



## Liverpool Street

# Method statement for Verizon works at Old Broad Street in relation to the Scheduled Monument City Wall (LO26N)

Document Number: CRL1-XRL-Z7-GMS-C101-50001

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Reviewed/Accepted by:(signature)	[REDACTED]
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## 1 Introduction

### 1.1 Background

1.1.1 This method statement sets out the procedure for preservation *in situ* of Scheduled Monument LO26N – the City Wall, in relation to the Verizon utility diversion works to be carried out at the southern end of Old Broad Street.

1.1.2 The Crossrail Act 2008 contains clauses that disapply the usual statutory controls for works that affect Scheduled Monuments. Consequently, the Nominated Undertaker (Crossrail) has signed the Deed relating to works affecting scheduled monuments in the City of London (Crossrail Act 2008), hereafter referred to in this document as 'the Deed', with the Secretaries of State and English Heritage. The Deed requires details of works that may affect Scheduled Monuments to be approved by the Secretaries of State. The Deed in full is reproduced in Appendix B.

### 1.2 Purpose

1.2.1 Clause 3.2 of the Deed states that: *'Before commencing relevant construction works for an affected monument, the nominated undertaker must submit to the Secretaries of State the works details for those works for their approval in writing'*.

1.2.2 Furthermore, Clause 3.4 of the Deed states that 'the nominated undertaker must at the same time as submitting the works details under clause 3.2 send that information to English Heritage'. Clause 3.4 part (b) also states that *'the Secretaries of State must not approve the works details submitted to them unless English Heritage have either given their comments on those details to the Secretaries of State or have indicated that they do not need to comment'*.

1.2.3 Schedule 1 Part 2 of the Deed sets out the required Method Statement details, stating that *a method statement for the utility diversion works having an impact on an affected monument is to show how damage to the monument is, so far as reasonably practicable, to be avoided or minimised, including:*

*(a) where works for utilities are required in Moorgate, Circus Place, Blomfield Street, Bishopsgate and London Wall which have an impact on an affected monument, the location and the depth of the routes to accommodate utility trenches and their relationship with the monument and modern materials above;*

*(b) suitable protective measures (both temporary and permanent) where works for utilities have an impact on an affected monument.*

1.2.4 The aim of this method statement and accompanying appendices is to obtain *the decision of the Secretaries of State, which Clause 3.5 of the Deed states may be –*

*(a) approval should be withheld for specified reasons,*

*(b) approval should be given (in which case it may be given subject to specified amendments or requirements).*



- 1.2.5 This document describes how the risk of encountering the scheduled monument is managed and sets out the strategy for ensuring that it is not damaged by the works. This document only applies to Crossrail works.

### 1.3 Structure of this Method Statement

- 1.3.1 This method statement is organised in two parts. The first half will describe the monument and the archaeological works carried out thus far to satisfy the process set out in the Deed. The second half will present the construction methodology and mitigation strategy to avoid/protect the monument should it be encountered.

## 2 Scheduled Monument LO26N – City Wall

### 2.1 Description and significance of Scheduled Monument LO26N

- 2.1.1 Schedule 1, Part 3 of the Deed sets out background information describing the Scheduled Monument LO26N:

*....The parts of the monuments which might potentially be affected by the utility diversions are buried below ground level. It is considered that earlier utilities have previously been dug at least part-way through localised parts of the monuments. The current English Heritage mapping of the buried monuments is not considered to be accurate in detail.*

*The wall around the landward side of the Roman city of Londinium was built in c AD 200. Bishopsgate was one of the five original major gates, later reconstructed to project c 8m from the wall line. The wall was refurbished in the medieval period, the gates rebuilt, and new ones, including Moor Gate, were added. Further refurbishment took place in the 17th century, and large portions of the wall were demolished from the mid 18th century onwards.*

*Scheduled monument LO26N, London Wall: remains of Roman and medieval wall from the west end of All Hallows Church to 38 Camomile Street*

*Section LO26N is c 235m long, and extends eastwards from All Hallows Church to 38 Camomile Street. Unlike section LO26P, the majority of this section runs beneath buildings to the north of London Wall and Wormwood Street. It might, therefore, only be affected by utility diversions where it crosses the southern ends of Old Broad Street and Bishopsgate. This section includes the site of the former Bishopsgate, which projects north of the line of the wall.*

*The centre of this section lies at approximately NGR 532820 181525. The extent of survival of the buried parts of the wall and the Bishopsgate is uncertain. The top of the surviving wall at Bishopsgate was previously observed at c 1.6m below ground level. The western end at All Hallows Church survives above ground level.*

*The Bishopsgate is believed to have originally been a Roman gateway, with a gatehouse projecting to the rear of the wall by c 6.1m. The medieval gateway which replaced it was rebuilt in 1479, and repaired in 1648. The gateway was replaced in the 17th century, and rebuilt again in 1735, but demolished in 1761. The location of the gate is poorly defined from archaeological records, but as currently mapped by English Heritage, it extends c 4m to 5m north of the wall, although this omits the early gatehouse projecting to the rear.*

## 2.2 Schedule 2 Assessment Process

2.2.1 Schedule 2 of the Deed sets out a process to be employed by Crossrail design engineers to inform the design of the utilities diversions. The assessment stages set out in Schedule 2, and the works carried out by Crossrail to satisfy that process, are set out in this section.

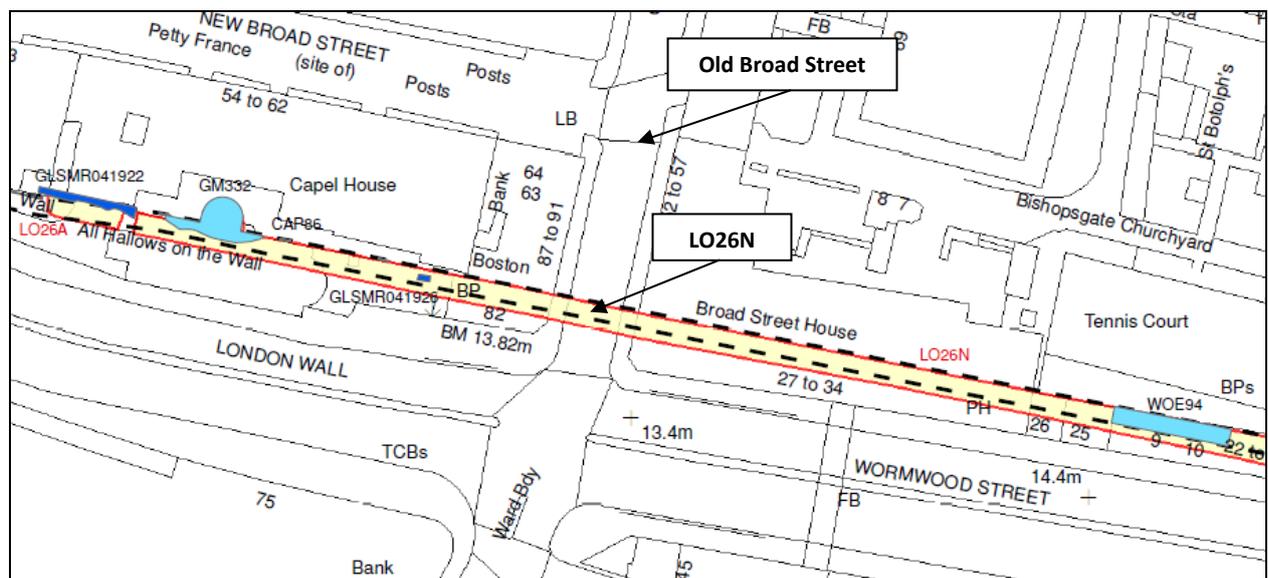
### Stage 1 – Detailed desk-based assessment

2.2.2 A desk based assessment was carried out by Crossrail and Museum of London Archaeology in 2008/09 to collate and map past observations of the City Wall and thereby understand the potential for encountering the scheduled monument during utilities works and consequently inform the necessity for a trial trench evaluation.

2.2.3 Refer to Appendix C for the full report. The results relating to the southern area of Old Broad Street are summarised below:

- A survey in 1991-92 observed the outer face of the City Wall to the east of Old Broad Street in the basement of 54-62 New Broad Street.
- The external face of the City Wall was identified in test pits to the east and west of the All Hallows on the Wall church (CAP86) to the east of Old Broad Street (figure 1)
- The City Wall forms the northern boundary of the All Hallows on the Wall churchyard, exposed and recorded to a height of 12ft (roughly contemporary ground level) in 1905 (figure 1).
- The City Wall was observed to its full width in the basement of 23-24 Wormwood Street, to the east of Old Broad Street during investigations in 1994 (WOE94 – figure 1).
- The alignment of the City Wall that constitutes section LO26N of the Scheduled Monument is extrapolated from observations at All Hallows on the Wall and at 23-24 Wormwood Street, to the west and east of Old Broad Street respectively. This alignment runs beneath Old Broad Street, however, the preservation of the City Wall in Old Broad Street is unknown.

**Figure 1 Alignment of the LO26N City Wall (Crossrail 2009a)**





*Stage 2 – Non-intrusive fieldwork*

- 2.2.4 Museum of London Archaeology (MoLA) advised Crossrail that Ground Penetrating Radar (GPR) is not an effective methodology in most urban areas due to the high level of interference from modern material which might overlie archaeological deposits.
- 2.2.5 MoLA reviewed the results of geotechnical investigations and identified an anomaly in an area to the east of Moorgate, where part of the City Wall was expected. Consequently, the Ground Penetrating Radar results were reviewed by Stratascan, a professional geophysical and specialist survey service often used to survey archaeological projects. Stratascan concluded that no archaeological features could be definitely identified, and that further radar work was not likely to produce reliable results. The decision was therefore taken to move directly from Stage 1 detailed desk-based assessment to Stage 3 intrusive fieldwork. Refer to Appendix D for the e-mail correspondence relating to the decision not to proceed with radar survey.

*Stage 3 – Intrusive fieldwork*

- 2.2.6 In accordance with Schedule 2 of the Deed intrusive fieldwork comprises exploratory field evaluation (trial pits or trenches), targeting key areas where the Crossrail utility works intersect the predicted line of the Scheduled Monument and further data is required to understand the risk of encountering it.
- 2.2.7 An archaeological watching brief and evaluation was carried out by Crossrail and MoLA on ten 1.5m deep trial trenches in 2009. Of the ten trenches, trench LIV19 was located at the southern end of Old Broad Street on the conjectured alignment of the London Wall LO26N. Refer to figures 2 and 3 for the location of LIV19.
- 2.2.8 Refer to Appendix E for the full evaluation report prepared by MoLA. The results relating to LIV19 are summarised below:
- Trench excavated to 1.5m below ground level.
  - Existing utilities occupied the full 1.5m deep trench; also the remains of an 18th or 19th century cellar were identified.
  - The Scheduled Monument was not encountered.

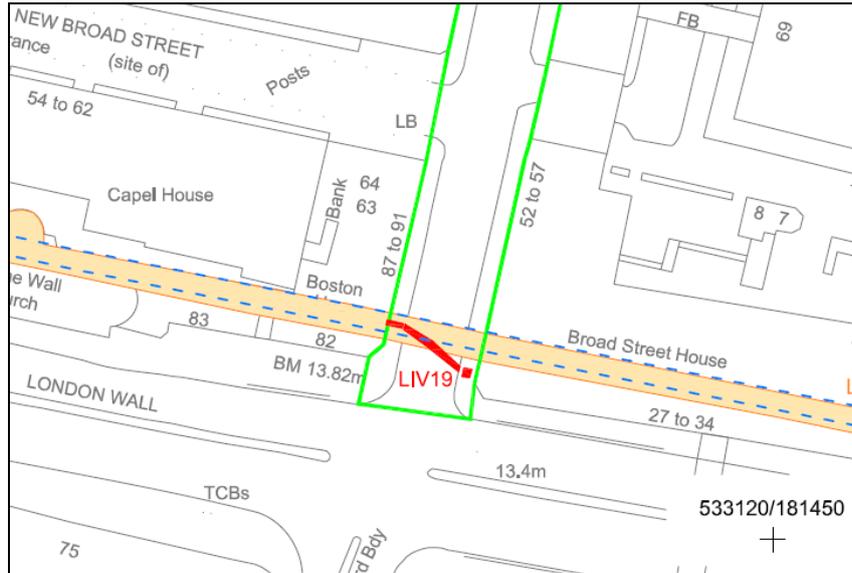


Figure 2 LIV19 trial trench at the southern end of Old Broad Street (Crossrail 2009b)

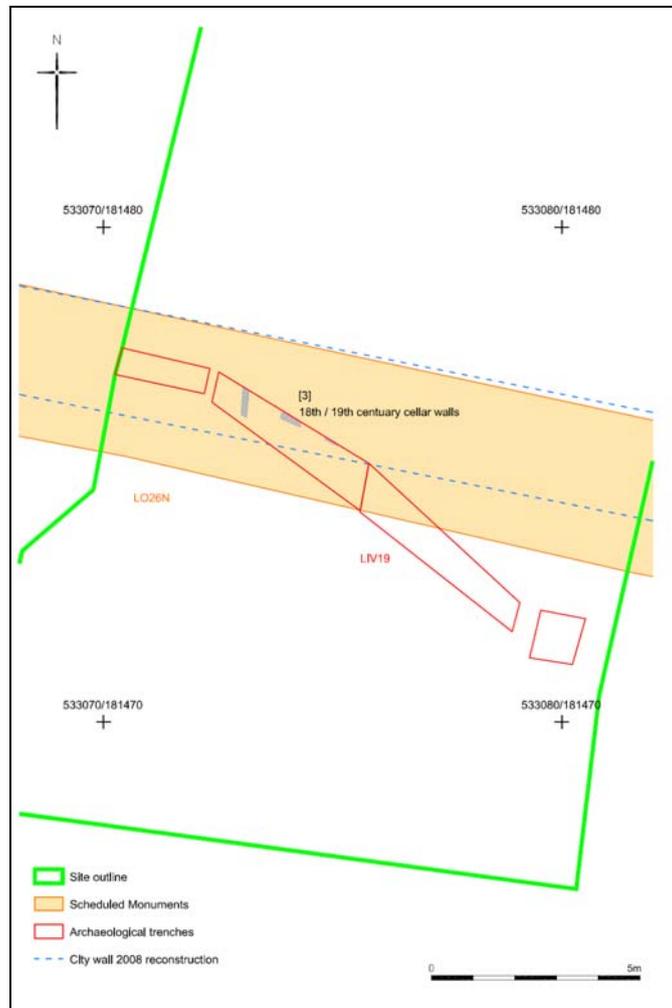


Figure 3 Plan of LIV19 and cellar walls (Crossrail 2009b)

2.2.9 Figure 4 and 5 (not to scale) show the concentration and depths of existing utilities and obstructions exposed in trench LIV19 in the section of Old Broad Street through which the Verizon ducts will be installed. Figure 5 shows modern disturbance to a minimum of 850mm below ground level, which is deeper than the proposed Verizon works. Figure 4 shows photographs of the exposed utilities in trench LIV19.



**Figure 4 Photographs of the exposed utilities in trench LIV19 (JB Riney 2009)**

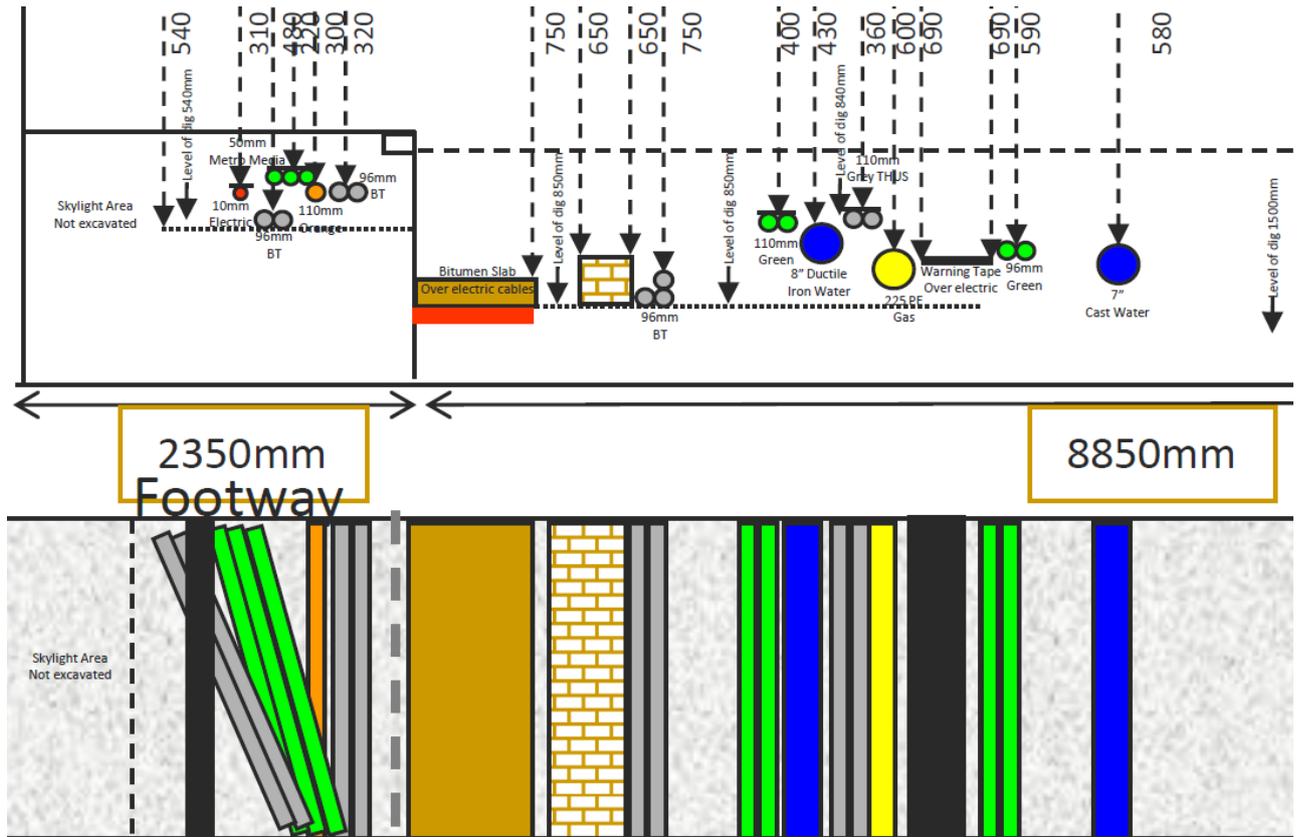


Figure 5 Diagram showing the concentration and depth of existing utilities in LIV19, not to scale (JB Riney 2009)

*Consultation with English Heritage*

2.2.10 In accordance with clause 2.2 of the Deed, before making a request for approval of the works under clause 3.2, Crossrail consulted English Heritage (Jane Siddell) on 14<sup>th</sup> October 2011. The full minutes of the meeting are provided in Appendix G, the key points are summarised below.

2.2.11 English Heritage stated that the location (figure 2) of the evaluation trench LIV19 does not comprehensively prove the absence of the Scheduled Monument at the location of the Verizon works, however no further archaeological evaluation is required if:

1. a strategy is provided setting out how the monument will be avoided/protected if it is encountered; and
2. that there will be an archaeological watching brief during the works at the monument location and within a buffer zone to the north and south.



2.2.12 Works details are to be submitted as per Schedule 3 of the Deed.

2.2.13 Consultation with English Heritage also took place in 2009 for the trial trench LIV19 and other trenches in the area. English Heritage (Jane Siddell) provided a specification for protection measures to be installed around the Scheduled Monument prior to backfilling. The same specification is set out in section 4 of this Method Statement, to be enacted should Scheduled Monument LO26N be exposed during the Verizon works.

## **2.3 Summary of the survival of Scheduled Monument LO26N at Old Broad Street**

2.3.1 The results of the assessment process carried out in accordance with Schedule 2 of the Deed are summarised below:

1. The projected alignment of Scheduled Monument LO26N intersects Old Broad Street and the Verizon works pass through that alignment.
2. The evaluation trench LIV19 did not identify Scheduled Monument LO26N and demonstrated modern disturbance to a depth up to 1.5m below ground level.
3. The evaluation trench LIV19 did not expose the entirety of the projected route of the London Wall and so therefore the risk of encountering it during Verizon works cannot be completely discounted. However this is considered unlikely given that the maximum excavation for the Verizon works is approximately 600mm below ground level only.



### 3 Scope of Works

- 3.1.1 The full scope of work is set out in the C503 Contractor's Method Statement in Appendix F.
- 3.1.2 The works are required to divert public utilities away from the footprint of the future Liverpool Street Crossrail ticket hall at Liverpool Street.
- 3.1.3 The works are programmed for late 2011/early 2012.
- 3.1.4 The works will take place in Eldon Street, Liverpool Street, Sun Street, New Broad Street, Old Broad Street and Blomfield Street. This document deals only with works at the southern end of Old Broad Street.
- 3.1.5 The general works comprise excavations for joint bays, duct routes, cable pits and access chambers, however, the works that pass through the projected alignment of Scheduled Monument LO26N will comprise only a duct route.
- 3.1.6 The following construction methodology is reproduced from the C503 Contractor's method statement:
1. Permit to penetrate (VCUK) and permit to dig (sub-contractor) need to be in place and checked by the VCUK Supervisor.
  2. Prior to the ground being broken the excavation area will be scanned by a trained subcontractor operative with a CAT and signal generator and checked against the Permit to Penetrate. Existing service records will be cross-checked.
  3. Services detected will be marked on the surface using line spray within and 2m beyond the footprint of the area to be excavated wherever possible.
  4. Based on the utilities agree with the VCUK Supervisor a suitable location for starting excavation. If location for excavation is moved, then start again from step 1.
  5. The tarmac will be saw-cut using floor saw and broken out using a 6t excavator with hydraulic breaker attachment. Where this is not possible, a hand-held breaker will be used.
  6. The 300mm mass concrete sub-base will be broken out by using the excavator. A banksman will be in attendance at all times whilst plant is in operation. Where this is not possible, a hand-held breaker will be used by the operatives.
  7. Made ground will be excavated by hand around the services to form trench. No excavation will be undertaken using mechanical excavator within 500mm of known or suspected services.
  8. Waste material will be transferred to the Liverpool Street compound using a dumper where it will be stored before it is tested and removed by the appointed subcontractor.
  9. Where an inspection deems the ground unstable, temporary ground support will be installed to a design approved by VCUK. A VCUK Engineer will carry out inspections of all excavations on a daily basis.



10. If services further to the ones known are identified, works will stop and refer back to VCUK supervision and management for guidance.



## 4 Approach to Mitigation at Scheduled Monument LO26N

- 4.1.1 Alongside the Contractor's construction methodology set out in section 3 the following mitigation, agreed in consultation with English Heritage, will be in place during the works at the southern part of Old Broad Street.
- 4.1.2 Continuous archaeological watching brief will be in place during works over the alignment of the Scheduled Monument and within a buffer zone of 6m to the north and south of the alignment. The area of continuous watching brief is shown on drawing CRL1-XRL-U-DDA-C101-00178, Appendix 1.
- 4.1.3 The general watching brief already in place for Crossrail utilities diversions at Liverpool Street will cover works outside of the 6m buffer zones. Refer to the Site Specific Written Scheme of Investigation (C138-MMD-T1-RST-C101-00001).
- 4.1.4 English Heritage will be informed by the Employer's Archaeologist one week prior to the start of works at the locations shown on drawing CRL1-XRL-U-DDA-C101-00178, Appendix 1, to allow a site visit to be organised.
- 4.1.5 Should the Scheduled Monument be encountered, the Principal Contractor will stop works immediately. Under no circumstances shall the works impact the Scheduled Monument. If any section of the Scheduled Monument is exposed it shall be:
- Avoided by the duct route – e.g. the duct route will be shallower to avoid the monument, or if this is not possible the route will be moved east or west until a suitable space for the duct route is identified.
  - Recorded and surveyed in full by the attending Archaeological Contractor;
  - Protected by a geotextile membrane and layer of sand (see 4.1.6) during reinstatement to the satisfaction of the Archaeological Contractor, Employer's Archaeologist and English Heritage.
- 4.1.6 The specification for protective materials for preservation *in situ* of the City Wall (Scheduled Monument) were supplied by the English Heritage Inspector of Ancient Monuments (Jane Sidell) to MoLA in advance of the evaluation fieldwork in 2009. The same specification shall be applied as follows:
- Geotextile: water-porous geotextile
  - Sand: effectively iron free, pale coloured (in the 7.5 YR, 10YR and 2.5 YR Munsell chart colour bracket), non-calcareous, relatively clay free, with particle size of no less than 98% below 63 microns and no more than 2% above 2mm, Loss on ignition value to be no more than 2%, e.g. 'Kingsley No 1'.



