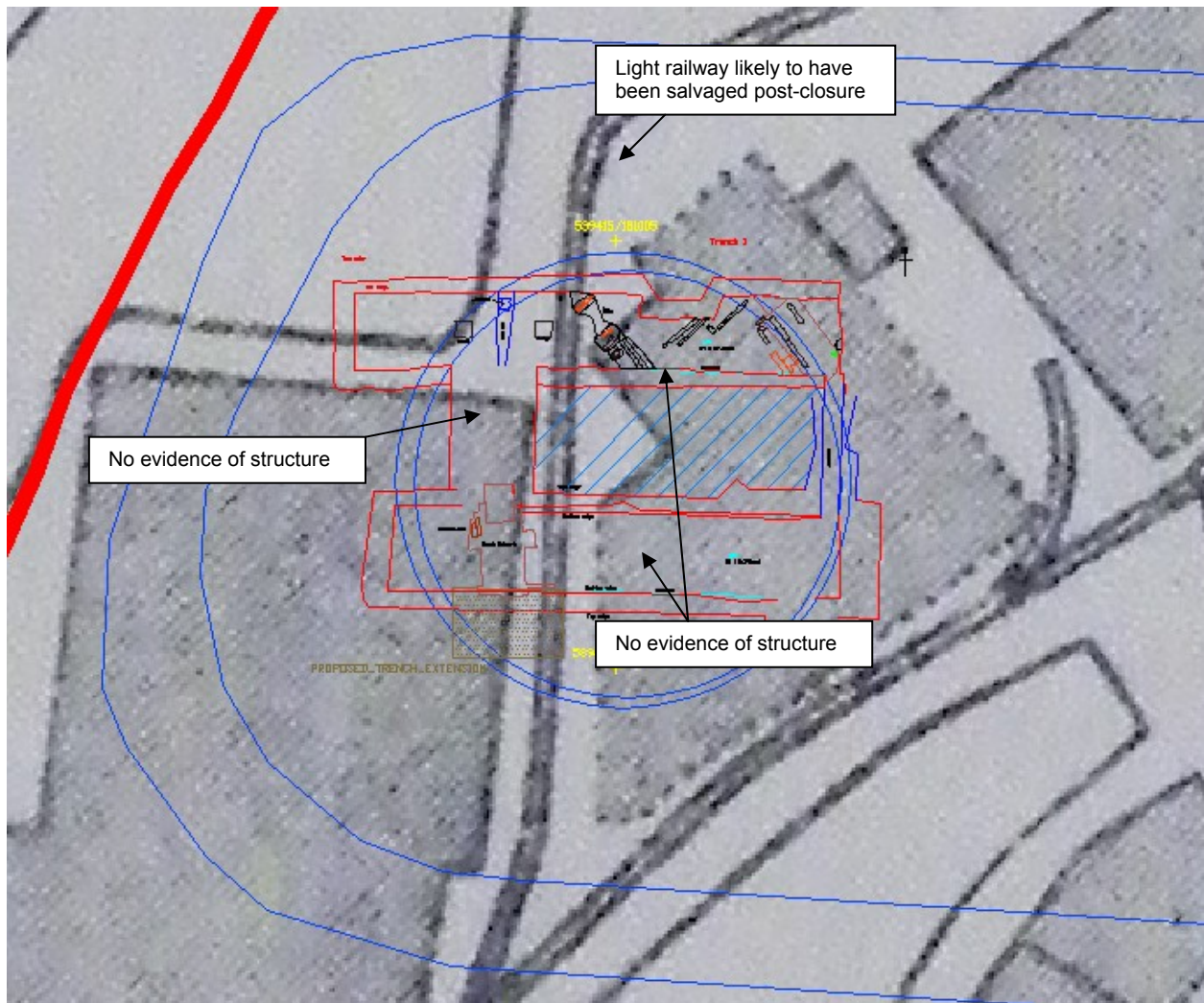


Figure 10 1916 OS map with shaft footprint overlaid