## 5 Reference documents

- Crossrail 2009a. Utilities Diversions: London Wall, Moorgate, Blomfield Street, Old Broad Street, Bishopsgate, Past Observations of City Wall. October 2008. Museum of London Archaeology Service.
- Crossrail 2009b. Liverpool Street & Moorgate Utilities Trial Trenches Archaeological Watching Brief & Evaluation. Document Number CR-PN-LIV-EN-MS-00003.
- Crossrail 2009c. Crossrail Act 2008: Deed relating to works affecting scheduled monuments in the City of London.
- Crossrail 2009d. Liverpool Street & Moorgate Utilities Trial Trenches. Archaeological Watching Brief & Evaluation Method Statement.
- Crossrail 2010. Archaeological Watching Brief & Evaluation, Utilities trial trenches, Liverpool Street and London Wall v2.0. Museum of London Archaeology Service.
- Crossrail 2011. C503 – Liverpool Street Method Statement Utilities Diversions – Excavation, Duct Installation, Backfilling. CRL Document Number: C503-VIN-C-GMS-C101-50010.
- JB Riney 2009. Liverpool Street Area – Trial Hole Number: 19 – Old Broad Street, Utility Trial Trench Report.



## Appendix A Drawing

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

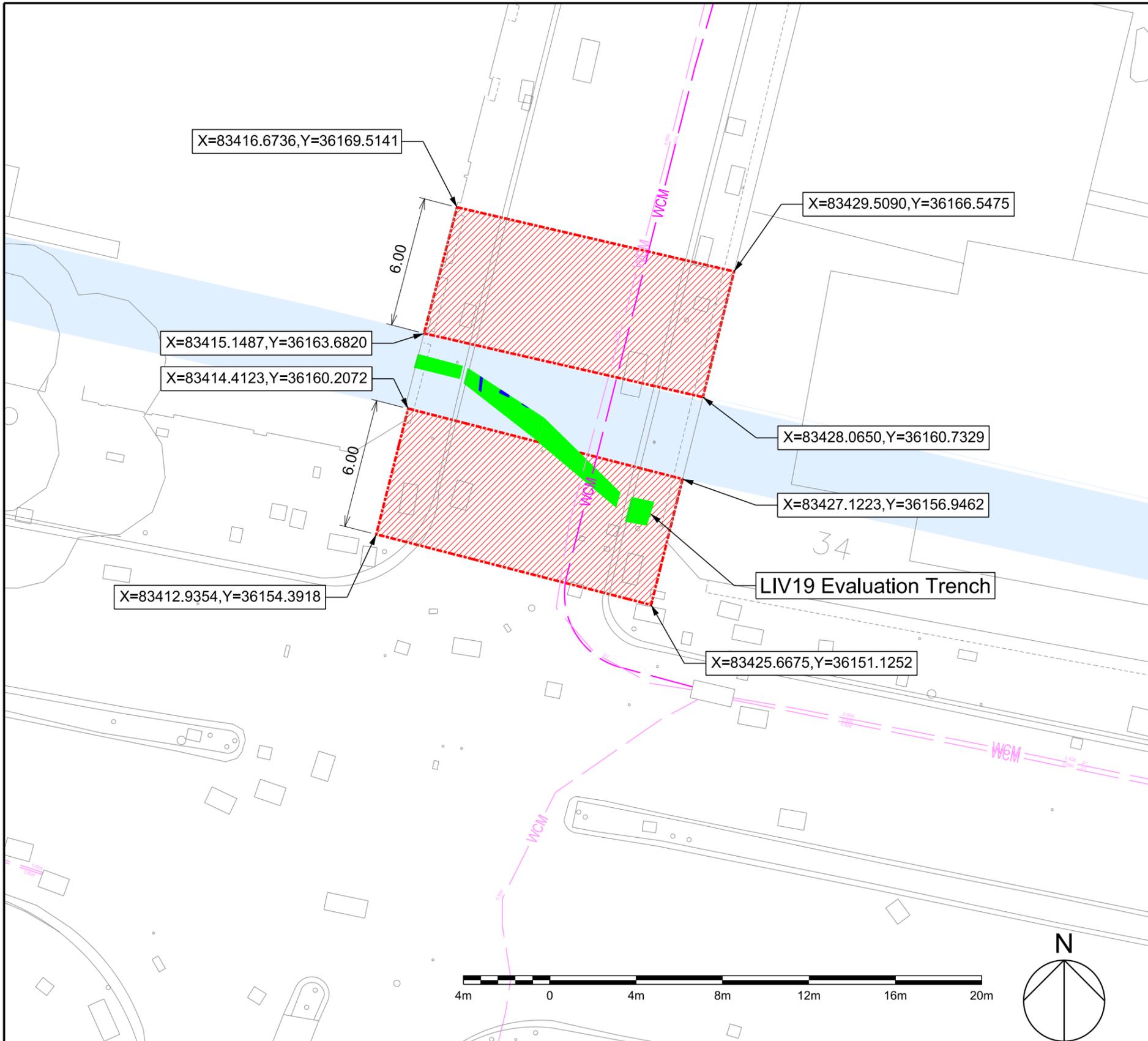
**Construction**  
 Ci.  
 Cii.  
 Ciii.

**Operations**  
 Oi.  
 Oii.  
 Oiii.

**Maintenance**  
 Mi.  
 Mii.  
 Miii.

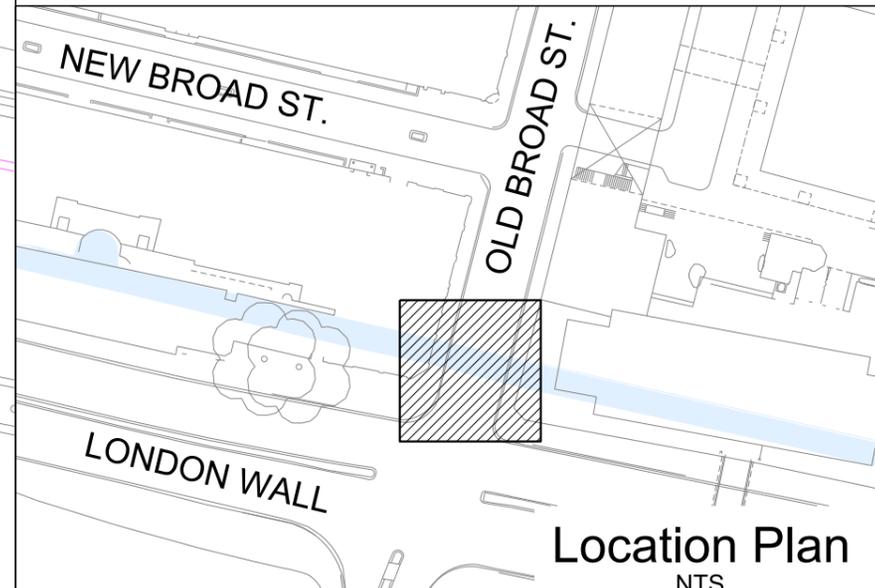
**Dismantling/Demolition (Future)**  
 Di.  
 Dii.  
 Diii.

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



### KEY

-  LIV19 Evaluation Trench
-  18th/19th Century cellar walls
-  Scheduled Monument of London Wall (Archeological watching brief area)
-  6m Buffer zone from London Wall (Archeological watching brief area)
-  Verizon - Existing Route (Surveyed)
-  Verizon - Proposed Diversion Route



Copy Approved for Design - Created: 01-NOV-2011

Rev.	Date	Description	By	Chkd	App	Auth
P01	01/11/2011	First Issue	MH	HC	-	-
P02	01/11/2011	Key amended	MH	HC	SS	-

**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.



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Contract : Crossrail Line 1 Programme		By : M.HOPPER	
Originator : Crossrail Ltd		Chk : H.CASEY	
Location : Liverpool Street Stn		App : S.SHEPHERD	
Title : Liverpool Street - Eastern Ticket Hall Existing Verizon Utilities at Scheduled Monument of London Wall		Auth : ---	
Drg No :	CRL1-XRL-U-DDA-C101-00178	Rev :	P02
Scale :	1:200 @ A3	Suit :	S4

Fit for authorisation

RESTRICTED



## **Appendix B      Crossrail Act 2008: Deed relating to works affecting scheduled monuments in the City of London**

Dated

27<sup>th</sup> April

2009

**Crossrail Limited (1)**

**The Secretary of State for Transport (2)**

**The Secretary of State for Culture, Media and Sport (3)**

**The Historic Buildings and Monuments Commission for England (4)**

Crossrail Act 2008: Deed relating to works affecting scheduled monuments in the City of London

THIS DEED is made the 27<sup>th</sup> day of April 2009

BETWEEN

CROSSRAIL LIMITED of 25 Canada Square, London, E14 5LQ ("the nominated undertaker") (1)

AND

THE SECRETARY OF STATE FOR TRANSPORT (2)

AND

THE SECRETARY OF STATE FOR CULTURE, MEDIA AND SPORT (3)

AND

THE HISTORIC BUILDINGS AND MONUMENTS COMMISSION FOR ENGLAND of 1 Waterhouse Square, 138-142 Holborn, London, EC1N 2ST ("English Heritage") (4)

WHEREAS

- (1) The Crossrail Act 2008 ("the Act") has been enacted authorising works in connection with the construction and operation of Crossrail;
- (2) Paragraphs 4 and 5 of Schedule 9 to the Act disapply certain provisions of the Ancient Monuments and Archaeological Areas Act 1979 and the National Heritage Act 1983;
- (3) Section 39 of the Act provides for the Secretary of State to appoint one or more bodies as nominated undertaker to carry out the works for Crossrail and the nominated undertaker has been so appointed by The Crossrail (Nomination) Order 2008 made on 23<sup>rd</sup> July 2008;
- (4) The nominated undertaker has been required by the Secretary of State to enter into this Deed providing for certain details of works affecting the scheduled ancient monuments known as the city wall of London and Armourers' and Brasiers' Hall to be subject to further approvals.

NOW THIS DEED WITNESSES as follows:-

## 1 Definitions

"the 1979 Act" means the Ancient Monuments and Archaeological Areas Act 1979;

"the affected monuments" means scheduled monuments LO26A, LO26N, LO26P, 26323 and LO32 in the City of London (comprising part of the Roman and medieval city wall and Armourers' and Braziers' Hall), and "affected monument" means any one of them;

"emergency" means circumstances where there is a risk to health and safety or to the preservation of an affected monument such that any of the relevant construction works require to be carried out immediately;

"the Promoter" means the Secretary of State and any person or body exercising powers or functions by virtue of an order under section 51 of the Act;

"relevant construction works" means, in relation to an affected monument, works to be carried out to the monument under the powers conferred by the Act which fall within section 2(2) of the 1979

Act but which do not require consent under section 2 of the 1979 Act by virtue of paragraph 4(2) of Schedule 9 to the Act;

“the required field evaluation” means a field evaluation concerning the affected monuments carried out in accordance with Schedule 2 hereto;

“the Secretary of State” means the Secretary of State for Transport;

“the Secretaries of State” means the Secretary of State for Transport and the Secretary of State for Culture, Media and Sport (or any successor Minister or Secretary of State to their respective portfolios), and includes officials in any of their departments;

“the works details” means in relation to relevant construction works concerning an affected monument (a) method statements covering the matters set out in Part 2 of Schedule 1 hereto and (b) particulars of any other works proposed by the nominated undertaker to the fabric of the monument for the purpose of protecting or restoring it; and

“the works specification” means, in relation to an affected monument, the works to the monument specified in Part 1 of Schedule 1 hereto.

## **2 Field evaluations**

2.1 Before making the first request for approval of works details under clause 3.2, the nominated undertaker shall carry out or complete the required field evaluation, so far as it has not been carried out or completed by the Promoter or some other relevant person or body.

2.2 Before making a request for approval of works details under clause 3.2 (whether the first request for such approval or any subsequent ones), the nominated undertaker shall consult English Heritage about whether in its view a field evaluation relating to the relevant construction works concerned which is in addition to the required field evaluation (or to any other relevant field evaluation which has been carried out and whose results are available to the nominated undertaker) should be carried out and the scope of any such additional evaluation to be undertaken.

2.3 Where the carrying out by the nominated undertaker of a field evaluation in accordance with this clause 2 may cause damage to an affected monument, the nominated undertaker shall not carry it out without obtaining the prior approval of the proposals in writing from the Secretaries of State; and the approvals procedures under clause 3.4 and 3.5 shall apply to the proposals as they apply to works details submitted under clause 3.2 (but with the substitution of the period of 3 weeks for the period of 6 weeks in clause 3.4(a)), and the Secretaries of State shall not unreasonably delay their decision and shall in any event give the decision within 4 weeks of a request in writing for approval being made.

## **3 The carrying out of relevant construction works**

3.1 Any relevant construction works to an affected monument must either –

- (a) fall within or be ancillary to the works specification for the monument,
- (b) fall within or be ancillary to a variation of that specification requested by the nominated undertaker and agreed in accordance with clause 4,
- (c) be connected with a field evaluation carried out in accordance with clause 2, or
- (d) be works for the purpose of protecting or restoring the monument.

- 3.2 Before commencing relevant construction works (other than those mentioned in clause 3.1(c)) for an affected monument, the nominated undertaker must submit to the Secretaries of State the works details for those works for their approval in writing, and the submission shall –
- (a) include so far as relevant to the works details concerned the matters mentioned in Schedule 3 hereto,
  - (b) have regard to the background information set out in Part 3 of Schedule 1 hereto,
  - (c) specify the opinion (if any) expressed by English Heritage on being consulted under clause 2.2,
  - (d) include the results of the required field evaluation where the submission for approval is the first one to be made by the nominated undertaker under this clause 3.2, and
  - (e) include the results of any field evaluation carried out by the nominated undertaker which is in addition to the required field evaluation and is relevant to the works details, together with the results where available to the nominated undertaker of any other such field evaluation as is referred to in clause 2.2 which is so relevant.
- 3.3 Subject to clause 3.8 and 3.9, the relevant construction works for an affected monument must be constructed in accordance with the works details so approved and subject to any requirements subject to which it is given.
- 3.4 The nominated undertaker must at the same time as submitting the works details under clause 3.2 send that information to English Heritage, and the Secretaries of State must not approve the works details submitted to them unless either–
- (a) a period of 6 weeks has elapsed after the submission, or
  - (b) English Heritage have either given their comments on those details to the Secretaries of State or have indicated that they do not intend to comment.
- 3.5 The decision of the Secretaries of State may be that –
- (a) approval should be withheld for specified reasons,
  - (b) approval should be given (in which case it may be given subject to specified amendments or requirements).
- 3.6 Where in the opinion of the Secretaries of State the required field evaluation has not been carried out (or not fully or adequately carried out), or a field evaluation in addition to the required field evaluation should have been carried out but has not been carried out (or not fully or adequately carried out), a decision to withhold approval under clause 3.5(a) may include a decision that no approval should be given before the required field evaluation, or a further field evaluation, is carried out and the results submitted to the Secretaries of State for consideration.
- 3.7 The decision of the Secretaries of State under clause 3.5 shall not be unreasonably delayed and shall in any event be given within 8 weeks of the submission for approval being made, or where the required field evaluation or a further field evaluation is carried out following a decision made under clause 3.6, of the results of the evaluation being submitted to the Secretaries of State for consideration, and shall be sent in writing to the nominated undertaker.

3.8 Clauses 3.1 to 3.3 do not apply in the case of emergency but the nominated undertaker must inform the Secretaries of State and English Heritage as soon as reasonably practicable of the nature of the emergency and the works to be carried out or which have been carried out, and shall so far as reasonably practicable take into account any proposals made by the Secretaries of State or English Heritage, where the emergency works have not yet been carried out.

3.9 In addition, clauses 3.1 to 3.3 do not apply in a case where –

- (a) in carrying out relevant construction works in accordance with approved works details, unexpected parts of an affected monument are discovered or any part of an affected monument is found to be in a different place than was expected when the works details were approved (all and any of which are referred to below as “the unexpected items”), and
- (b) it is not reasonably practicable (whether by virtue of the effects on traffic circulation or on the construction timetable for Crossrail or otherwise) to delay the carrying out of the relevant construction works while the change procedures of clause 4 are followed to accommodate the unexpected items;

but where those events have occurred, then the nominated undertaker must in carrying out the relevant construction –

- (i) minimise so far as reasonably practicable any additional impacts on the affected monument in the carrying out of the relevant construction works which arise from the discovery of the unexpected items,
- (ii) if, notwithstanding paragraph (i) above, any removal of parts of the affected monument not envisaged when the works details were approved falls to be carried out, so far as reasonably practicable and required by good archaeological practice record the remains to be removed prior to removal, and
- (iii) so far as reasonably practicable, consult the Secretary of State and English Heritage on the matters referred to in paragraphs (i) and (ii) above and take their views into account.

3.10 Where the carrying out of relevant construction works (whether approved for the purposes of this clause 3 or works carried out under clause 3.8 or 3.9) causes damage to an affected monument for the remedying of which provision is not made in approved method statements, the nominated undertaker shall as soon as reasonably practicable submit details for the carrying out of remedial works to make good the damage (so far as such remedial works can reasonably be carried out notwithstanding the presence of the permanent works or other things constructed or installed under the Act or the removal of any of the affected monument), and the approvals procedures under clauses 2, 3.2, 3.4 to 3.7 and 4 shall apply to details submitted for the purposes of this clause 3.10 as they apply to works details submitted under clause 3.2; and subject to clause 3.11 the nominated undertaker shall carry out the remedial works as so approved.

3.11 The duty to carry out remedial works under clause 3.10 is subject to the obtaining of any necessary consents, agreements or other approvals required for the purpose, which the nominated undertaker shall use reasonable endeavours to obtain.

3.12 English Heritage shall use reasonable endeavours, having regard to the nature of the works details submitted and in particular to whether they relate only to a variation of works details previously approved, to give its comments (or indicate that it does not

propose to comment) earlier than the period of 6 weeks mentioned in clause 3.4(a) in order that the Secretaries of State may make their decision promptly in accordance with clause 3.7.

- 3.13 Where recording is carried out under clause 3.9(ii), the results of the recording are to be sent by the nominated undertaker to the Secretaries of State or to such other person or body as the Secretaries of State may specify.

#### **4 Changes to works specification or to approved works details**

- 4.1 Where the nominated undertaker wishes to make changes to the works specification, or to any revised works specification or works details previously approved by the Secretaries of State under this Deed, the nominated undertaker shall submit a revised works specification or (as the case may be) further works details to the Secretaries of State for approval.
- 4.2 The approvals procedures under clauses 2, 3.2 and 3.4 to 3.7 shall apply to the revised works specification or (as the case may be) to the further works details as they apply to works details submitted under clause 3.2.
- 4.3 Where the nominated undertaker submits a revised works specification for approval under clause 4.1, the Secretaries of State may, not later than the time at which they give any approval to the revised works specification, specify in writing any changes to the matters set out in Part 2 of Schedule 1 which in their opinion are required in consequence, and the extent to which any works details previously approved in relation to the works in question require to be resubmitted for approval; and where they do so the works details requiring approval under clause 3 shall (subject any further change proposed under clause 4.1) have effect subject to the changes and requirements for resubmission so specified.

#### **5 Delegation of functions**

- 5.1 The Secretaries of State may delegate any of their functions under this deed to another public authority (whether comprised in the Crown, a local authority or some other public body); and if they do so, they may (but shall not be obliged to) prescribe arrangements under which the nominated undertaker may appeal to the Secretaries of State against any decision of the delegatee with which the nominated undertaker is aggrieved, or any failure of the delegatee to take a decision.
- 5.2 On such an appeal, the Secretaries of State may take any decision which, but for the delegation, they could take under this Deed and under such extended timetable to accommodate the appeal as they think appropriate.

IN WITNESS of which the parties have executed this Deed and have delivered it on the date first above written.

Executed as a deed by Crossrail Limited  
acting by:

..... Director/Secretary  
..... Director

The Corporate Seal of the Secretary of State for Transport hereunto affixed to this deed is authenticated by

*Rebecca Wood*

.....  
Authorised by the Secretary of State for Transport

SEAL REF No.

DFT/2909



The Corporate Seal of the Secretary of State for Culture, Media and Sport hereunto affixed to this deed is authenticated by

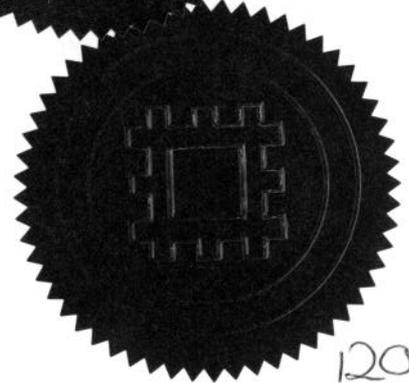
*H. Rea*

.....  
Authorised by the Secretary of State for Culture, Media and Sport



The Common Seal of the Historic Buildings and Monuments Commission for England was affixed in the presence of

*W. H. W. W.*



1207

## Schedule 1

Roman and medieval City Wall and Armourers' and Braziers' Hall  
(Scheduled Monuments LO26A, LO26N, LO26P, 26323 & L032)

### *Part 1 – Works Specification*

Diversion of utilities which may impact on the affected monuments from the areas of the proposed Crossrail works to routes across and along London Wall, and along Moorgate, Circus Place, Blomfield Street, and Bishopsgate, involving (amongst other matters) the excavation of cut-and-cover trenches for the diverted utilities.

### *Part 2 – Method Statement details*

A method statement for the utility diversion works having an impact on an affected monument is to show how damage to the monument is, so far as reasonably practicable, to be avoided or minimised, including:

- (a) where works for utilities are required in Moorgate, Circus Place, Blomfield Street, Bishopsgate and London Wall which have an impact on an affected monument, the location and the depth of the routes to accommodate utility trenches and their relationship with the monument and modern materials above;
- (b) suitable protective measures (both temporary and permanent) where works for utilities have an impact on an affected monument.

### *Part 3 – Background context information concerning the monument*

This Schedule is concerned with scheduled monuments LO26A, LO26N, LO26P, 26323 (four of the twenty-one surviving sections of the Roman and medieval city wall), and scheduled monument LO32 (Armourers' and Brasiers' Hall). The parts of the monuments which might potentially be affected by the utility diversions are buried below ground level. It is considered likely that earlier utilities have previously been dug at least part-way through localised parts of the monuments. The current English Heritage mapping of the buried monuments is not considered to be accurate in detail – in particular, the eastern c two-thirds of LO26P appears to be mapped too far to the south, and the eastern end of LO26A does not appear to include the full length of the surviving wall.

The wall around the landward side of the Roman city of *Londinium* was built in c AD 200. Bishopsgate was one of the five original major gates, later reconstructed to project c 8m from the wall line. The wall was refurbished in the medieval period, the gates rebuilt, and new ones, including Moor Gate, were added. Further refurbishment took place in the 17th century, and large portions of the wall were demolished from the mid 18th century onwards.

*Scheduled monument LO26P, London Wall: remains of Roman wall and conduit and medieval postern, Bloomfield House (sic) to site of Moor Gate*

Section LO26P is c 280m long and lies beneath the roadways of London Wall and Moorgate. It extends eastwards from the junction of London Wall and Moorgate, across the junctions of London Wall with Circus Place (leading to Finsbury Circus) and Blomfield Street. It includes the site of the former Moor Gate, which projects north of the line of the wall, and of a postern at the junction of London Wall and Blomfield Street. The Roman 'conduit' is a drain passing through the wall foundations, opposite 48 London Wall.

The centre of section LO26P lies at approximately NGR 533120 181470 but as currently mapped by English Heritage, approximately two-thirds of the length of LO26P is poorly located in plan. Notably, on the current mapping, the hypothesised eastern end of section LO26P (from a point

opposite Copthall Avenue eastwards) appears to lie too far to the south to align with the existing above-ground sections at All Hallows on the Wall (LO26A & LO26N).

The extent of survival of the buried wall and Moor Gate is uncertain. Previous observations of the top of the surviving wall at three points between Moorgate and Throgmorton Avenue vary between c 0.7m and c 3.6m below ground level.

The Moor Gate was a medieval postern rebuilt c 1415 as a gateway flanked by projecting towers. It was rebuilt again in 1673, and demolished in 1762. The medieval and post-medieval Moor Gate was located in 1925; as currently mapped, it extends c 14m to 17m north of the wall.

*Scheduled monument LO26A, London Wall: section bounding All Hallows churchyard*

Section LO26A is c 11m long, lying to the west of All Hallows Church with the centre of this section at approximately NGR 533000 181490. Along section LO26A, the city wall survives up to, and above, street level (it stands up to c 3.7m above ground level, where it is reduced to c 0.5m in width). The visible section consists of medieval stonework, on Roman fabric, with modern brick capping. The extent of the buried parts is uncertain; the wall is currently mapped by English Heritage as being c 3.5m wide, which would include such elements. It appears that the mapping does not extend sufficiently far eastwards to include the eastern c 2m of wall visible above ground level.

*Scheduled monument LO26N, London Wall: remains of Roman and medieval wall from the west end of All Hallows Church to 38 Camomile Street*

Section LO26N is c 235m long, and extends eastwards from All Hallows Church to 38 Camomile Street. Unlike section LO26P, the majority of this section runs beneath buildings to the north of London Wall and Wormwood Street. It might, therefore, only be affected by utility diversions where it crosses the southern ends of Old Broad Street and Bishopsgate. This section includes the site of the former Bishopsgate, which projects north of the line of the wall.

The centre of this section lies at approximately NGR 532820 181525. The extent of survival of the buried parts of the wall and the Bishopsgate is uncertain. The top of the surviving wall at Bishopsgate was previously observed at c 1.6m below ground level. The western end at All Hallows church survives above ground level.

The Bishopsgate is believed to have originally been a Roman gateway, with a gatehouse projecting to the rear of the wall by c 6.1m. The medieval gateway which replaced it was rebuilt in 1479, and repaired in 1648. The gateway was replaced in the 17th century, and rebuilt again in 1735, but demolished in 1761. The location of the gate is poorly defined from archaeological records, but as currently mapped by English Heritage, it extends c 4m to 5m north of the wall, although this omits the early gatehouse projecting to the rear.

*Scheduled monument 26323, London Wall: section of Roman wall within the London Wall underground car park, 25m north of Austral House and 55m north west of Coleman Street*

Section 26323 was formerly scheduled as LO26J. The scheduled area has been significantly altered with the revised designation. It is situated within an underground car park, beneath the roadway of London Wall, NGR 532578 181580.

The section of the city wall standing above the car park floor is c 11.2m long, 2.6m wide and 3.3m high. The scheduled area surrounding the wall measures c 15m x 8m, and includes the ground beneath the floor of the car park, which lies c 5m below ground level. The extent of any remains below floor level is not known. The schedule excludes the floor and other structural elements of the car park.

*Scheduled monument LO32, Armourers' and Brasiers' Hall*

The hall of this livery company is a standing building at the junction of Coleman Street and London Wall, NGR 532660 181535. It is a Grade II\* Listed building as well as a scheduled monument. The two-storey hall was built, in Greek style, in 1840, of brick with painted and Portland Stone dressings.

## Schedule 2

### Scope of the required field evaluation

The results of the field evaluation are to be employed to advise Crossrail design engineers on appropriate routes, depths and construction methodology, that will so far as reasonably practicable avoid or minimise damage to the affected monuments, including informing any design variations that may be needed to achieve that objective. The required field evaluation is to include the following stages, each of which is intended to inform and focus the next:

#### *Stage 1 – Detailed desk-based assessment*

Stage 1 is to –

- (a) assess results of the radar survey already carried out (designed to identify existing utilities) to determine if the monument may be identified;
- (b) assemble and map existing archaeological data and historical sources on the predicted route and depth of the wall. This includes identifying the relatively extensive areas where there is insufficient predictive data;
- (c) assemble and map data on the location and depth of existing utilities (one option for examination for diverted services is the re-use of existing trenches);
- (d) assemble and map data on the location and depth of proposed service diversions to accommodate Crossrail.

#### *Stage 2 – Non-intrusive fieldwork*

Using the results of stage 1, stage 2 is to identify the areas for an archaeologically-focused ground penetrating radar survey, eg areas of uncertainty, in particular the critical areas where the proposed services may cross surviving sections of the wall

#### *Stage 3 – Intrusive fieldwork*

Stage 3 is to comprise exploratory field evaluation (trial pits or trenches). Because the works are likely to be in or adjacent to the public highway they may require temporary road closures. For these reasons it is intended to target just key areas, where the proposed Crossrail diversions cross the predicted line of the wall and further data is required. If stages 1 and 2 are thorough, it should be possible to keep the more difficult intrusive works to a minimum.

### Schedule 3

Information to accompany submissions of works details

#### *Information on Proposals*

- a description of the monument and the part(s) affected by the works and their historical significance;
- an up to date location plan at a scale not smaller than 1:1,250 showing the location of the monument and the location and depth of the walls;
- survey drawings of the areas affected at a suitable scale;
- a description of the proposed works in sufficient detail for officers properly to understand the proposals; and
- drawings of the proposed works at appropriate scales.



## **Appendix C      Utilities Diversions: London Wall, Moorgate, Blomfield Street, Old Broad Street, Bishopsgate. Past Observations of City Wall**



**CROSSRAIL**  
**UTILITIES DIVERSIONS:**  
**LONDON WALL, MOORGATE,**  
**BLOMFIELD STREET, OLD BROAD**  
**STREET, BISHOPSGATE**  
**PAST OBSERVATIONS OF CITY WALL**  
**OCTOBER 2008**

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**MUSEUM OF LONDON**

**Archaeology Service**

23/02/2009

## **Executive Summary**

*This document consists of locational information from past observations of the Roman and later city wall, a Scheduled Monument. It covers the area where below-ground remains of the city wall might be affected by Crossrail utility diversions. This is a piece of focused desk-based research, not a full DDBA (detailed desk based assessment).*

*The aim of this work has been to locate past observations of the city wall, assess their reliability, and digitise them, so that the previous reconstructions of the line of the city wall can be refined.*

*The combined results of a series of antiquarian observations, often poorly located, and more reliable recent records mean that the alignment of the city wall in this area can be reconstructed with a reasonable degree of confidence. This has produced a refined reconstruction of the line of the city wall, and in particular the mapping accompanying the Scheduled Monument descriptions.*

*The most important revision comes from the area around the former postern gate at the junction of Blomfield Street and London Wall, where it can now be seen that the mapping of Scheduled Monument LO26P is inaccurate. Recent observations combined with earlier records indicate very strongly that the wall ran in a straight line westwards across this junction, immediately to the north of the schedule mapping.*

*The extents of the various former gatehouses at Moorgate and Bishopsgate remain less well-known than the line of the wall. Areas within which the different Roman, medieval, and post-medieval gatehouse structures may have lain have been presented with the refined reconstruction of the city wall*

# 1 Introduction

This document and the accompanying drawings present the results of desk-based research into past observations of the Roman, medieval, and post-medieval city wall (a Scheduled Monument) in an area from approximately Moorgate to Bishopsgate in the City of London.

The city wall is often referred to as London Wall; as this is also a modern road name, the historic structure is referred to here as the city wall, reserving 'London Wall' for the road.

In this area the remains of the city wall lie below ground level. They do not form a continuous structure, but where recorded have survived as individual lengths of walling damaged to various degrees by later actions. These have been noted surviving to variable heights, anywhere between *c* 0.3m and *c* 4m or more below modern street level. As will be seen from the accompanying mapping, the recorded sections of the wall form only a small proportion of its length, and survival or otherwise is unknown over the majority of its length.

The purpose of this research is to provide better locational data for the city wall than was previously available (notably an older MoLAS reconstruction, and the mapping accompanying the English Heritage schedule descriptions). This is to contribute to designs for Crossrail utility diversions, associated trial trenches, and the related archaeological mitigation strategies.

This is a piece of focused, problem-oriented, desk-based research, not a full DDBA (detailed desk-based assessment).

The work has been carried out by collecting information on observations of the city wall, from those of 19th/20th-century antiquaries to an archaeological watching brief being conducted at the time of the work (October 2008). The results were then assessed to ascertain their reliability, and digitised. These results were then analysed, and a refined reconstruction of the line of the city wall was produced.

# 2 Acknowledgements

MoLAS and Crossrail would like to thank Geoff Potter of Compass Archaeology for kindly providing information and plans of his recent observations of the city wall, as well as his co-operation during a visit to the site. Thanks are also due to the staff of the London Archaeological Archive and Resource Centre (LAARC) for their assistance with archive records relating to the wall.

## 3 Methodology

### 3.1 Sources consulted:

- MoLAS City Wall audit (Cohen. N, & Hill, J, 2005, *The London City Wall*, unpub rep for Corporation of London)
- MoLAS unpublished archaeological fieldwork reports
- MoLAS' London GIS
- Compass Archaeology: recent unpublished archaeological fieldwork results, including plan information
- LAARC (London Archaeological Archive & Research Centre), primary records, site summaries, etc
- Greater London Sites and Monuments Records (GLSMR)
- Text and mapping accompanying the English Heritage scheduled monument descriptions.
- Published material relating to antiquarian observations and historical maps (including those held by the Museum of London library & Guildhall Library)

### 3.2 Method

Each reference relating to the city wall in the above sources was examined to determine whether it included locational data or not. Those observations producing plan data have been categorised according to the reliability of both the source data and the method(s) required to locate it onto the Ordnance Survey national grid. These are, in descending order: Accurate, Good, Moderate, and Poor (see below). The digitised observations are colour coded on the accompanying digital drawing and the source data for each site included in the table.

Modern digital surveys tied in to the Ordnance Survey (OS) have provided the most accurate locations. Where no OS references are available in site archive material, observations have been digitised as a 'best fit' to modern OS mapping. Similarly, where plans of antiquarian observations are available, these have been digitised as best fits, using historical OS mapping as reference points for calibration where possible.

In many cases, the wall was recorded in section only. The extent of the wall in each relevant section was digitised and offset 0.2m each side of the section line as appropriate (ie where it did not represent the wall face) to create a polygon.

The distinctive colours, and typical examples for assigning degrees of reliability are noted below:

- Accurate (green): surveyed and/or located onto the Ordnance Survey to modern standards (eg directly surveyed with EDM or total Station, or via a local site grid similarly tied in to the OS National Grid).

- Good (light blue): eg digitised from a plan drawing with a recent OS mapping background.
- Moderate (dark blue): eg where site records suggest that the city wall may not have been located to modern standards, and/or multiple stages are required to locate the record onto the OS National Grid.
- Poor (red): eg antiquarian observations with a sketch plan that has been 'best-fitted' via reference points on a historic map onto the OS National Grid. Such points might be metres from the location of the original observations, and should be treated with considerable caution.

## 4 Notes on the observations of the city wall

With the exception of the scheduled section preserved in the car park beneath London Wall, it is unclear from the published accounts whether the masonry exposed during the various interventions during the 20th century survives *in situ*. The wall is also known to survive at the junction of London Wall and Cophthall Avenue.

A brick foundation, *possibly* the west wall of the 17th-century rebuild of Moorgate, as it projected north from the city wall, was recorded at the north-west corner of the junction of London Wall and Moorgate (site code MOO80).

The southern edge of the truncated wall core observed in section at AOP99 (close to the junction of London Wall and Cophthall Avenue) appears to extend a little to the south of the reconstructed alignment (based on a uniform width) and it may be that there is a minor local variation here.

Between Moorgate and Blomfield Street, a change in alignment was discussed by Norman and Reader in 1905. However, this wall observation is poorly located; a degree of error is also noted in the archive material relating to the BLM87 observation to the east.

It has been noted in earlier work for Crossrail that between Circus Place and just east of Blomfield Street, the Scheduled area (LO26P) appears to lie to the south of the likely line of the wall, and in particular, the fragments recorded at Blomfield House (BLM87).

The site of a postern (small gateway) is shown on 17th- and 18th-century maps and noted on modern Ordnance Survey mapping at the junction of London Wall and Blomfield Street. Whilst a change in alignment, eg a dog-leg, might have occurred in the area of a postern, the historic mapping depicts the wall as a straight line pierced by the small postern gateway.

As a result, the schedule mapping in this area should be used with extreme caution. It is noted that a fragment of wall foundation has recently been recorded by Compass Archaeology in the northern carriageway of London Wall at this junction. The fragment was observed during a visit to this site by a MoLAS archaeologist, and Compass Archaeology have kindly provided a plan which has been incorporated into this project. It

is not entirely certain whether the northern edge of this fragment represented the original northern face of the wall, or if the facing stones had been removed. The newly-exposed section lies in line with those seen to the east at Blomfield House and All Hallows on the Wall (BLM87, Scheduled Monument LO26A, CAP86, etc), and also at some distance to the west in London Wall (LON82 & AOP99).

The Compass Archaeology findings, in conjunction with those to the west and east, indicate very strongly that the wall ran in a straight line in this area. Previous theories about curves or dog-legs in the line of the wall near the junction at Blomfield Street can now be discounted. Similarly, it indicates that the mapping of Scheduled Monument LO26P is in need of substantial revision, and cannot be used as a guide to the precise location of the wall.

Note that a 1905 observation a short distance west of Blomfield Street (GM333) does not fall within the reconstructed alignment, but it is recognised that this record is of poor reliability and it may be discounted.

The wall may survive beneath Old Broad Street itself.

Between Old Broad Street and Bishopsgate, the wall is known to survive at 22–24 Wormwood Street (WOE94). Although no location plan could be found for the exposed city wall in the archive, the rear wall of the property apparently conformed to the alignment of its external face. This was accurately located, and by offsetting to the south, the line of the wall can be plotted in this area with a reasonable degree of confidence.

The location of Bishopsgate is poorly defined. To the east of the gate, between Bishopsgate and Outwich Street, the only evidence of the wall is a small, poorly identified fragment of foundation recorded at KPH05, with antiquarian observations (GM349) and more recent excavations (HSD89) reflecting a change in the wall alignment further East.

## **5 Conclusions**

### **5.1 Reconstructed line of the city wall**

The combined results of a series of antiquarian observations and more recent interventions mean that the alignment of the city wall from the area east of Coleman Street to west of Bishopsgate can be projected with a reasonable degree of confidence. Although a number of the observations plotted from antiquarian records are of Poor reliability, there are sufficient records of Accurate to Moderate reliability, which form consistent lines, to refine previous reconstructions of the line of the city wall, and in particular the mapping accompanying the Scheduled Monument descriptions.

The most important revision comes from the area around the former postern gate at the junction of Blomfield Street and London Wall, where it can now be seen that the mapping

of Scheduled Monument LO26P<sup>1</sup> is inaccurate. Recent observations combined with earlier records indicate very strongly that the wall ran in a straight line westwards across this junction, immediately to the north of the schedule mapping.

This refined reconstruction is presented in the accompanying digital mapping as the ‘2008 reconstruction’ of the line of the city wall.

## **5.2 Reconstructed gatehouses**

The plans of gatehouses at Moorgate and Bishopsgate are much less well known than the line of the wall. The areas marked in the 2008 reconstruction represent assessments of the areas in which the gatehouses might lie. They have been chosen to include the areas of English Heritage schedule mapping, but expanded to include the observations plotted in the course of this assessment, and to produce inner and outer faces orthogonal to the streets indicated by historic mapping. They do not represent the individual plans of the various gatehouses in different periods; for instance they cover both the likely Roman gatehouses extending within the line of the wall, and also medieval and post-medieval structures extending outside it.

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<sup>1</sup> Received from National Monuments Record August 2007.

## 6 Data

Record	General Location	Depth/Level	Location information	Plan reliability	Source	National Grid Reference
BHC02	Wood Street	0.36m bGL (14.18– 14.52m OD)	Wood Street (former Cripplegate). <b>CAD plan</b> available, but as this is to the west of the Crossrail works, only the depth is directly relevant.	<b>Accurate</b> , but plan not directly relevant	Unpub MoLAS Watching Brief report, Feb 2003	Approx 532388 181641 (S) to 532394 181654 (N) [scaled from report].
SAM 26323 (= Merrifield ref W37)	London Wall, opposite the west end of Austral House	Survives to maximum height of 12.65m OD (level information from MoLAS survey)	Scheduled Monument (formerly LO26J). Wall exposed in underground car park, beneath London Wall. Accurately located by MoLAS in 2000 using modern survey techniques. The project included locating the wall fragment relevant to OS mapping, sectional and plan drawings of the structure, rectified photography and a condition survey.  Also part of GM109 (see below).  Surviving section is c 11.1m long.	<b>Accurate</b>  (digital survey by MoLAS, 2000)	MoLAS Geomatics original survey data (2000)  MoLAS Audit of the City Wall, unpub report for CoL	532578 181580

Record	General Location	Depth/Level	Location information	Plan reliability	Source	National Grid Reference
GM109 GLSMR 040490 040493 (= site code WFG23 and Merrifield ref W37)	London Wall, between Aldermanbury and Coleman Street	See above	<p>During clearance for the new road London Wall in 1956, a stretch of about 210ft of the Roman City wall was exposed, extending from about 60ft west of Coleman St. Much of the external N face had survived standing 2–6 ft above the footings with its chamfered sandstone plinth and levelling tile course. The thickness of the wall was recorded as 8ft 3 in.–8ft 6in. (c 2.50–2.58m)</p> <p>Equivalent to WFG23 - watching brief by RMLEC in 1957. The archive for this site is incomplete and very little data regarding the details of the wall survive. A series of brick arches against its inner face were interpreted by Grimes as belonging to the work of Mayor Joceline (1477).</p> <p>Also note that the full extent of this section was numbered W37 by Merrifield.</p> <p>Survival: GM109 includes the portion now preserved in the underground car park (see SAM 26323 above), which is the only surviving part of GM109.</p>	<b>Moderate</b>  Digitised from 16ft to 1 inch plan of London Wall (Basinghall/Coleman Streets) dated 1957 (GM109 archive, LAARC), using 1952 OS map and MoLAS 2000 survey (see above) for reference.	GM109 site archive (LAARC). Note that location plan was wrongly archived under GM108.  RMLEC WFG23 site archive (LAARC)  Grimes, F 1968 The Excavation of Roman and Medieval London, 82–4  Merrifield, R 1965, The Roman City of London, 309	532605  181575 (as digitised)

Record	General Location	Depth/Level	Location information	Plan reliability	Source	National Grid Reference
GM334 GLSMR 040495  (= Merrifield ref W36)  Also appears as W.26 on plan in GM253 site archive	122 London Wall  (corner with former N part Coleman Street)	c 0.3m bGL (1920)	Demolition of 122 London Wall in 1920 exposed a section of the Roman wall ... cut back almost to the building line and down about 10' below the level of the pavement. Section shows top of wall as 1.5' below ground level. The whole face of the wall was exposed at the west end of the site.  (NB Merrifield describes this section as 'adjoining' GLSMR 040493 at 123 Coleman Street - not included in this table. They were in fact divided by Coleman Street.)  Survival: unclear	<b>Poor</b>  Digitised from photocopy of original publication plan as reproduced in Lambert 1921 (an approximate location), using 1913 OS for reference points.  An alternative location has been digitised from a plan in the site archive for GM253 where it is shown as W26. The source of information for this plan is unclear and is therefore equally unreliable.	Guildhall Museum GM253 site archive (LAARC)  Lambert, F., 1921, <i>Some Recent Excavations in London, Archaeol</i> , Vol. LXXI, 73–75	532660 181565 (as digitised)  SMR: 532655 181567

Record	General Location	Depth/Level	Location information	Plan reliability	Source	National Grid Reference
GM108 GLSMR 040496	London Wall (N side, immediately west of Moorgate )	c 1.8m bGL 1.2m aGL in 1882, down to 2.4m bGL	<p>Site notes for GM108 dated 1961 state that ‘At a depth of about 6ft from the modern pavement an irregular double course of Roman bonding tiles in yellow cement was seen’. This is the same piece as was observed in 1882 (see GLSMR 040496, Merrifield ref W35 below)</p> <p>Note that the published grid reference and address details place this site location opposite the end of Coleman Street, while the site notes state that the masonry was observed immediately west of Moorgate.</p> <p>Survival: It is unclear from the archive whether the masonry exposed survives <i>in situ</i>.</p>	<b>Poor</b> GM108 archive consists of site notes with sketch plan only, dated 1961. However, this wall observation is shown (as W.25) on a plan in the site archive for GM253 and has been digitised from this. It is unclear what information this plan was based on.	Guildhall Museum GM108 and GM253 site archives (LAARC)	532700  181555 (amended)

Record	General Location	Depth/Level	Location information	Plan reliability	Source	National Grid Reference
GLSMR 040496 (= GM108)  (= Merrifield ref W35)	London Wall, immediately west of Moorgate Street	1.2m aGL in 1882	Building work monitored by Loftus Brock in 1882 revealed <i>c</i> 43ft (13.11m) of the city wall lying beneath the street frontage. It was 9ft 2in (2.8m) thick (2ft (0.6m) of this being medieval thickening). A series of perhaps 6 supporting arches were noted on the inner face. These were semi-circular 2ft 6in (0.76m) wide, 1ft 11in (0.58m) deep, with piers 1ft 11in (0.58m) wide & lay <i>c</i> 15ft (4.55m) below ground level. The wall itself is recorded as standing 4ft (1.22m) above the surface (of the excavated site) & extending 'quite 8ft below'.	<b>No plan</b>	Loftus Brock, E P, The Roman Wall of London at Moorgate, <i>JBAA</i> vol 38, 424–426,  RCHME 1928. Roy Comm Hist Momuments Engl, An inventory of the historical monuments in London: Vol 3, Roman London, 89  VCH. London, vol 1, p 61,  Lambert F. 1921, Some recent excavations in London, <i>Archaeol</i> Vol LXXI, 74	532691 181560

Record	General Location	Depth/Level	Location information	Plan reliability	Source	National Grid Reference
MOO80	London Wall, near junction with Moorgate	Top of wall at c 9.5m OD	<p>A GPO tunnel beneath the south carriageway of London Wall near its junction with Moorgate probably went through the brick foundations of the 15th-century Moorgate. A substantial brick wall was recorded: possibly the west wall of the 17th-century rebuild of Moorgate, as it projected north from the city wall, or a building fronting onto the road north of the gate.</p> <p>Survival: unclear.</p>	<p><b>Poor</b></p> <p>Limits of brick wall as recorded in section digitised in relation to hand drawn approximate trench location on photocopy of contemporary OS map (MOO80 site archive, LAARC)</p>	DUA MOO80 Level 2 site archive (LAARC)	532705 181565
Radar survey	Junction of Moorgate & London Wall	c 1.8m bGL (measured from Fig 03 by MoLAS)	Approx. east-west radar anomaly corresponding to MoLAS prediction of S edge of the Moor Gate	<p><b>Good</b></p> <p>Digitised from hard copy Stratascan radar plot (1:500) on OS background</p>	Stratascan assessment of Subtechnics' utilities radar survey (Fig 03, July 2008)	532705 181550

Record	General Location	Depth/Level	Location information	Plan reliability	Source	National Grid Reference
GM253 (= Merrifield ref W34)	Opposite 108–115 London Wall	Less than or equal to c 1.2m bGL	In 1930 a tunnel for telephone cables was cut through the Roman wall which was exposed for a length of more than 105ft [c 32m] immediately east of the junction of London Wall and Moorgate. There was a single course of tiles at 4ft below street level, a double course at 6½ft, and a triple course at 10ft. In the western part of the trench, a triple facing-course of tiles was seen on the internal face of the wall at a depth of 13 ft.	<b>Poor</b> Digitised from wall location plan from GM253 site archive (LAARC)	Schofield & Maloney 1998 Guildhall Museum GM253 site archive (LAARC)	532730 181550 (as digitised)
LWL87 (within area of Merrifield ref W32)	Opposite 45–50 London Wall	Top of wall recorded at c 10.33m OD	A British Telecom trench was excavated in the middle of the road along London Wall, east of Moorgate. For a short distance the trench ran parallel to the south (internal) face of the wall where a 3.6m length was recorded. A medieval culvert conducted a tributary of the Walbrook through the Roman wall. This was 1.2m wide at its base and 0.9m from roof to floor. It extended S from the inner face of the wall. Survival: unclear	<b>Moderate</b> Digitised from hand drawn 1:100 trench location plan (measured in relation to contemporary pavements/buildings) and 1:20 section location, with limits of City wall marked as recorded in section (LWL87 site archive, LAARC).	DUA Level 2 site archive for LWL87 (LAARC)	532766 181540 (as digitised)

Record	General Location	Depth/Level	Location information	Plan reliability	Source	National Grid Reference
<p>AOP99 GLSMR085088 -9 (within area of Merrifield ref W32)</p>	<p>London Wall (near junction with Copthall Avenue)</p>	<p>11.80m OD (0.83m bGL). Foundation continues below 8.60m OD.</p>	<p>Replacement of a large telephone manhole in the centre of the road re-exposed two sections across the Roman and Medieval city wall Both faces of the wall had been cut back by later intrusions (including the 1934 manhole*), except at the east end, where the outer (north) face of the wall was intact. This face was interpreted as a medieval refacing. At this location the wall was at least 2.6m wide.</p> <p><i>*see also GM72</i></p> <p>Survival is indicated beneath the floor of the manhole and immediately to the east and west of the recorded sections.</p>	<p><b>Accurate</b></p> <p>Trench and section surveyed by MoLAS to OS grid.</p> <p>But note that as Section 1 is missing from the archive, the exact location of N face of wall within section at east end of trench is unclear.</p> <p>Photographic evidence suggests the face was c 0.2m from the northern limit of the recorded section location and it has been digitised as such.</p>	<p>Westman, A 1999 BT Hole in London Wall, EC1, An Archaeological watching brief, unpub MoL rep</p> <p>MoLAS Geomatics original survey data</p>	<p>532780 181538 (as digitised).</p>

Record	General Location	Depth/Level	Location information	Plan reliability	Source	National Grid Reference
GM72 GLSMR 044360	London Wall (near junction with Cophall Avenue)	<i>c</i> 3.7m bGL? (but see AOP99)  core of wall at <i>c</i> 3m bGL	In 1934 at a depth of 12ft 3in the back of the city wall was exposed and a 'tunnel' cut through it. The wall was just over 7 ft (2.13m) thick.  <i>*see also AOP99</i>	<b>No Plan.</b> GM72 archive contains no accurate site location.	Schofield & Maloney 1998	532785 181540
LON82 (within area of Merrifield ref W32)	London Wall, junction with Cophall Avenue	<i>c</i> 10.35m OD	Opposite no. 55 and 57 London Wall.  Observations during work on a telephone manhole in London Wall street. A 2m–2.5m stretch of the Roman city wall was exposed. (N.B. Archive summary grid reference is wrong)  Survival: unclear	<b>Good</b>  Digitised from LON82 1:100 site/section location plan (with OS refs) and 1:10 sections/elevations (LAARC)	DUA LON82 Level 2 site archive (LAARC)	532810  181530 (as digitised).
GM333 (= Merrifield ref W31)	London Wall, opposite Carpenters' Hall	1.6m bGL	In 1905, a shaft was sunk on the outside face of the wall at this point. The wall, 4' thick, was encountered 5' 3" down. The base of the wall was 19' below the surface.  Survival: unclear	<b>Poor</b>  Digitised from plan in Archaeologia 1906 article, related to copy of 1894 OS	Norman, P and Reader, F 1906, Recent Discoveries in connexion with Roman London, in <i>Archaeologia</i> LX pt 1, 171	532900 181515 (as digitised)

Record	General Location	Depth/Level	Location information	Plan reliability	Source	National Grid Reference
WBH06 (part) Blomfield Street	Junction of London Wall and Blomfield Street	0.8m bGL	<p>Eastern side of the junction of Blomfield Street and London Wall (TW water main replacement).</p> <p>There was a fairly smooth/regular face to the north, although this may be the core exposed by robbing of the facing blocks.</p>	<p><b>Good</b></p> <p>Digitised from image of wall locations on OS mapping supplied by Compass Archaeology</p>	Compass Archaeology communications and plan	

Record	General Location	Depth/Level	Location information	Plan reliability	Source	National Grid Reference
BLM87 GLSMR 041918	85 London Wall. Blomfield House, Junction of London Wall and Blomfield Street	c 9.30m OD (c3.2–3.25m bGL)	<p>85–86 London Wall, 53 New Broad Street. Part of the external face of the city wall was recorded at the southern edge of the site in 1988. The observed, external face of the Roman wall includes the sandstone plinth, 4 ragstone courses and the first tile string course, but the core of the wall survived to a height above the second tile string course.</p> <p>NB This puts the remains of the wall to the north of the scheduled area.</p> <p>Survival: the city wall in the south face of current building survives in two arches in the south-west corner of site; it was destroyed in two others.</p>	<p><b>Moderate</b></p> <p>Digitised from BLM87 1:100 hand drawn trench and section location plan, site grid plan referenced to OS, and City wall projection plan (LAARC)</p> <p>A note in the site archive suggests that there is a fairly large degree of error in the plotting of the wall in relation to the site grid.</p>	DUA Level 2 site archive for BLM87 (LAARC)	532950  181505 (as digitised)

Record	General Location	Depth/Level	Location information	Plan reliability	Source	National Grid Reference
CAP86	Capel House, 54-62 New Broad Street	Base of plinth recorded at 10 to 10.66m OD; only few courses survive	<p>The external (north) face of the city wall formed the southern boundary of the site (immediately north of All Hallows on the Wall). The wall itself was not observed in the excavation trenches but within test pits dug prior to demolition. The wall was recorded in TP 1 to the west of the church (base of wall at 10m OD), TP 3 and 4 on east side of church (base at 10.25 and 10.66m OD) and TP 2 north of vestry</p> <p>Survival: a survey in 1991-2 found that the outer face of the wall is visible in a basement area of 54–62 New Broad Street for a distance of c 23m west and c 24m east of bastion 11 (the vestry of All Hallows) and part of the bastion fabric is also visible.</p>	<b>Good</b>  Digitised from CAP86 1:100 site & trench location and 1:10 elevations, best fitted to OS using church of All Hallows on the Wall (LAARC)	DUA CAP86 Level 2 site archive (LAARC)	533006 181494
GLSMR 041922  (= Merrifield ref W29)	London Wall, All Hallows Churchyard (west of church)		<p>The city wall forms the northern boundary of the churchyard. When the external face of the city wall was uncovered in 1905, Roman work was found remaining to a height of 12 ft (i.e. to about contemporary ground level). Above the plinth were 4 courses of squared ragstone, a triple bonding course, 5 courses of ragstone, a second triple bonding course, 6 courses of ragstone, a double bonding course, and 3 more courses of ragstone. Below the plinth, a brick-lined culvert passed through the foundation. It lay in a hollow depression, possibly a stream bed, apparently pre-dating the city ditch.</p>	<b>Moderate</b>  Digitised from published plan dated 1906 (pl XXV) in Archaeologia vol LX pt 1, using 1894 OS map as reference.	Norman P & Reader FW. 1906, Recent discoveries in connexion with Roman London, Archaeologia vol LX pt 1, 207–210 and pl XXV	533000 181492

Record	General Location	Depth/Level	Location information	Plan reliability	Source	National Grid Reference
GM332 GLSMR 041924–5 (= Merrifield refs B11, W28)	All Hallows on the Wall church, London Wall (vestry)		<p>Excavation in 1905 by the Society of Antiquaries revealed the vestry of All Hallows Church to have its foundations set on a bastion of the city wall. It was 19ft (5.79m) in diameter &amp; projected 15ft (4.57m) from the face of the wall. It survived to a height of 8ft, of which 3ft extended below the plinth of the city wall. Its N edge overlay the S edge of the Roman ditch.</p> <p>(SMR grid ref (533028 181496) is not accurate – c 6m from bastion)</p> <p>This work also revealed the lower part of the city wall, which forms N boundary of church/churchyard. The wall consisted of he plinth, with four courses of squared ragstone and a triple bonding course.</p>	<p><b>Good</b></p> <p>Digitised from published plan dated 1906 (Archaeologia vol LX pt 1, pl XXV), relative to extant vestry of All Hallows church on modern OS mapping.</p>	<p>Norman P &amp; Reader FW., 1906, Recent discoveries in connexion with Roman London, <i>Archaeol</i> vol LX pt 1, 200 ff</p> <p>Norman, P, &amp; Reader, FW, 1912, Further discoveries relating to Roman London, <i>Archaeol</i> vol LXIII, p 271 ff</p>	<p>Centre of Vestry / bastion on OS = 533021 181491</p>

Record	General Location	Depth/Level	Location information	Plan reliability	Source	National Grid Reference
GLSMR 041926 (= Merrifield ref W27)	London Wall, East of All Hallows Church		Building work monitored by P Norman & FW Reader in 1905 revealed a small portion of the Roman fabric of the city wall 45ft (13.72m) E of All Hallows church. The plinth & 2 courses of squared ragstone were exposed. (see also 041923)	<b>Moderate</b>  Digitised from published plan dated 1906 (pl XXV) in Archaeologia vol LX pt 1, using 1894 OS map as reference.	Norman P & Reader FW. 1906, Recent discoveries in connexion with Roman London, Archaeologia vol LX pt 1, 211-212 and pl XXV	533050 181482 (as digitised)

Record	General Location	Depth/Level	Location information	Plan reliability	Source	National Grid Reference
WOE94 GLSMR 044079	22–24 Wormwood Street	<i>c</i> 13.24m OD	<p>The Roman city wall survived to its full width through the north side of the basement of 23–24 Wormwood Street, retained by a 1 brick thick wall.. The top of the Roman masonry was exposed in 24 Wormwood Street.</p> <p>The north basement wall of 22 Wormwood Street had been constructed on the line of the city wall in the post-medieval period out of reused stone from the wall. This wall was recorded by means of rectified photography.</p> <p>Survival: city wall preserved and covered over in basement.</p>	<p><b>Good</b></p> <p>There is no site location or plot of the wall in the archive. In the absence of such information, OS values of photo targets on back wall of property (from MoLAS survey data archive sheet, (LAARC)) were digitised, to give N face of wall, and offset 2.53m to the south to provide alignment across Nos. 23–24 Wormwood Street.</p>	<p>MoLAS WOE94 Level 2 site archive (LAARC)</p> <p>Sankey, D 1998, 22–24 Wormwood Street, An archaeological watching Brief, unpub MoL rep</p>	533165 181460

Record	General Location	Depth/Level	Location information	Plan reliability	Source	National Grid Reference
WOD86 GLSMR 044244 & 041927  See also WOE94	22 Wormwood Street	Localised area of clay and flint foundation recorded at 11.82m OD	The northern face of a <b>post-medieval</b> wall of reused ragstone, forming the north cellar wall apparently conformed to the alignment of the external face of the City wall. However, the only surviving evidence of the original structure was a localised patch of clay and flint foundation material.	<b>Moderate</b>  (but no actual survival of wall superstructure )  Line of post-medieval rebuild digitised from WOD86 1:200 site /section location (manually plotted onto OS 1:1250 tracing) and 1:20 elevation (LAARC)	Sankey D, 1994 22 Wormwood Street, An archaeological evaluation (unpub MoL rep)  MoLAS Level 2 site archive for WOD86 (LAARC)	533170 181455
WOM94 GLSMR 044147, 044149–50, 044441, 044437	20–21 Wormwood Street, 105–107 Bishopsgate		20–21 Wormwood Street, 105–107 Bishopsgate.  The City wall had been entirely removed from 20–21 Wormwood Street. At no. 21 a post-medieval masonry wall on the north perimeter had replaced it.  Further work under this site code at 105–107 Bishopsgate in 1996 revealed no trace of the City Wall.	<b>No wall recorded</b>	Sankey D, 1996 20 and 21 Wormwood Street, An archaeological evaluation, unpub MoL rep	533180 181455

Record	General Location	Depth/Level	Location information	Plan reliability	Source	National Grid Reference
WBH06 (part) Bishopsgate	Wormwood street/ Bishopsgate junction	1.1–1.4m bGL (more heavily truncated elsewhere)	Western carriageway of Bishopsgate, opposite No. 105/106 (TW water main replacement).  To N: wall probably from 17th-century gatehouse. ‘start of the masonry was just about’ at the N edge of the SAM mapping (G. Potter, CA, pers comm).  To S: wall of medieval/Roman city wall or gate.	<b>Good</b>  Digitised from image of wall locations on OS mapping supplied by Compass Archaeology	Compass Archaeology summary and plan	(approx. NGR 533206 181450 – as digitised)
GLSMR 041929/02	Bishopsgate	1.5m bGL	NW corner of junction of Bishopsgate and Wormwood Street  A mass of ragstone rubble <i>c</i> 6 ft 6 in square, at a depth of 5ft (1.5m). This extended to a depth of 10ft (3.0m) below the surface. It contained fragments of Roman tile & was apparently carefully faced on its S side. This rested on a puddling of flint & clay, <i>c</i> 10 ft square (whole of manhole being observed). The remains probably formed part of the S face of a gatehouse of the Roman Bishopsgate & projected <i>c</i> 20ft (6m) inside (S of) the city wall.	<b>Poor</b>  Digitised from Norman & Reader’s published Fig 3 sketch plan ( <i>Archaeologia</i> Vol LX pt 1, 186), but this does not tally with accompanying text, & is difficult to locate to street/building lines	Norman, P, & Reader, FW, 1906 <i>Archaeologia</i> Vol. LX. pt 1, 184–187	533205 181445 (as digitised)

Record	General Location	Depth/Level	Location information	Plan reliability	Source	National Grid Reference
BTB89 GLSMR 041929	Bishopsgate	c 12.75m OD	Bishopsgate, north of junction with Wormwood Street & Camomile Street.  Watching brief during British Telecom tunnelling by DUA revealed foundations of Kentish rag & clay with mortared ragstones, recorded in section. These were thought to represent part of the Roman Bishopsgate.	<b>Good</b>  Site surveyed by DUA to OS grid.  Locations of wall foundations recorded in section digitised from 1:10 sections in relation to hard copy 1:100 site plan tied to OS.	DUA BTB89 Level 2 site archive (LAARC)	533208 181442 (S)  533217 181453 (N) (as digitised)
GLSMR 041929/01	Bishopsgate	0.9m bGL	Excavation "on the N side of" 108 Bishopsgate by WC Edwards in 1921 revealed 'Roman masonry, apparently a wall c 5ft (c 1.5m) thick, at a depth of 3ft from the surface. This ran N-S (ie at right angles to the city wall) & may have formed part of the gateway'	<b>No plan</b>	Edwards, 1922 ( <i>TransLAMAS</i> NS IV, 332)	SMR: 533220 181450 (minimum 10m)

Record	General Location	Depth/Level	Location information	Plan reliability	Source	National Grid Reference
CMI00 & KPH05 GLSMR 085135	Kempson House and Bishops(gate) House	<i>Possible</i> city wall: 11.42m OD	<p>25–37 Camomile Street, 106–126 Bishopsgate. <u>Site</u> centre: NGR 533250 181450.</p> <p>CMI00: two test pits in the SE and SW corners of the underground car park confirmed that no trace of the City wall, or its robbing in antiquity, survived. The City wall, therefore, must originally have been situated either along the southern edge of the present buildings or even further to the S, outside the [CMI00] site boundaries.</p> <p>KPH05: In one of two test pits along the S frontage of the site a possible Roman wall foundation survived beneath the modern truncation. The remains continued beyond the N and E limits of excavation, but not in a westerly direction as might perhaps be expected for the Roman City wall foundation. It may therefore be either an isolated deep level foundation for the City wall, or part of an earlier structure.</p>	<p><b>Good</b></p> <p>(good location, but poor identification)</p> <p>MoLAS digital survey data</p>	<p>MoLAS KPH05 digital survey data</p> <p>Tyler, K. Evaluation at Kempson House, unpub MoL rep</p>	<p>KPH05 533260 181425 (as digitised)</p>

Record	General Location	Depth/Level	Location information	Plan reliability	Source	National Grid Reference
GM349 GLSMR 041932-3	27-33 Camomile St, junction with Outwich St		Demolition work monitored by JE Price in 1876 revealed a stretch of the city wall c 88ft (46.82m) in length. It was 8ft (2.44m) thick. It was destroyed above the plinth.  Also a semi circular bastion attached to the city wall. This was 20ft (6.10m) in diameter & projected 14ft 9in (4.50m) from the walls face. Uncertainty exists regarding the bastion's exact location.	<b>Poor</b>  Digitised from photocopy of RCHM 1928 plan, using contemporary OS for reference points	Price JE, 1880, <i>On a bastion of London Wall, or, Excavations in Camomile Street Bishopsgate, London, 23-25</i> , Fig. reproduced in RCHM, 1928, <i>London, III, Roman London</i> , 86, 101	SMR: 533274 181421
HSD89 GM288 GLSMR 041935	58-60 Houndsditch	Foundation of wall at 12.03m OD.  Wall survives to a maximum height of 4m in places	HSD89: The Roman city wall was exposed running along the SW edge of the site: the stones of the outer face were cut away by later cellaring, leaving only the core. The surviving portion was 5.2m long and 4m high and is to be preserved.  GM288: Part of the city wall forming the rear (S) of 58-60 Houndsditch and dividing it from the graveyard of St Martin Outwich was recorded by P Norman and F W Reader in 1905, again in 1926. In 1926 the bottom of the plinth was seen 8ft 4in. below street level. The fragment of wall stood in 1905 to a height of 14ft 6in. above the base of the plinth. The site records for 1926 could not be located.	<b>Accurate</b>  Digitised from HSD99 1:100 site plan/section location (with survey points referenced to OS) and 1:200 plan showing City wall (LAARC)	DUA, HSD99 site archive (LAARC)	Site centre: NGR 533320 181400  SMR: 533293 181412

Record	General Location	Depth/Level	Location information	Plan reliability	Source	National Grid Reference
WHB06 (part) Goring Street	Goring Street	c 0.4–0.6m bGL (truncated more deeply elsewhere)	(TW water main replacement).  As this is well to the east of the Crossrail works, only the depth is directly relevant .	<b>Good</b>  Digitised from image of wall location on OS mapping supplied by Compass Archaeology	Compass Archaeology summary and plan	Approx. 533380 181330

## 6.1 Abbreviations

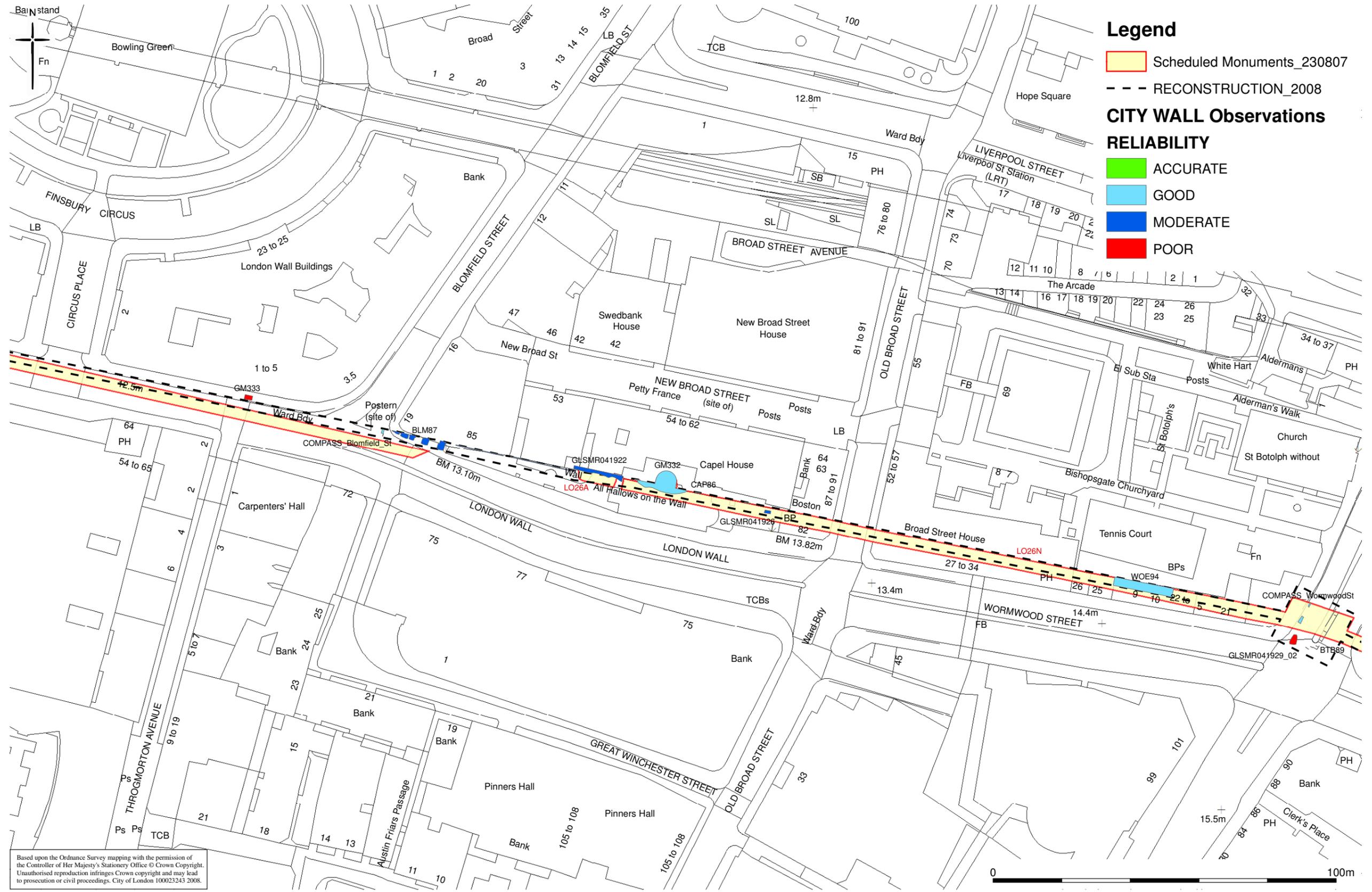
aGL	above ground level
bGL	below ground level
DUA	Department of Urban Archaeology (Museum of London)
GLSMR	Greater London Sites and Monuments Record
OS	Ordnance Survey
LAARC	London Archaeological Archive and Research Centre
LAMAS	London and Middlesex Archaeological Society
RMLEC	Roman and Medieval London Excavation Council

MoLAS, Audit of the City Wall	Cohen. N, & Hill, J, 2005, <i>The London City Wall</i> , unpub rep for Corporation of London
RCHM	Royal Commission of Historic Monuments, Roman London Vol 3
Schofield & Maloney 1998	Schofield, J, with Maloney, C (eds), 1998 <i>Archaeology in the City of London, 1907–1991: a guide to records of excavations by the Museum of London and its predecessors</i> , Archaeol Gazetteer ser 1, MoL
Shepherd 1998	Shepherd, J D, 1998a Post-war archaeology in the City of London, 1946–1972: a guide to records of excavations by Professor W F Grimes held by the Museum of London, Archaeol Gazetteer ser 3, MoL



**Legend**

- Scheduled Monuments\_230807
- RECONSTRUCTION\_2008
- CITY WALL Observations**
- RELIABILITY**
- ACCURATE
- GOOD
- MODERATE
- POOR



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City wall DDBA: centre

### Legend

Scheduled Monuments\_230807

- - - RECONSTRUCTION\_2008

### CITY WALL Observations

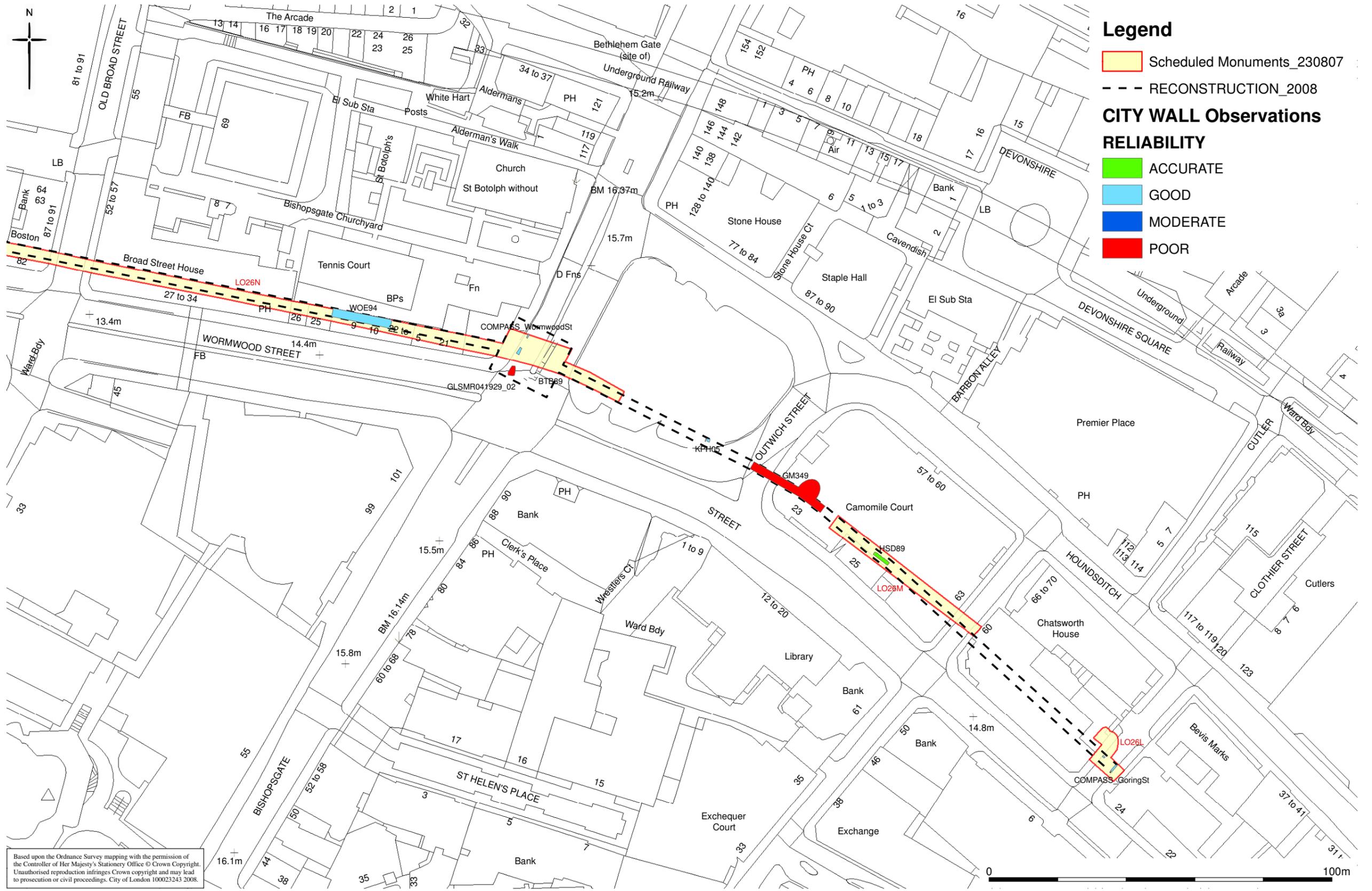
#### RELIABILITY

ACCURATE

GOOD

MODERATE

POOR



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City wall DBA: east



## **Appendix D      E-Mail Correspondence relating to radar surveys**

## Mike Court

---

**From:** Simon Haddrell [Simon.Haddrell@stratascan.co.uk]  
**Sent:** 01 August 2008 09:16  
**To:** Elsden, Nick  
**Subject:** RE: City Wall, London

Nick,

The original survey in the west was inconclusive, with the same conditions being expected in the east this would suggest that any radar work here would give similar results to that in the first area. This is of course based on the assumption that the wall did pass though the survey area in the west.

Regards

Simon

---

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Achilles UVDB Registration No. 80959

---

**From:** Elsden, Nick [mailto:NElsden@molas.org.uk]  
**Sent:** 31 July 2008 14:10  
**To:** Simon Haddrell  
**Subject:** RE: City Wall, London

thanks for you explanation on the phone, Simon.

As this was the last of the three questions in the document we sent you at the beginning, I would be grateful if you could just put in writing for us and our client, Crossrail, the conclusion that we came to on e the phone.

I.E. that it seems unlikely that a radar survey of the second half of the area, assumed to have similar conditions to the first, would yield significantly greater results than the first half (or words to that effect).

Thanks,  
Nick

### Nicholas Elsden

Project Officer\Senior Archaeologist  
Museum of London Archaeology Service  
Mortimer Wheeler House  
46 Eagle Wharf Road  
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*Now available, The London Guildhall; an archaeological history of a neighbourhood from early medieval to modern times:* generously funded by the City of London Corporation, evidence from archaeological excavations is combined with historical and architectural analysis to create a major integrated history of the London Guildhall, the home of the City of London's government (MoLAS Monogr Ser 36 (2-part set); £65)

 Before printing, think about the environment

---

**From:** Simon Haddrell [<mailto:Simon.Haddrell@stratascan.co.uk>]  
**Sent:** 31 July 2008 13:51  
**To:** Elsden, Nick  
**Subject:** RE: City Wall, London

Hi Nick,

Due to the lack of evidence in this survey for the city wall I think further radar surveys over this area will give very limited results. As for the section to the east I think it would be safer to make an assessment from a DBA. If the wall crosses the road and is still intact it should be possible to see this through the services. I would also suggest a low frequency antenna to see as deep as possible if the survey is for archaeology exclusively. I hope this helps

Regards

Simon

---

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---

**From:** Elsden, Nick [<mailto:NElsden@molas.org.uk>]  
**Sent:** 31 July 2008 13:33  
**To:** Simon Haddrell  
**Cc:** Dennis, George; Claire Hicks  
**Subject:** RE: City Wall, London  
**Importance:** High

Dear Simon,

this last item has now become urgent, as Crossrail have only a limited time in which to commission future archaeological fieldwork on the basis of these results.

I would be grateful if you could either email me or phone me (020 7410 2282) today or tomorrow.

Regards,  
Nick

**Nicholas Elsden**

Project Officer/Senior Archaeologist  
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 Before printing, think about the environment

---

**From:** Elsden, Nick  
**Sent:** 29 July 2008 13:55  
**To:** 'Simon Haddrell'  
**Cc:** Dennis, George; 'Claire Hicks'  
**Subject:** RE: City Wall, London

Dear Simon,  
thank you for the 'graphic report'.

However, it did not answer the third question in the assessment purpose' document, which was:

- Do these results suggest that any **future radar surveys** (archaeologically focused – to locating the wall) are likely to be either **unproductive or productive** ?
  - a) in this section previously surveyed ? (may not be required, depending on the results of this assessment).
  - b) in the sections to the east of the existing survey, where the density of services is likely to be similar ?

This is effectively the most important point, as we need to decide whether there is any point in conducting further radar surveys to find the gaps or low points in the surviving sections of the wall (where new services can be passed).

Clearly part of the answer to the above lies in whether the surveys need to be 'tuned' to different settings to locate masonry from those required to locate services - could you tell me if this is the case, or not ?

Many thanks,  
Nick

---

**From:** Simon Haddrell [mailto:Simon.Haddrell@stratascan.co.uk]  
**Sent:** 25 July 2008 16:45  
**To:** Elsden, Nick  
**Subject:** City Wall, London

Nick,

Please find the results attached for the City wall, London.

Regards

Simon

---

Simon Haddrell BEng.(Hons) AMBCS PIFA  
Project Officer

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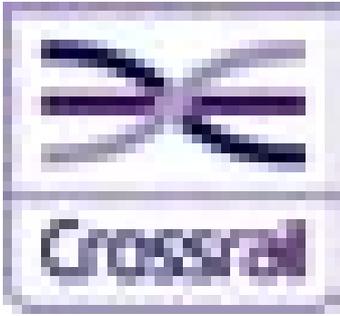
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## **Appendix E Archaeological Watching Brief & Evaluation – Utilities trial trenches, Liverpool Street and London Wall**



# **CROSSRAIL**

## **ARCHAEOLOGICAL WATCHING BRIEF & EVALUATION**

### **Utilities trial trenches, Liverpool Street and London Wall**

### **November 2009**

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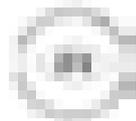
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#### **Museum of London Archaeology**

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*Fig 9 Vertical view of city wall in LIV16, looking north*

*Fig 10 City wall in LIV26, looking north*

*Fig 11 Plan of cellar walls in LIV19*

*Fig 12 Revised reconstruction of the city wall*

See also Annex 1 for figures from the city wall DDBA (Crossrail 2008a)

## Executive Summary

*Ten 1.5m-deep engineer's trial trenches to trace existing utilities within streets at London Wall, Old Broad Street and Liverpool Street, in the City of London were monitored in a watching brief commissioned by Crossrail, and conducted by MOL Archaeology. The trial trenches selected for monitoring were those across the line of the Roman and medieval city wall, a Scheduled Monument (LO26N and LO26P), and those within the former burial ground of the hospital of St Mary Bethlem, where human remains have been discovered previously.*

*This monitoring serves as both an archaeological watching brief, and as the Required Evaluation for the city wall, as set out in a Scheduled Monument Deed under the Crossrail Act (2008). A further aim was to ensure that the works did not damage the Scheduled Monument, should the city wall be encountered.*

*Remains of the city wall were recorded in London Wall (road) east of the junction with Moorgate. A second fragment of the city wall was found in London Wall south of the junction with Blomfield Street. Protective materials were installed before the trenches were reinstated.*

*In general these results substantially confirm the reconstruction of the line of the city wall produced in 2008 for the Crossrail utility works (DDBA), which differs from the English Heritage Schedule mapping in the area around Blomfield Street. There is a minor change in the reconstruction between Moorgate and Blomfield Street, illustrated in the accompanying figures.*

*These observations will inform design of the proposed utility diversions that will be required in advance of the main construction phase for Crossrail. In particular, although negative results should be used with caution (because of the limited depth and area of the trenches), the trenches at the junction of London Wall and Blomfield Street do appear to indicate that there may well be a considerable area at that location where 1.5m-deep utility diversions would not disturb the Scheduled Monument. The two sections of the city wall which were found support (and slightly refine) the 2008 reconstruction (Crossrail 2008a), allowing it to be used with greater confidence in designing utility diversions parallel with the city wall in this area.*

*Disarticulated human bone was observed in two trenches in Liverpool Street. One group may represent the top of a deposit containing burials at greater depths than those reached in the trial trench, the other was found amongst modern overburden. Both have been reburied in the respective trenches.*

*Remains of 18/19th-century cellars were recorded beneath modern services in Old Broad Street, near the junction with London Wall.*

*The limited amount of human remains encountered in Liverpool Street should be treated with caution. Whilst it does demonstrate the extensive modern disturbance within c 1.5m of ground level already known from previous work in Liverpool Street, it should be expected that more extensive, or deeper, trenches for utility diversions have a high potential to encounter further localised areas of dense burials.*

# 1 Introduction

## 1.1 Site background

A new station is to be constructed in the Liverpool Street/Moorgate area of the City of London for the Crossrail project. In order to construct the station, a large number of existing utilities will have to be diverted in advance of construction, and utilities trial trenches were conducted to inform the plan for those diversions.

This report describes the results of an archaeological watching brief on utilities trial trenches in the Liverpool Street–Moorgate area, at London Wall (street), Liverpool Street, Blomfield Street, and Old Broad Street (Fig 1), hereafter called the site. The centre of the site is at OS National Grid Reference 532893 181531. The site code is XRF09. The trial trenches were monitored between 9th May and 1st August 2009.

The Roman and medieval city wall is often referred to as London Wall; but since this is also a modern road name, the historic structure is referred to in this report as the city wall, reserving 'London Wall' for the road.

The trial trenches in London Wall, Blomfield Street, and Old Broad Street lie across the line of the Roman and medieval city wall, a Scheduled Monument (LO26N and LO26P). This work was conducted in accordance with a Scheduled Monument Deed under the Crossrail Act (2008), which replaces Scheduled Monument Consent (see 1.2).

The archaeological survival data obtained during this monitoring also forms the *Required Field Evaluation* as set out in the Scheduled Monument Deed. Any further field evaluation requirements, and mitigation measures for the utilities diversions, will be determined from the results of the current work and will be inserted within the Crossrail Site-Specific Written Scheme of Investigation for Liverpool Street Station.

## 1.2 Planning and legislative framework

Crossrail will be built under the powers of the Crossrail Act (2008), which disapplies various pieces of legislation, and replaces them with alternative provisions. Those pertinent to these works are:

- The Ancient Monuments and Archaeological Areas Act 1979, is modified by Schedule 9 (Paragraph 4) of the Crossrail Act in respect of works authorised by the Act. Alternative provisions are set out within a Scheduled Monument Deed: *Crossrail: Works affecting scheduled monuments in the City of London* (Crossrail 2008c)

The Scheduled Monument Deed is included in full as Appendix 1. The following is a summary of the requirements and procedures relating to approvals and archaeological requirements under the Deed:

- A *Required Field Evaluation* is required before requesting approval for construction works that might affect the Scheduled Monument (Clause 2.1).
- Following the *Required Field Evaluation*, English Heritage shall be consulted as to whether any *Additional Field Evaluation* is required before requesting approval for construction works (Clause 2.2).

- Where the carrying out of either a *Required Field Evaluation* or *Additional Field Evaluation* may cause damage to an affected monument, Crossrail shall not carry it out without obtaining the prior approval of the proposals in writing from the Secretaries of State.
- The main construction works (in this case the utilities diversions) require works details to be submitted for approval by the Secretaries of State for Transport and for Culture, Media, and Sport.
- The monitoring of the trenches which lie across the city wall is intended to fulfil the requirement for an initial *Required Field Evaluation*.
- The Burial Act 1857, modified by Schedule 15 of the Crossrail Act, provides the mechanism for obtaining the necessary authority to remove human remains from a burial ground which is either still in use or continues to have the appearance of a burial ground. Since Schedule 15 of the Act was confirmed not to apply at Liverpool Street, a burial licence (MoJ number 09-0064) was obtained in advance of the fieldwork, in case circumstances would require burials to be excavated and removed from the site. In the event, this did not happen, and the small quantity of human remains present were reburied before backfilling the trenches (see 3.1.3).
- *Planning Policy Guidance 16 (DoE 1990)*. The principles of PPG16 are encompassed within the *Crossrail Environmental Minimum Requirements (EMR; Crossrail 2008b)*, in particular *Annex 2: Planning & Heritage Memorandum*, and the *Crossrail Generic Written Scheme of Investigation (Crossrail 2009c)*.

### 1.3 Summary of Previous Crossrail Studies

Environmental Impact Assessment was conducted to support the Crossrail Bill, resulting in:

- *Crossrail Environmental Statement (Crossrail 2005a)*
- Supporting Specialist Technical Reports: *Crossrail, Assessment of Archaeology Impacts, Technical Report*, Parts 1 (Introduction and Summary), Part 2 (Central Section), and Part 6 (Figures). (Crossrail 2005b – STR)
- During the passage of the Crossrail Bill through Parliament, and subsequent to enactment in 2008, archaeological studies have proceeded in tandem with the development of the engineering design for Liverpool Street Station and the outcomes are set out in the *Crossrail Liverpool Street Station Site-Specific Written Scheme of Investigation*, doc. no. CR-PN-LIV-EN-SP-00001 (Crossrail 2009b – SS-WSI).
- *Crossrail Utilities Diversions: London Wall, Moorgate, Blomfield Street, Old Broad Street, Bishopsgate, Past Observations Of City Wall (Crossrail 2008a – detailed desk based assessment (DDBA) for the city wall only)*

This work involved collating records of past observations of the city wall in the area of the utilities trial trenches, assessing the reliability of their locational data (which varied considerably, especially for the older observations), and digitising them. From these records, it was possible to produce a reconstruction of the alignment of the city wall in this area, that differs from that of the English Heritage mapping of the Scheduled Monument in the area around Blomfield Street (see Annex 1). The reconstruction has been slightly refined as a result of the watching brief (see 3.3, 4.1, & Fig 12).

- The DDBA for the city wall informed the design (Method Statement) prepared by MOL Archaeology for this watching brief: *Liverpool Street & Moorgate, Utilities*

*Trial Trenches, Archaeological Watching Brief & Evaluation Method Statement, April 2009.*

## **1.4 Origin and scope of the report**

This report was commissioned by Crossrail and produced by Museum of London Archaeology (MOLA). The report has been prepared within the terms of the relevant Standard specified by the Institute for Archaeologists (IFA, 2001).

The purpose of the present report is to assess and present the results of the watching brief against the original research aims, in particular the reconstruction of the line of the city wall in the 2008 DDBA, and to comment on possible effects on the Crossrail utility diversions. This work is also intended to act as the Required Field Evaluation under the Scheduled Monument Deed.

## 1.5 Aims and objectives

The prime purpose of the watching brief was to prevent damage to the Scheduled Monument, and to ensure that human remains were dealt with in accordance with the burial licence under the 1857 Burial Act. Secondly, archaeological recording was to provide information on the presence, absence, and survival quality of the city wall (within the limited depth of the trial trenches), to form the *Required Field Evaluation*, and inform the detailed design of future Crossrail utility diversions. Similarly, recording was intended to provide further archaeological data on the extent, location, survival quality, and density of human remains within Liverpool Street.

The following are the specific objectives of the fieldwork set out in the *Method Statement* (Crossrail 2009a, Section 5):

### 1.5.1 *The City Wall in London Wall, Blomfield Street, and Old Broad Street*

RA1: *To determine, if possible, the line of the city wall between Moorgate and Bishopsgate with more certainty than current reconstructions, in order to locate utilities diversions away from the monument.*

RA2: *To determine the survival of the city wall at the junction of Blomfield Street and London Wall, and options for utility diversion routes across it.*

RA3: *To determine the line of the city wall in Old Broad Street.*

### 1.5.2 *Burials in Liverpool Street*

RA4: *To record human remains from the trial trenches in Liverpool Street in accordance with relevant applicable standards and guidelines.*

RA5: *To provide further archaeological data on the extent, location, survival quality, and density of human remains within Liverpool Street (to contribute to both the design of the utility diversions and mitigation works for the future Broadgate Ticket Hall and link passage).*

### 1.5.3 *Research Aims*

This fieldwork also has potential to contribute to wider academic research aims. The following generic research aims have been selected from those in *A research framework for London archaeology* (Museum of London 2002, 82 & 85) as being applicable:

- Refining our understanding of the chronology and function of the landward and riverside defences and extramural evidence of defensive or military structures in the Roman period.
- Understanding life expectancy, origins and belief, seen through studying health, diet and disease, and preparing models for future research.

## 2 Topographical and historical background

The following summary of the archaeological background concentrates on those elements likely to be affected by the utilities trial trenches, ie those likely to survive within c 1.5m of modern ground level in the areas of the trenches.

The archaeological potential of the whole Crossrail Liverpool Street site is described at greater length in the Specialist Technical Report (Crossrail 2005b) and SS-WSI (Crossrail 2009b).

The natural geology consists of Taplow terrace gravels generally c 3.5 to 6m below modern ground levels, forming the base of the archaeological sequence.

### 2.1 Roman Period (AD 50–450)

There is limited evidence for prehistoric activity in the Liverpool Street area, but the northern edge of the Roman city of Londinium ran through it. When the city boundary was formally marked by a wall in AD 120–290 this ran approximately east–west either along the line of the road named London Wall, or a short distance to the north. The wall divided the urban area of the city to the south, from extra-mural areas to the north, where various activities, possibly including some occupation, took place. Roman cemeteries were placed outside the city boundaries, in particular along roads leading out of the city such as Ermine Street, modern Bishopsgate. Although Roman burials can be expected in this area (below the level of the proposed utilities diversions, with the possible exception of any deep sewer works), many have been washed into the Walbrook stream, at least one of the numerous branching channels of which passed through the northern side of the city in the vicinity of Blomfield Street.

Construction of the city wall appears to have blocked or constricted the course of the Walbrook, and from the later Roman period through to the end of the medieval period, a marsh was formed in this extra-mural area. These deep marsh deposits account for some of the considerable depth of archaeological deposits in this area.

The wall itself was constructed of Kentish ragstone with tile courses around a rubble and mortar core. It generally survives to a width of up to c 2.5 to 3.0m, at variable heights, anywhere between c 0.3m and c 4m or more below modern street level (depending upon the extent of later truncation).

### 2.2 Medieval Period (AD 450–1540)

Whilst the Moorgate Marsh would have inhibited human activity in this area north of the wall during the medieval period, repairs and reconstruction of the wall included the addition of new exits from the City at Moorgate (The Moor Gate) and a postern (small gate or doorway) at what would become Blomfield Street. During the later medieval period the marsh was drained.

The hospital of St Mary of Bethlehem (later Bethlem Hospital) was founded in 1247, located east of the Moor Fields, between the Great Ditch (probably a course of the Walbrook, around Old Broad Street) and the road north out of the Bishopsgate.

### 2.3 Post-medieval (AD 1540–1900)

The 'Bethlem burying ground', also known as the New Churchyard, was founded in 1569 by the City to relieve the congestion occurring in parish burial grounds. The cemetery was used up to at least 1720. The burials that were found during

excavations at Broadgate in the 1980s were of a high density, some eight per cubic metre, but extensive truncation beneath modern Liverpool Street is reflected in the relatively localised areas of burials discovered in the course of past utilities works in that road.

The area between Moorgate and Bishopsgate gradually filled in with buildings during the 17th and 18th centuries, with the exception of the open Moor Field lying west of Blomfield Street, which survived as the open grounds of the relocated Bethlem Hospital (Bedlam).

Parts of the city wall, notably the gates at Moorgate and Bishopsgate, had been rebuilt or refaced in brick during the 17th century, but from the mid 18th century onwards, large portions of the wall, and eventually the gates, were demolished to ground level.

## **2.4 Archaeological Potential within 1.5m of ground level**

Archaeological potential within the 1.5m-deep utilities trial trenches, located in roadways, is extremely limited.

Truncation from existing services and other modern disturbance is extensive, particularly in Liverpool Street. However, it is clear from past observations, fieldwork, and records of police call-outs to MOL Archaeology's Head of Osteology that localised densely-packed areas of burials survive in Liverpool Street, and that, despite later damage, sections of the Scheduled city wall (both known and unknown) survive beneath London Wall, Bishopsgate, and potentially Old Broad Street. These potentially include the Moor Gate (probably fragmented remains as appears to be the case with the Bishop's Gate).

Any such remains are of high importance. Although the majority would be present only at a greater depth than the utilities trial trenches, there is potential for structural remains of the city wall to be present from 0.3m below ground level (bGL), and for burials from 0.5m bGL, although the majority of burials seen previously lay below 1.2m bGL.

In addition, the trenches were also likely to affect the upper parts of low-grade late post-medieval deposits, mostly dump layers or levelling deposits associated with late post-medieval construction.

## 3 The watching brief

### 3.1 Methodology

#### 3.1.1 General

All on-site archaeological work was carried out in accordance with the Crossrail *Method Statement* (Crossrail 2009a), and the Museum of London *Archaeological Site Manual* 3rd edition (1994).

The trenches were dug at weekends, following road closures, by the trial trench contractors: J B Riney & Co Ltd. The primary intention was to establish utility routes and sub-surface obstructions, and trenches were 1.5m deep wherever possible (Crossrail 2009a). They were backfilled at the end of each working day, which required the longer trenches to be dug in separate segments, on different days.

The trial trench contractors removed modern road surface and concrete sub-base using machines where necessary. Excavation beneath the sub-base was conducted carefully by the trial trench contractor with hand tools, under close archaeological supervision. The archaeologist(s) inspected the trench at appropriate intervals, entering when required.

When archaeological remains were reached; the archaeologist exposed and recorded them. There were no finds from the trial trenches, with the exception of the features and deposits left *in situ*.

#### 3.1.2 City wall

Six trenches across the predicted line of the city wall were monitored (MOR18 & 19: Fig 2; and LIV16, 19, 25, & 26: Fig 3).

The city wall and associated deposits were left *in situ*. Care was taken throughout the process of excavation and other fieldwork to avoid damage to the Scheduled Monument. Removal of modern material was conducted by the GI contractors under close supervision by an experienced Senior Archaeologist for each trench, and ceased when the archaeologist determined that archaeological deposits, in particular the Scheduled Monument (city wall), had been reached. The Senior Archaeologist, aided by an Archaeologist, then exposed, cleaned, and recorded the city wall and any other archaeology.

The locations of archaeological remains were recorded by the archaeologists using local baselines. The reference points for these baselines, a limited number of levels, and the trench outlines were surveyed by the GI contractor's surveyors.

Following the completion of archaeological (and utilities) recording, protective materials were installed for the scheduled monument before the trenches were backfilled.

Kathryn Stubbs for the City of London Corporation and Jane Sidell, the English Heritage Inspector of Ancient Monuments, visited the site whilst work progressed.

### **3.1.3 Burial ground of St Mary Bethlem**

The four trenches within the predicted area of the burial ground of the Hospital of St Mary Bethlem were monitored (LIV5, 6, 8, & 29). A fifth trench, LIV12, was cancelled; for the location of the remaining trenches see Fig 3.

The need to reinstate the trial trenches for road traffic and good archaeological practice required that stratified human remains were not exhumed at this stage, and were left *in situ* following recording. Unstratified disarticulated material from modern overburden was collected and reburied when the trench was backfilled. Similarly, spoil from excavation beneath the modern sub-surface slab was returned to the trenches, in order that any human remains did not leave the site.

The trench outlines were surveyed by the archaeologists, using off-sets from buildings shown on Ordnance Survey mapping.

## 3.2 Results of the watching brief

Ten trenches were monitored, the results are tabulated below. For trench locations see Fig 2 and Fig 3.

### 3.2.1 Trial trenches along the projected line of the city wall

<b>Trial Trench MOR18 (Fig 4, Fig 5, Fig 6, &amp; Fig 7)</b>	
Location	London Wall east of Moorgate
Dimensions	17.6m (including north and south pavements) x 0.6m x 1.5m deep
Modern ground level	12.42–12.54m OD (carriageway)
Base of modern fill/surface	North pavement: Concrete and tarmac 0.24m bGL Carriageway: Concrete and tarmac 0.5m bGL South pavement: slabs and concrete be 0.2m bGL
Modern subsurface deposits	Pipes, ducts and loose grey ashy fill with modern inclusions mostly to 1.2m bGL (base of trench) but to 1.5m bGL in north pavement
Level of base of archaeological deposits observed and/or base of trench	1.5m bGL (max) base of trench
Natural observed (truncated/not truncated ?)	None observed
Extent of modern truncation	Mostly to or below 1.2m bGL, but only to 0.5m bGL, over part of the city wall (below)
<b>Archaeological remains</b>	<b>Date</b>
Orange-brown silty sand [4] and gravel with loose stones thought to be derived from the city wall. This abutted:	Unknown
The city wall [2], 2.75m-wide, and surviving from 0.5m bGL (12.04m OD), immediately below the concrete road bed. It was made of ragstone rubble <190mm across, set in yellow sandy lime mortar. The north and south edges of the wall were obscured by fibre optic cables and a gas main. Parts of the top of the wall had been reduced by <750mm by the insertion of modern ducts (Fig 4)	Undated
<b>Trench interpretation and summary</b>	
The city wall description is consistent with that of the Roman poured core of the city wall (Fig 5, Fig 6, & Fig 7). Unfortunately the faces were obscured by modern services. The 2.75m breadth is wider than that of some nearby exposures, but is not inconsistent with the known construction details. The wall lies on the predicted route (Fig 12). Apart from some mixed demolition deposits [4], the rest of the trench was occupied by modern services.	

<b>Trial Trench MOR19</b>	
Location	London Wall west of Moorgate
Dimensions	13.4m (including south pavement) x 0.6m x 1.5m deep.
Modern ground level	N carriageway: 12.64 m OD N carriageway: 12.54 m OD
Base of modern fill/surface	Carriageway: Concrete and tarmac 0.5m bGL South pavement: tarmac and concrete 0.1m bGL
Modern subsurface deposits	Pipes, ducts and loose modern cellar fill mostly to 1.5m bGL (base of trench)
Level of base of archaeological deposits observed and/or base of trench	1.5m bGL base of trench
Natural observed (truncated/not truncated ?)	None observed
Extent of modern truncation	South pavement: ducts to 0.45m bGL (no further excavation). South carriageway: pipes and ducts to 1.5m bGL. North Carriageway, central reservation, and part of south carriageway: remains of buildings demolished in the 1950s to below the 1.5m limit of excavation
<b>Archaeological remains</b>	<b>Date</b>
None observed	
<b>Trench interpretation and summary</b>	
The remains of buildings demolished in the 1950s, including in-filled cellars, extended across the predicted line of the city wall, and may have truncated it to a greater depth than the base of the trial trench. No indications of the wall were found, or any of any other archaeological remains.	

<b>Trial Trench LIV16 (Fig 8 &amp; Fig 9)</b>	
Location	Junction of London Wall and Blomfield Street
Dimensions	14.5m (not including the central reservation – not dug) x 0.6m x 1.5m deep
Modern ground level	Road surface varies 12.53m OD (north) 12.58m OD (adjacent city wall remains) and 12.37m OD (south)
Base of modern fill/surface	Road: Concrete and tarmac 0.5m bGL
Modern subsurface deposits	Cables, pipes, etc continued to 1.5m bGL except where the remains of the city wall were observed. The top of a BT manhole was exposed at the bottom of the trench in the south carriageway.
Level of base of archaeological deposits observed and/or base of trench	1.55m bGL base of trench.
Natural observed (truncated/not truncated ?)	Not reached
Extent of modern truncation	0.8m–1.55m bGL
<b>Archaeological remains</b>	<b>Date</b>
A firm dark brown silt [5], at 0.8m bGL (11.78m OD). This overlay:	Unknown
A disturbed or reworked section of masonry [7] 200mm north–south at, or about the same level, to the north of and stratigraphically above:	Unknown
The city wall [6] 1.2m east–west and 500mm north–south, 380mm deep made of ragstone rubble <300mm across, set in hard yellow lime mortar. The top of the wall lay at 11.42m OD (1.17m bGL). Part of this section of wall was recorded in trench LIV26 below (Fig 8 and Fig 9).	Undated
<b>Trench interpretation and summary</b>	
<p>All three contexts can be regarded as part of the Scheduled Monument, which therefore survives to 0.80m below ground level (11.78m OD). The city wall has previously been observed east of LIV16 beneath the adjacent pavement cellars of 85 London Wall. The earliest fragment of the city wall [6], at 11.42m OD, is consistent with the Roman construction of the wall, of ragstone rubble poured into a retained core with hard yellow lime mortar. The vertical face may imply that this is near the true edge of the original wall, here at a tangent to London Wall road, and that the facing blocks have been removed for reuse. The exposure was too small to determine whether the fragment of masonry that lay above it [7] was part of the original construction or a modification of the wall. The silt on top was a later deposit marking the disuse of the wall [5].</p> <p>Elsewhere, modern truncations had removed deposits to below the base of the trench.</p>	

<b>Trial Trench LIV19 (Fig 11)</b>	
Location	Old Broad Street junction with London Wall
Dimensions	14.2 (including east and east pavements) x 0.6m x 1.5m deep
Modern ground level	Road surface varies 13.14m OD (west) 13.21m OD (centre) and 13.10m OD (east)
Base of modern fill/surface	Road: Tarmac 0.1m bGL Decayed concrete bed merges with crushed concrete filling service trenches. Pavement: slabs 70mm thick over <200mm of concrete bed.
Modern subsurface deposits	Cables, pipes etc occupy the full 1.5m deep trench, except for the remains of a late 18th or 19th-century cellar. The top of a BT manhole was exposed at the bottom of the trench in the south carriageway.
Level of base of archaeological deposits observed and/or base of trench	1.5m bGL base of trench.
Natural observed (truncated/not truncated ?)	Not reached
Extent of modern truncation	1.2m–1.5m bGL
<b>Archaeological remains</b>	<b>Date</b>
Two red-brick cellar walls [3], 1.2m bGL (c 12.0m OD, see Fig 11).	Late 18th- or 19th-century, based on brick styles and late 19th-century pottery in disturbed fills
<b>Trench interpretation and summary</b>	
A great many services occupied the width of this trench. The walls of a late 18th- or 19th-century cellar were observed between gaps in the services. There were no observations of the city wall, but there were also many areas where the full depth of the trench (1.5m) could not be reached because of the multiple services. Therefore the city wall might survive beneath the services, although it may be truncated if later cellars are also present.	

<b>Trial Trench LIV25</b>	
Location	Junction of London Wall and Blomfield Street
Dimensions	13.3m x 0.6m x 1.7m deep
Modern ground level	12.40–12.45m OD
Base of modern fill/surface	Road: Tarmac on a concrete bed 500mm thick, from 12.40m OD north, 12.52m OD at junction with LIV26, and 12.45m OD south
Modern subsurface deposits	Cables, pipes etc occupy the full depth of the trench which varied from 0.73m in the south carriageway (limit caused by the density of services, to 1.7m in the north carriageway).
Level of base of archaeological deposits observed and/or base of trench	1.7m bGL (max) base of trench.
Natural observed (truncated/not truncated ?)	Not reached
Extent of modern truncation	1.7m bGL
<b>Archaeological remains</b>	<b>Date</b>
No <i>in-situ</i> remains, but a single ashlar corner block of a yellowish limestone (not retained) was possibly from part of the post-medieval postern gate	17th- or 18th-century (onset of using ashlar corner blocks)
<b>Trench interpretation and summary</b>	
The entire depth of this trench has been disturbed or reworked by services. An 18-inch and a 36-inch gas main were observed in the vicinity of the projected line of the city wall. This, together with the adjacent area of LIV26 may indicate a potential route for diverting services, if they can avoid the gas mains.	

<b>Trial Trench LIV26 (Fig 8 &amp; Fig 10)</b>	
Location	Junction of London Wall and Blomfield Street
Dimensions	16.0m x 0.6m x 1.8m deep
Modern ground level	c 12.40–12.58m OD
Base of modern fill/surface	Tarmac and concrete 300–500mm thick (from 12.52m–12.58m OD west to east)
Modern subsurface deposits	Cables, pipes etc to base of trench in parts
Level of base of archaeological deposits observed and/or base of trench	1.8m bGL base of trench.
Natural observed (truncated/not truncated ?)	Not reached
Extent of modern truncation	1.2m–1.8m bGL
<b>Archaeological remains</b>	<b>Date</b>
The city wall [6]. Part of this section of wall was recorded in trench LIV16 (above). See LIV16 for the description, and Fig 8 and Fig 10.	Undated
<b>Trench interpretation and summary</b>	
<p>This trench was designed to follow the line of the city wall exposed in LIV16. It uncovered the masonry remains to the point at which it had been truncated by a modern water main.</p> <p>West of the water main was a manhole, and west of that the width of the trench was reduced to fit between services. Collapsing sides required excavating the trench deeper than the intended depth, to 1.8m bGL. No evidence of the city wall or the later postern gate were found in this western area of the trench, but modern batteries in backfill indicated the location of headings dug below the level of ducts. It is possible that remains survive at a lower depth than this.</p>	

### 3.2.2 Trial trenches in Liverpool Street

<b>Trench LIV5</b>	
Location	Liverpool Street
Dimensions	27.5m x 0.6m x 1.3m deep maximum
Modern subsurface deposits	Modern backfill, concrete and service pipes and cables varying between 0.17m and 1.3m bGL
Level of base of archaeological deposits observed and/or base of trench	Base of trench: 1.3m bGL (max)
Natural observed (truncated/not truncated ?)	N/A
Extent of modern truncation	Modern backfill, concrete and service pipes and cables along majority of length of trench.
<b>Archaeological remains</b>	<b>Date</b>
Mixed dumps, consisting of a mid grey/brown silty clay, with animal bone, CBM fragments, oyster shell, CTP and occasional disarticulated human bone [1]	Post-medieval
<b>Trench interpretation and summary</b>	
Modern backfill, concrete and service pipes and cables along majority of length of trench. Small area of undisturbed mixed dumps with occasional disarticulated human bone was observed at 1.3m bGL, but not excavated. <i>Ex situ</i> Human bone was bagged and reburied within the trench.	

<b>Trench LIV6</b>	
Location	Liverpool Street
Dimensions	27.0m x 0.6m x 1.5m deep maximum
Modern subsurface deposits	Modern backfill, concrete and service pipes and cables varying between 0.25m and 1.5m bGL
Level of base of archaeological deposits observed and/or base of trench	Base of trench: 1.5m bGL (max)
Natural observed (truncated/not truncated ?)	N/A
Extent of modern truncation	Modern backfill, concrete and service pipes and cables along full length of trench.
<b>Archaeological remains</b>	<b>Date</b>
None	
<b>Trench interpretation and summary</b>	
Modern backfill, concrete and service pipes and cables occupied the whole area of the trench. A small quantity of disarticulated human bone found throughout this modern disturbance, and was bagged and reburied within the trench.	

<b>Trench LIV8</b>	
Location	Junction of Liverpool Street and Old Broad Street
Dimensions	9.85m x 0.4m x 1.2m deep max
Modern subsurface deposits	Modern backfill, concrete and service pipes and cables varying between 0.17m and 1.2m bGL
Level of base of archaeological deposits observed and/or base of trench	Base of trench: 1.2m bGL (max)
Natural observed (truncated/not truncated ?)	N/A
Extent of modern truncation	Modern backfill, concrete and service pipes and cables along full length of trench.
<b>Archaeological remains</b>	<b>Date</b>
None	
<b>Trench interpretation and summary</b>	
Modern backfill, concrete and service pipes and cables along full length of trench.	

<b>Trench LIV29</b>	
Location	Liverpool Street
Dimensions	6.5m x 0.55m x 1.4m deep max
Modern subsurface deposits	Modern backfill, concrete and service pipes and cables varying between 0.15m and 1.4m bGL
Level of base of archaeological deposits observed and/or base of trench	Base of trench: 1.4m bGL (max)
Natural observed (truncated/not truncated ?)	N/A
Extent of modern truncation	Modern backfill, concrete and service pipes and cables along full length of trench.
<b>Archaeological remains</b>	<b>Date</b>
None	
<b>Trench interpretation and summary</b>	
Modern backfill, concrete and service pipes and cables along full length of trench.	

### 3.3 Summary of results

#### 3.3.1 City wall

The city wall was recorded in two areas. To the west it was recorded in trench MOR18, context [2] (Fig 4). The exposure was up to 0.75m wide in the trench, and the wall continued for an unknown distance to the west and east of it (Fig 5 & Fig 6). Whilst the external faces were obscured by cables and a gas main (Fig 7), the width of the wall exposed (2.75m) is comparable to reliable observations elsewhere.

The wall core was made of ragstone rubble up to 190mm across, set in yellow sandy lime mortar. The highest surviving stone was at 12.03m OD, 0.51m bGL. A small amount of sandy gravelly brickearth abutted and overlay the wall on the north side [4]. It was left in place. The edges of the wall were obscured by live services, therefore the external faces probably lay near to the point where the wall was obscured. This section of masonry lies on the line of the city wall predicted in the DDBA (Crossrail 2008a, see Annex 1), but the width is marginally wider than that predicted (Fig 12, red dashed line).

The results of the watching brief allow the reconstructed line of the city wall to be slightly revised in the area between Moorgate and Circus Place (Fig 12, blue dashed line), if an allowance is made for the facings which did not survive in trench MOR18. The southern edge of the wall foundations were observed at site AOP99 and the revised reconstruction uses that as the south line of surviving masonry. The northern face of the wall at the nearest modern observations on which to base a projection (site AOP99), had been refaced at some period – removing the ferruginous sandstone decorative plinth seen elsewhere. It is possible that the thickness of the wall was reduced when this occurred. However, slightly further to the east, the original wall face survived at LON82, and this has been used as a reference point for the northern edge.

A further part of city wall [6] was exposed in trenches LIV16 and LIV26 (Fig 8–Fig 10). It was 1.3m long east–west (truncated on the west side and continued for an unknown distance beyond the trench edge to the east) and 0.5m north–south. Part of the south edge had a vertical face, and may reflect where the facing blocks had been removed. It falls within the 2008 reconstruction of the line of the city wall, which therefore does not need revision in this area.

The western end of city wall [6] appears to be the southern end of the section recorded by Compass Archaeology in a watching brief for Thames Water in 2008, see Fig 8 (site WBH06, Geoff Potter, pers comm & Crossrail 2009a). The location of the latter was plotted from features shown on OS mapping, and does not match the directly-surveyed section [6]. It is most likely that the WBH06 section is relatively accurately located north–south (ie in relation to the width of the city wall), but that on the east–west axis (ie along the wall), it should be relocated c 0.4m to the west, to make the western edges of the sections match. It should be noted that whilst wall section [6] was truncated to the west, the WBH06 section was only truncated in its southern part; to the north it appears to have extended west and east of the Thames Water trench.

The top of the wall [6] was at 11.47m OD. However, additional masonry [7] (Fig 9) over the top of this wall (which can also be considered part of the Scheduled Monument) survived to 11.78m OD (0.8m bGL – the same depth recorded for the Compass Archaeology finding, WBH06). This area of masonry was observed in an

exposure 600mm east–west, 200mm north–south and 200mm high, and is of the same materials as the city wall elsewhere, yellow sandy hard lime mortar and ragstone rubble. This masonry fragment [7] may be a separate part of the original construction from that recorded below it [6], or it could be a later remodelling of the city wall. The northern edge does not align with the earlier phase of the city wall, and this later masonry may be truncated in that area. Over both areas of masonry [6] and [7], there was firm dark grey-brown ashy silt [5]. It filled cavities in the masonry up to 400mm deep (left *in situ*).

A potential route for new services was identified at the junction of the west side of Blomfield Street and London Wall. It includes the western carriageway and the central reservation. The area of LIV26 south of these points did not expose remains of the city wall (it is possible that remains survive at a greater depth, below 10.75m OD, 1.8m bGL).

### **3.3.2 Human remains**

Of the trenches in Liverpool Street, only trench LIV5 produced any potential archaeological deposits within the depth of excavation (1.2–1.5m). Here mixed dumps with occasional disarticulated human bone were observed at 1.3m bGL, but not excavated [1]. This may be the disturbed upper levels of deep cemetery deposits, similar to those seen in earlier fieldwork in this area, eg as exposed within a shaft in Liverpool Street where the densely-packed burials extended down to 3.2m bGL (Crossrail 2009a, 3.2).

Disarticulated human bone was also observed within modern backfill in trench LIV6.

### **3.3.3 Other remains**

At the junction of Old Broad Street with London Wall, the only archaeological remains exposed were a red-brick cellar [3] in LIV19 (Fig 11). Remains of buildings demolished in the 1950s were recorded in the north carriageway of London Wall, west of Moorgate (trench MOR19). Such cellars may have abutted and/or cut into the Roman and medieval city wall, although the latter was not exposed within the trenches.

The line of Blomfield Street is that of one channel of the former Walbrook stream. A BT manhole exposed at the base of LIV16 south of the central reservation (beneath which it extended) was observed in the 1980s, and had stream sediments from approximately 2m to 4m bGL (LWB89).

## 4 Conclusions

### 4.1 City wall

Two sections of the wall were recorded, and substantially confirmed the reconstruction of the city wall in the DDBA (Crossrail 2008a, see Annex 1). The western section in trench MOR18 was a little wider than previous projections of the city wall (Fig 12), and the top of the wall was truncated by ducts, but survived in part to 0.50m below road level. The eastern observations in trenches LIV16 and LIV26 at the junction of London Wall and Blomfield Street (and the earlier WBH06 work) fell within the projected line of the wall, surviving up to 1.2m bGL (Fig 8 & Fig 12).

The city wall does not survive within 1.5m below the modern road surface in trench MOR19 west of Moorgate, suggesting localised truncation west of the section recorded as GM108, but the extent of this truncation outside the trench footprint, and its depth, are unknown.

There were no remains of the city wall or the postern gate to Moorfields surviving within 1.5m below the road surface in LIV25 and the western part of LIV26 (ie the area of London Wall south of the traffic island and the western carriageway in Blomfield Street).

Similarly, no surviving remains of the city wall were exposed in trench LIV19 in Old Broad Street, where remains of a red-brick cellar were revealed in the western carriageway. However, there were areas of this trench which did not reach 1.5m below ground level because services were too crowded to allow excavation between. Therefore the presence of the city wall in this location remains uncertain.

It should be noted that the levels to which the city wall survives are highly variable and localised (Crossrail 2008a). The depths (and areas of absence) seen in the watching brief are not necessarily a guide to survival outside the trenches concerned, or below their bases.

Notwithstanding the above, the results from the comprehensive array of trenches at the junction of London Wall and Blomfield Street (LIV16, 25, and 26) do appear to indicate that there is a considerable area at that location where 1.5m-deep utility diversions would not disturb the Scheduled Monument (although some or all of this might already be occupied by existing services).

However, the section of wall found by Compass Archaeology in 2008 (WBH06) suggests that there may be greater survival of the wall just to the north of trench LIV26, but over an unknown area. The WBH06 section was mostly located just to the north of trench LIV26, and to the west of LIV16 (Fig 8); how far it may extend to the west (or east) is unknown.

These data may be used, cautiously, in designing the utility diversions and new utilities in the area of Blomfield Street, avoiding the relatively small sections of the wall shown on Fig 8 – taking into the uncertainty over the extent of the WBH06 section.

The two sections of the city wall which were found support (and slightly refine) the 2008 reconstruction, allowing it to be used with greater confidence in designing utility diversions parallel with the city wall in this area.

The western part of trench LIV19 (Old Broad Street) lies over the predicted line of the city wall. Because of the density of existing services and an earlier vault, it is not possible to draw conclusions about the western pavement, only excavated to 0.50m bGL. However, the cellar walls at 1.2m bGL in the carriageway suggest an area which may be suitable for utility diversions.

## 4.2 Burials in Liverpool Street

*in situ* burials and/or disarticulated or redeposited bone may be found throughout the area adjacent to Liverpool Street Station, but within the 1.5m maximum depth of the trial trenches, human remains were limited to disarticulated bone found in trenches LIV5 and LIV6. The depth of 1.3m bGL for the remains in LIV5 falls within the 1.2–1.5m bGL range for previous finds noted in the Method Statement, although one deposit has been found within 0.55m of modern ground level (Crossrail 2009a, 3.2).

The human bone in LIV5 was present in the top of an archaeological deposit that was recorded and preserved *in situ*, unexcavated. It is likely from previous archaeological work in this area that *in situ* human burials are to be found deeper within these deposits, but the trial trenches dug for utilities purposes were not deep enough or extensive enough to confirm this.

The bone from trench LIV6 was redeposited in modern overburden, probably from the installation of the existing services or other modern disturbance.

These results suggest that survival of archaeological deposits is highly variable and localised within Liverpool Street, mainly as a result of the high density of modern services and other disturbance. The limited amount of human remains encountered in this group of trial trenches should be treated with caution. Whilst it does demonstrate the extensive modern disturbance within c 1.5m of ground level (already known from previous fieldwork), it does not alter earlier predictions of a high potential for dense, but localised, pockets of burials within c 1.5m bGL (also demonstrated by earlier fieldwork), much of which is likely to be *in situ*.

Such burials probably extend over a much larger proportion of Liverpool Street at depths below 1.5m (except where significant disturbance has taken place, such as the known railway tunnels). This indicates that utility diversions would require mitigation in the form of an archaeological watching brief, with sufficient resources and time available in the programme to deal with any such local areas of surviving burials.

These trial trenches were too few and too shallow to provide useful data that would inform mitigation designs for the deeper and more extensive station box etc at Liverpool Street.

## 4.3 Significance of the data

These two new observations of the city wall, surveyed to modern standards, are of considerable local importance, in that they help to confirm and slightly refine the reconstruction of the line of the city wall in the area of the Crossrail utility diversions (Crossrail 2008a). for example, it can be seen that between approximately Circus Place in the west and Blomfield Street in the east, the projected line of the city wall diverges from the Scheduled area (Fig 3).

These data will contribute to the design for Crossrail utility diversions, and towards protection of the Scheduled Monument.

The results from Liverpool Street regarding human remains provide some data that will contribute towards utility diversions in that area, but broadly confirm previous observations.

In both cases the depth limitations of the utilities trial trenches, and the density of existing services, limits any wider inferences with regard to predictive modelling of archaeological deposit survival in relation to proposed Crossrail works (other than utilities).

## 4.4 Publication and archiving

The observations of the city wall, a Scheduled Monument, and the refining of the DDBA reconstruction of the route of the wall (which differs significantly from English Heritage's schedule mapping) are significant results of these two pieces of work. They will be included in the post-excavation assessment for the archaeological works to be conducted for Crossrail's Liverpool Street Station, and published in an appropriate form.

The site archive containing original records (no finds were removed) will be stored in accordance with the terms of the *Method Statement* (Crossrail 2009a).

## 5 References

Church of England/English Heritage, 2005 *Guidance for best practice for treatment of human remains excavated from Christian burial grounds in England*

Corporation of London Department of Planning and Transportation, 2004 *Planning Advice Note 3: Archaeology in the City of London, Archaeology Guidance*

Crossrail, 2005a *Environmental Statement*

Crossrail, 2005b *Assessment of Archaeology Impacts, Technical Report. Part 2 of 6, Central Section, Westbourne Park to Stratford and Isle of Dogs*. Crossrail Doc No. 1E0318-C1E00-00001

Crossrail, 2008a, *Utilities Diversions: London Wall, Moorgate, Blomfield Street, Old Broad Street, Bishopsgate, Past Observations of City Wall* (DDBA for city wall only)

Crossrail, 2008b *Environmental Minimum Requirements*, (EMR). Crossrail Doc No. CR/HB/EMR/0001

Crossrail, 2008c *Crossrail: Works affecting scheduled monuments in the City of London* (Scheduled Monument Deed)

Crossrail, 2009a *Method Statement for Trial Trenches in Liverpool Street & Moorgate*, Document No. CR/DV/LIV/X/MS/00001, version 1.0 (MS)

Crossrail, 2009b *Liverpool Street Station, Site-Specific Archaeological Written Scheme of Investigation, v. 1.0*, Document No. CR-PN-LIV-EN-SP-00001.

Crossrail, 2009c *Archaeology Generic Written Scheme of Investigation, v. 2.0*, Document Number 14022008-44ES-P2Z1

Department of the Environment, 1990 *Planning Policy Guidance 16, Archaeology and Planning* [PPG16]

Institute for Archaeologists (IFA), 2001a *By-Laws, Standards and Policy Statements of the Institute for Archaeologists: Standards and guidance – Field Evaluation*

Institute for Archaeologists (IFA), 2001b *By-Laws, Standards and Policy Statements of the Institute for Archaeologists: Standards and guidance – Watching Brief*

Institute for Archaeologists (IFA), supplement 2001 *By-Laws, Standards and Policy Statements of the Institute for Archaeologists: Standards and guidance – the collection, documentation conservation and research of archaeological materials*

Institute for Archaeologists (IFA; Brickley, M and McKinley, J eds), 2004 *Guidelines to the Standards for Recording Human Remains*, Institute of Field Archaeologists/British Association of Biological Anthropology and Osteoarchaeology

Museum of London, 1994 *Archaeological Site Manual 3rd edition*

Museum of London, 1998 *General Standards for the preparation of archaeological archives deposited with the Museum of London*

Museum of London, 2002 *A research framework for London archaeology 2002*

MOL Archaeology, April 2009 *Liverpool Street & Moorgate, Utilities Trial Trenches, Archaeological Watching Brief & Evaluation Method Statement, V. 1.1 (MS)*

MOL Archaeology, 2009 *Guidelines and notes for Senior Archaeologists on the excavation of human remains and burial grounds*. Unpub MOLA guidelines

United Kingdom Institute for Conservation, 1983 *Conservation Guidelines No. 2, Packaging and Storage of Freshly-Excavated Artefacts from Archaeological Sites*

JB Riney & Co Ltd, March 2009 *Environmental Management Plan, Liverpool Street and Moorgate Station Area, Utility Trial Trenching Works, Rev. 0.2*

## 6 NMR OASIS archaeological report form

OASIS ID: molas1-66202

### Project details

Project name Crossrail Utilities trial trenches, near Liverpool Street and Moorgate Stations

Short description of the project 1.5m-deep Trial trenches to investigate the locations of utilities were monitored. Two fragments of the city wall were exposed along the line of London Wall road and two trenches exposed disarticulated human bone near to Liverpool Street Station. The results will be used to inform the design of utilities diversions in the area.

Project dates Start: 09-05-2009 End: 01-08-2009

Previous/future work No / Yes

Any associated project reference codes XRF09 - Sitecode

Type of project Recording project

Site status Scheduled Monument (SM)

Current Land use Transport and Utilities 1 - Highways and road transport

Monument type CITY WALL Roman

Monument type BURIAL GROUND Post Medieval

Investigation type 'Watching Brief'

Prompt Scheduled Monument Consent

Prompt The Ancient Monuments and Archaeological Areas Act 1979, replaced with a Scheduled Monument Deed: Crossrail: Works affecting scheduled monuments in the City of London (Crossrail 2008c)

### Project location

Country England

Site location GREATER LONDON CITY OF LONDON CITY OF LONDON Crossrail Utilities trial trenches, near Liverpool Street and Moorgate Stations

Postcode EC2

Study area 11709.48 Square metres

Site coordinates TQ 3289 8153 51.5165425440 -0.08455126364940 51 30 59 N 000 05 04 W Point

Site coordinates TQ 33012 81635 51.5174574470 -0.08275420440790 51 31 02 N 000 04 57 W Line

Site coordinates TQ 33012 81635 51.5174574470 -0.08275420440790 51 31 02 N 000 04 57 W Line

Site coordinates TQ 33116 81604 51.5171542843 -0.08126775386160 51 31 01 N 000 04 52 W Line

Site coordinates TQ 33080 81465 51.5159135338 -0.08183883842330 51 30 57 N 000 04 54 W Line

Site coordinates TQ 32661 81564 51.5169020613 -0.08783724478460 51 31 00 N 000 05 16 W Line

Site coordinates TQ 32938 81490 51.5161717278 -0.08387490719350 51 30 58 N 000 05 01 W Line

### Project creators

Name of Organisation MoL Archaeology

Project brief originator Crossrail and HMI-AM

Project design originator MoL Archaeology

OASIS ID: molas1-66202 (cont'd)

Project George Dennis

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Project supervisor David Sankey

Project supervisor Adrian Miles

Type of Local authority controlled infrastructure development company

sponsor/funding

body

Name of Crossrail

sponsor/funding

body

**Project archives**

Physical Archive No

Exists?

Digital Archive LAARC

recipient

Digital Media 'Images raster / digital photography','Survey','Text'

available

Paper Archive LAARC

recipient

Paper Contents 'Stratigraphic'

Paper Media 'Context sheet','Manuscript','Notebook - Excavation',' Research',' General

available Notes','Photograph','Plan','Section','Unpublished Text'

Paper Archive trench record sheets

notes

**Project**

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Entered on 23 October 2009

## **Figures**

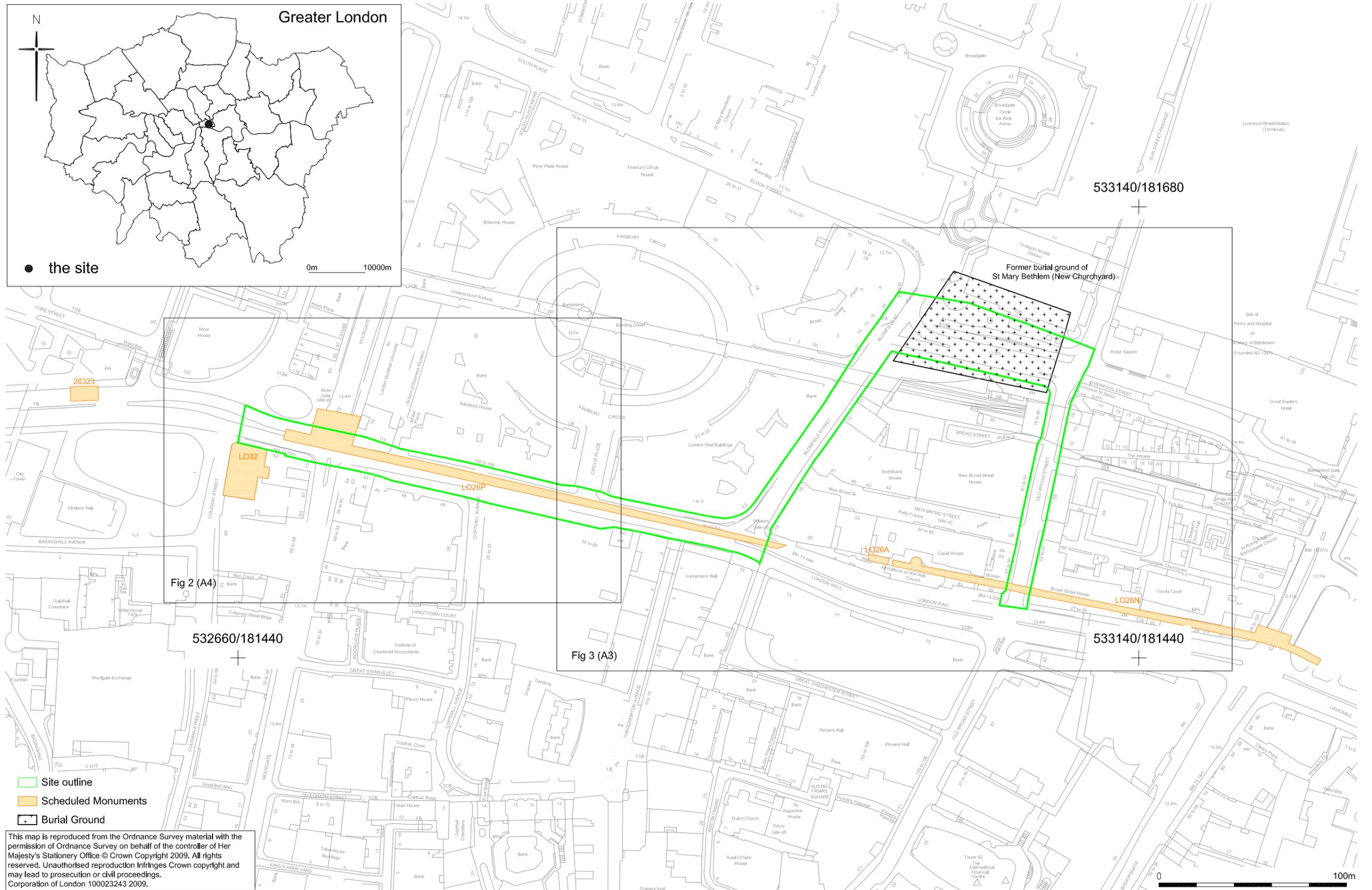


Fig 1 Site location

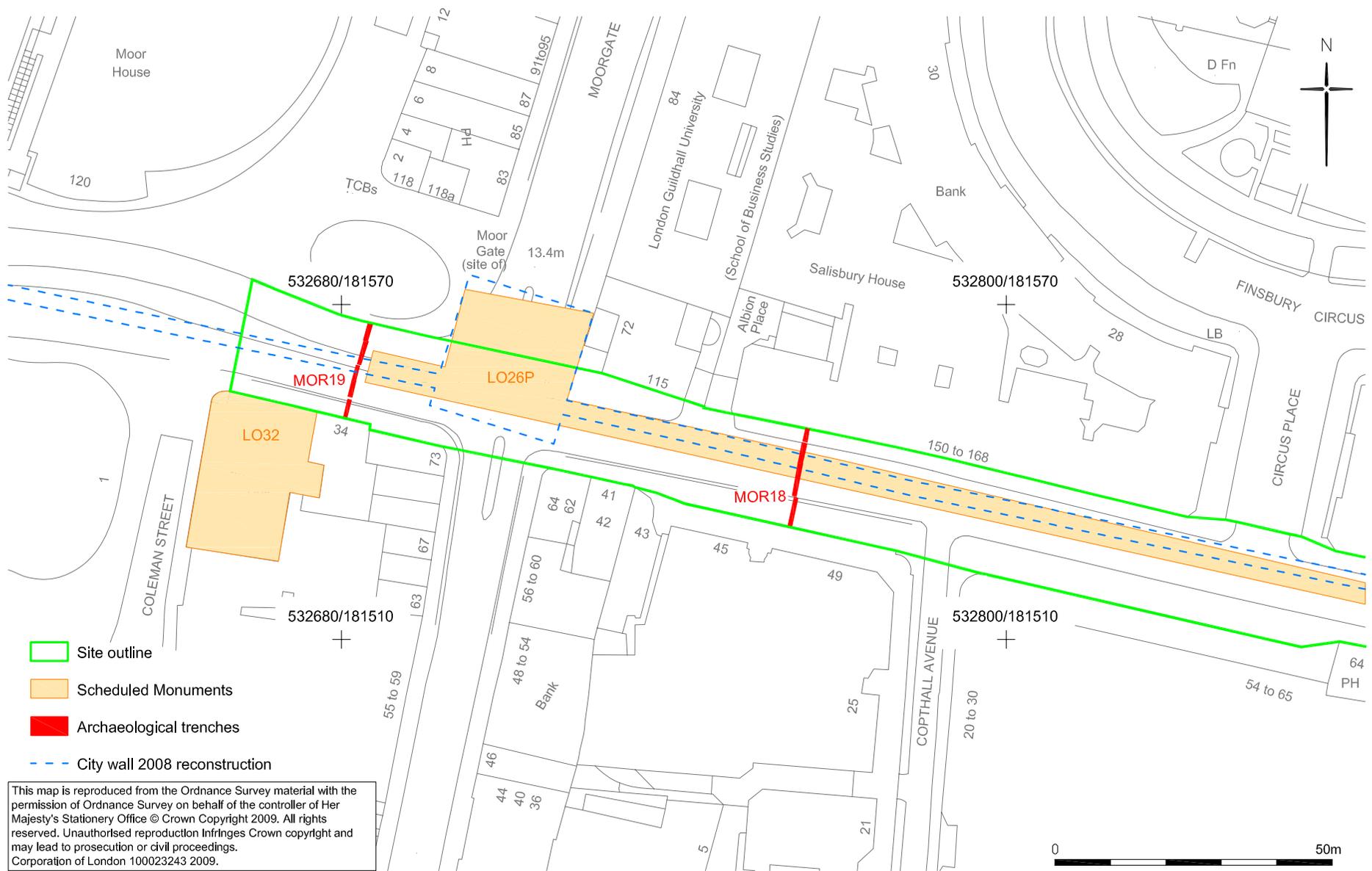


Fig 2 Trench location (west)

MLU/T1051WB09#02

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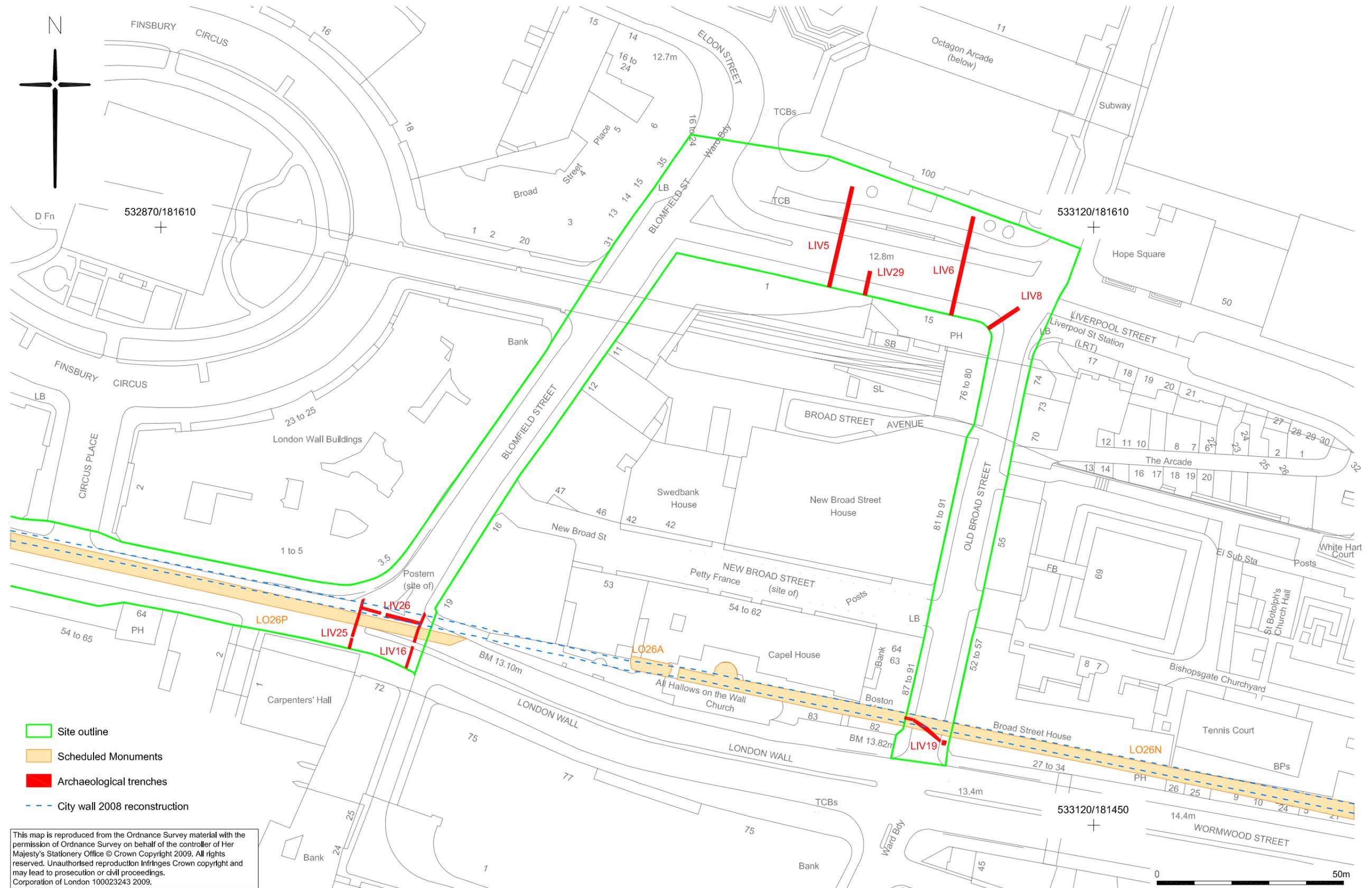


Fig 3 Trench location (east)

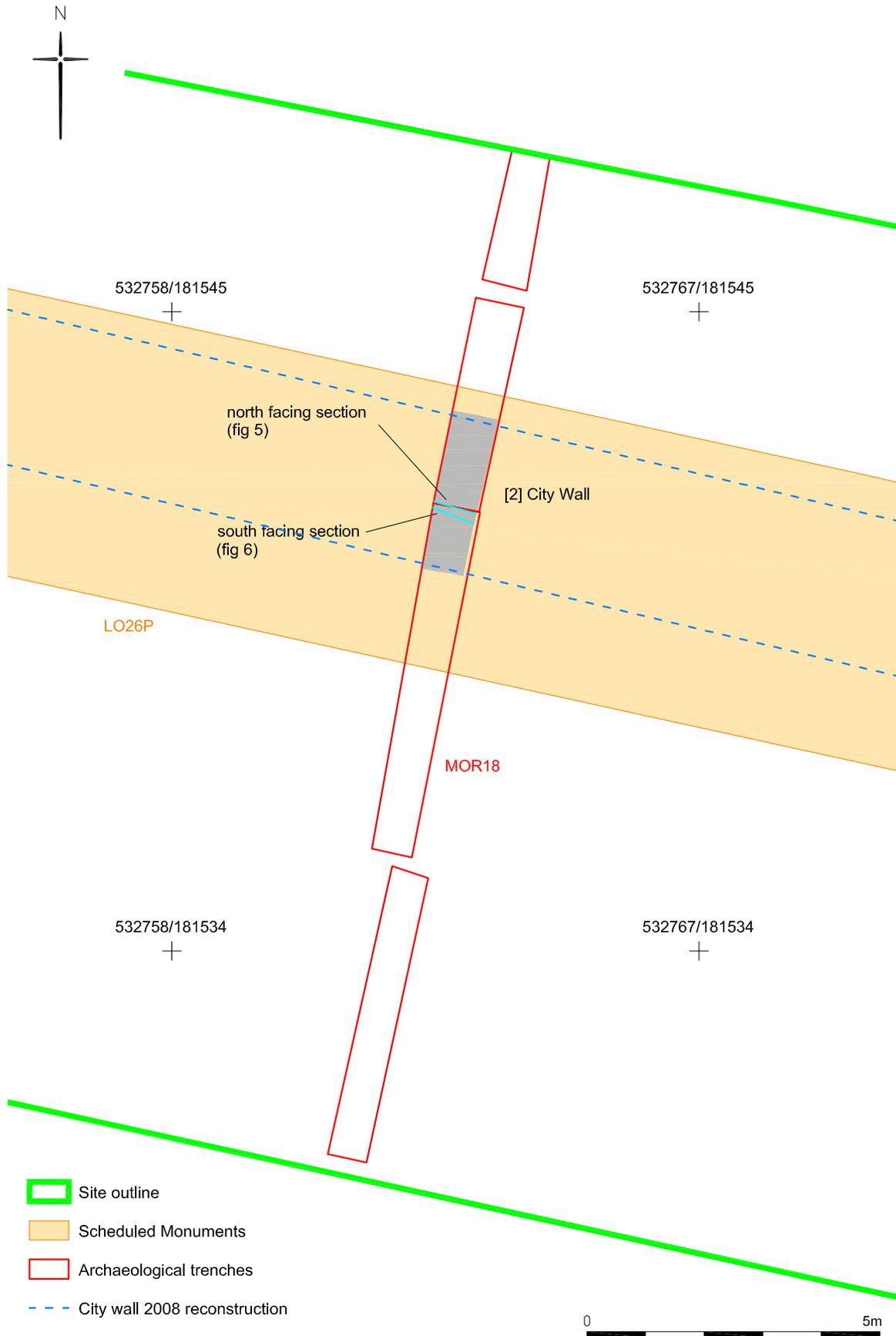


Fig 4 Plan of city wall in MOR18

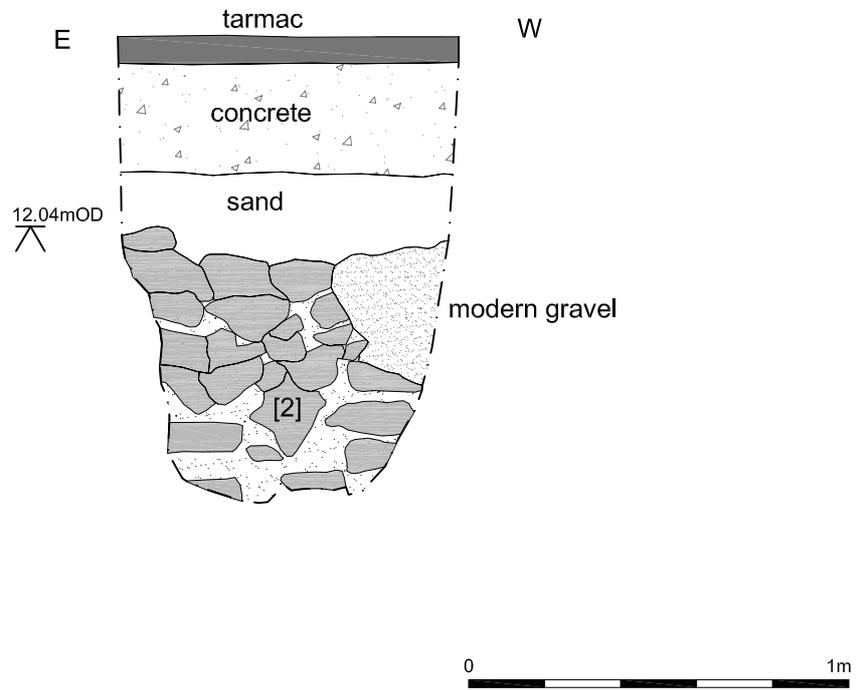


Fig 5 Section across city wall E - W in Trench MOR18

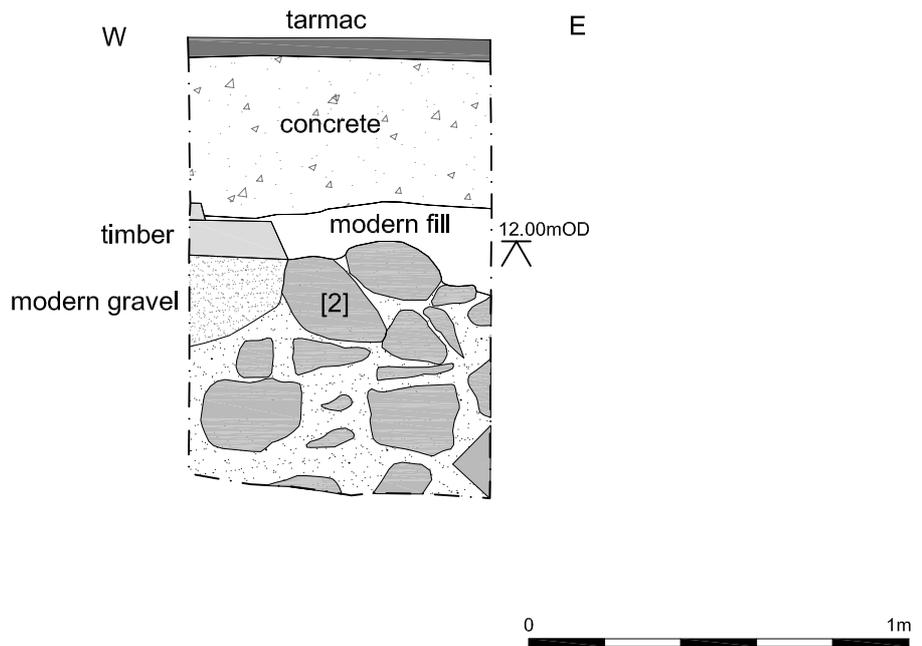


Fig 6 Section across city wall W - E in Trench MOR18

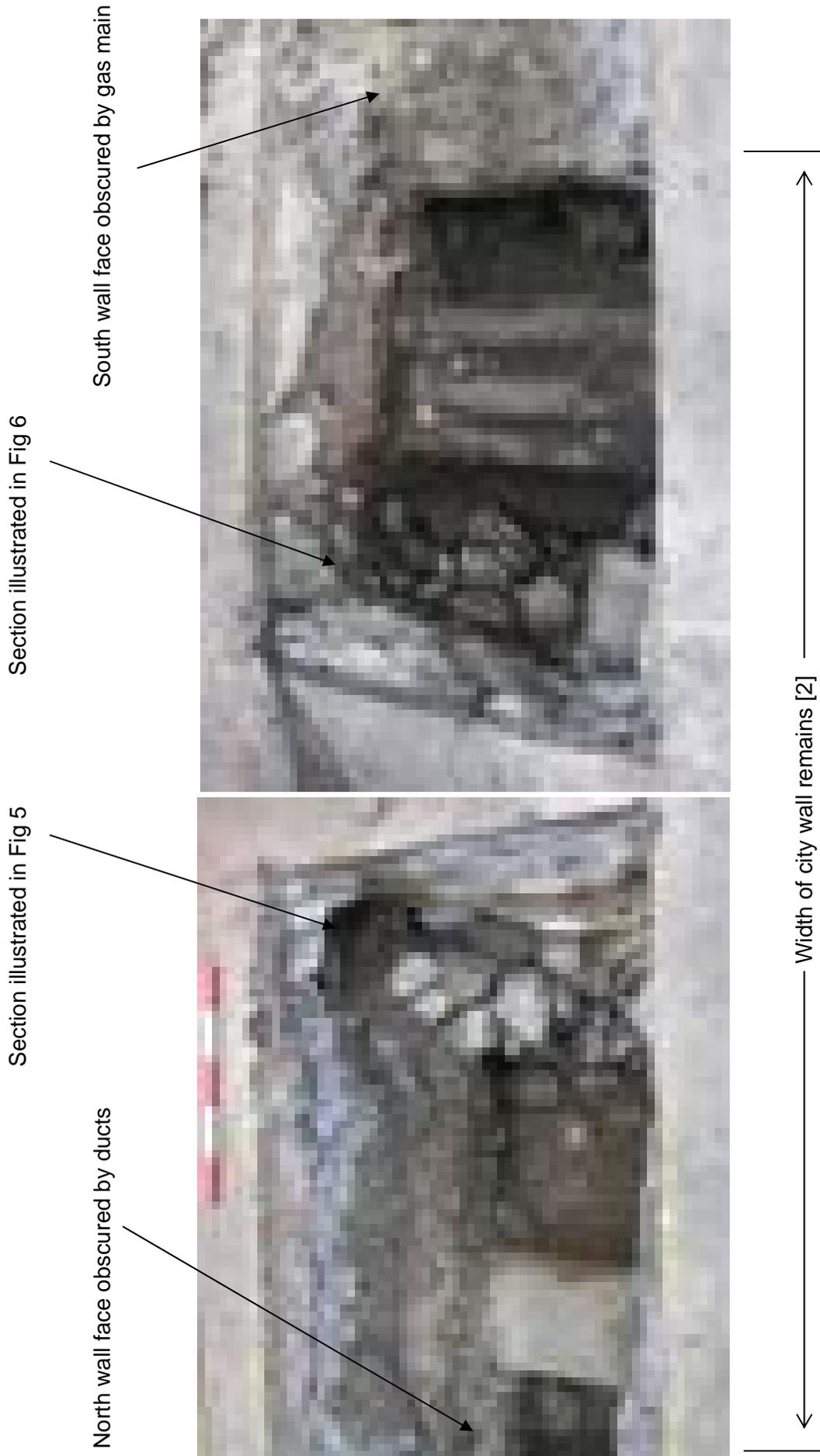


Fig 7 MOR18, looking east. Scale is 500mm (half-metre)

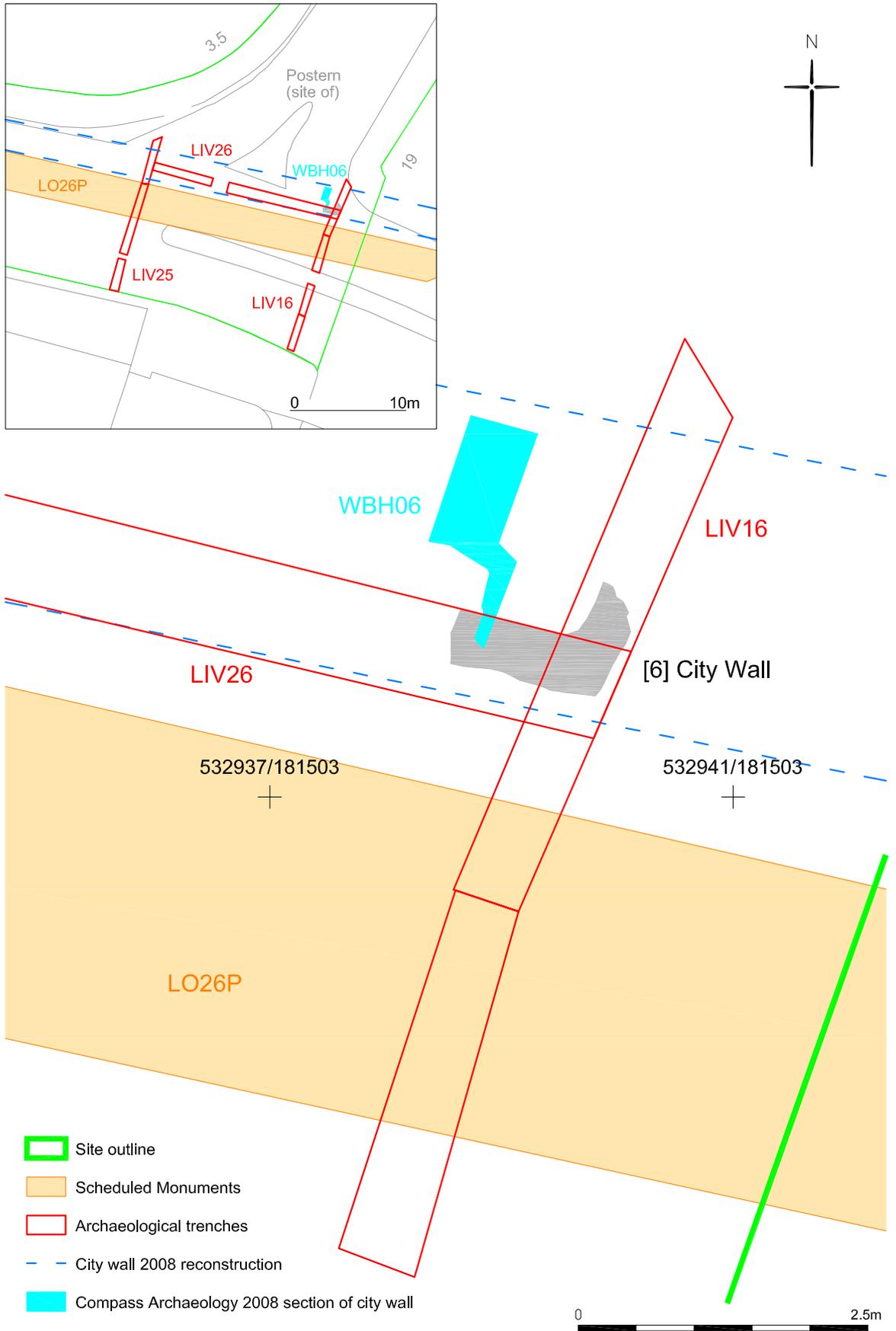


Fig 8 Plan of city wall at the junction of London Wall and Blomfield Street



Fig 9 Vertical view of the city wall in LIV16, looking north



Fig 10 City wall in LIV26, looking north. Wall context [6], earlier exposed in LIV16, continues beneath ducts. Position "A" is the same in both photographs.

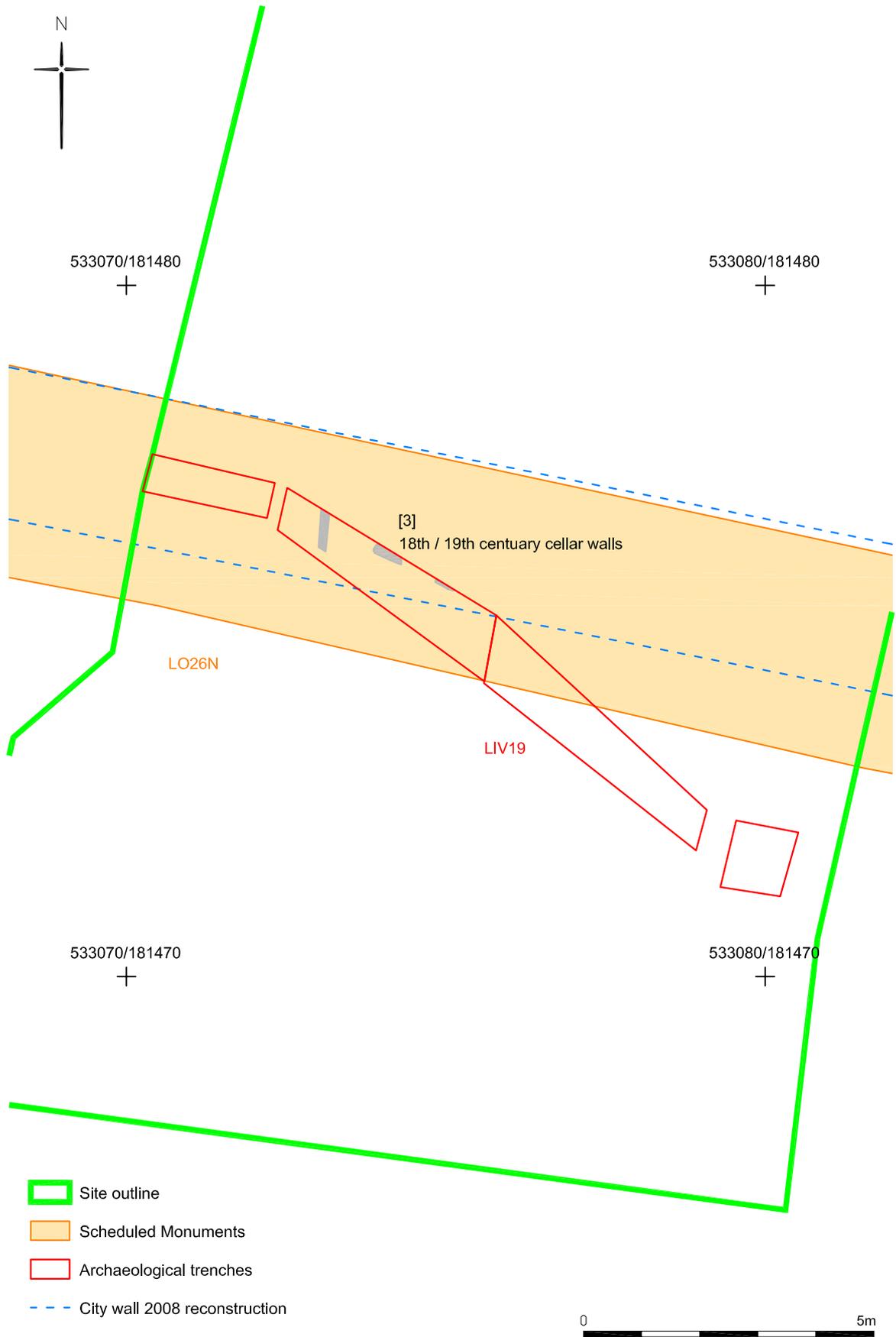
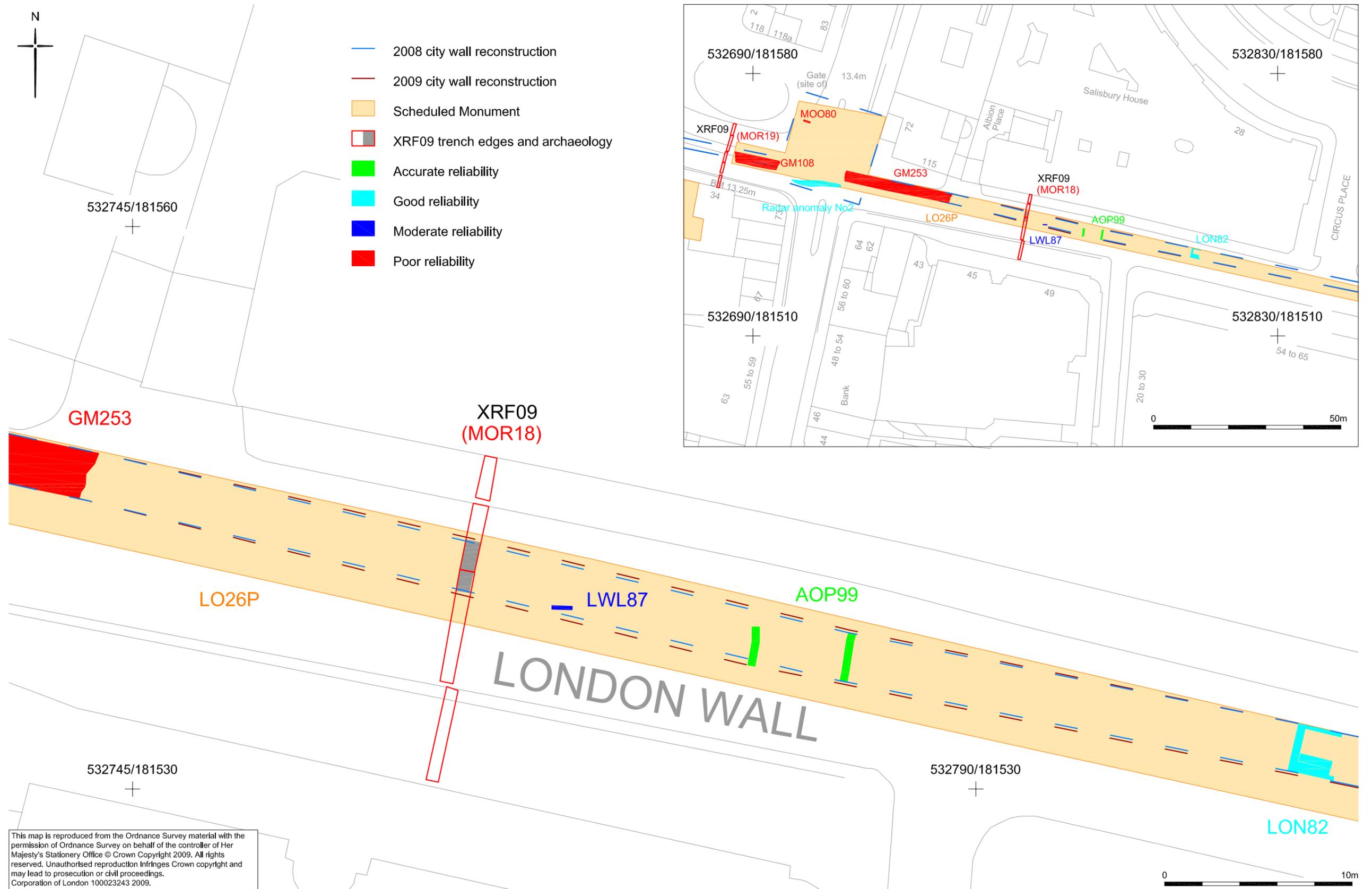


Fig 11 Plan of cellar walls in LIV19

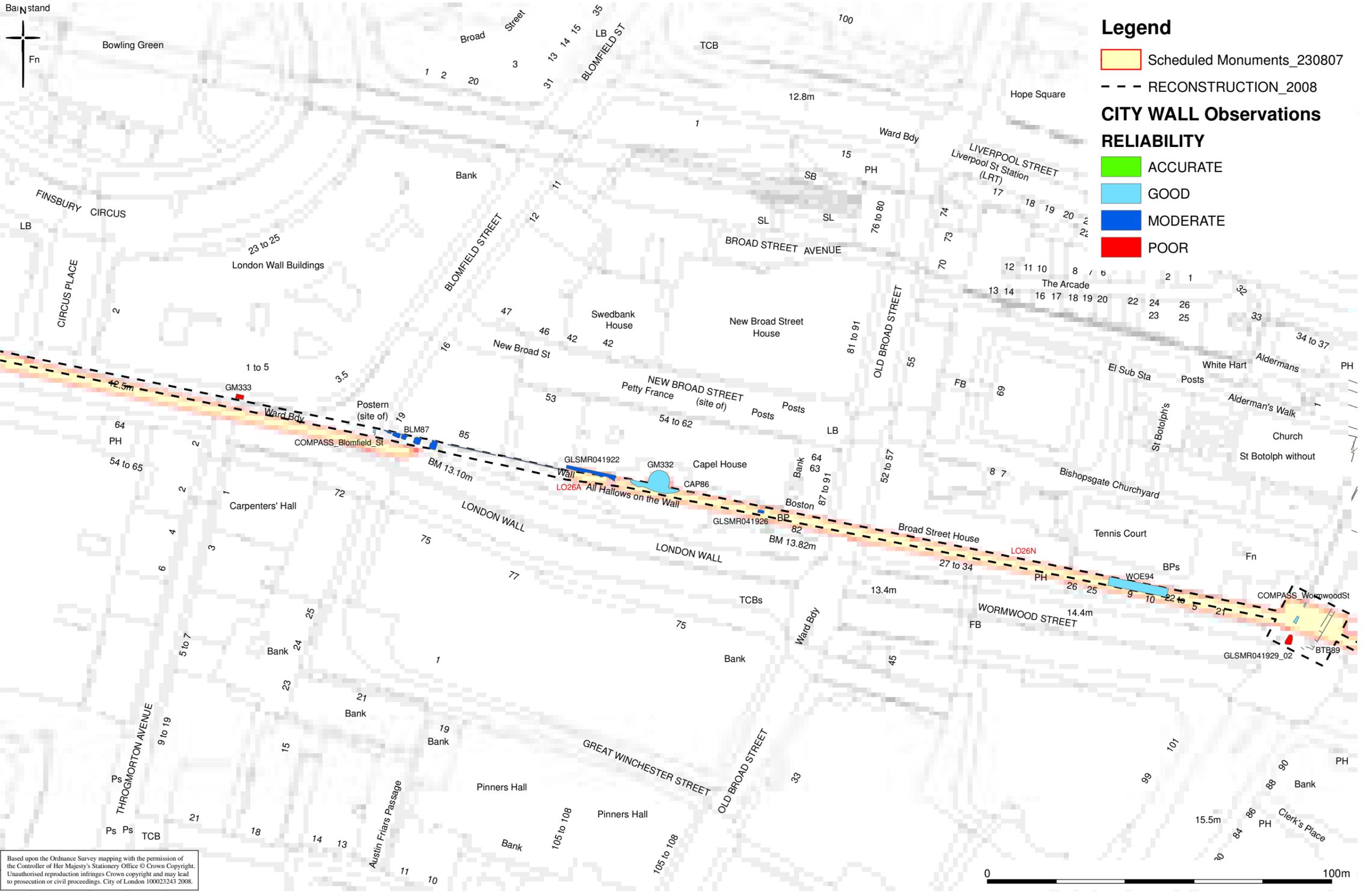
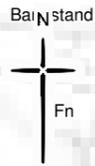


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Fig 12 Revised reconstruction of City Wall location (inset shows revised reconstruction in relation to surrounding area)

## **Annex 1: Additional figures from city wall DDBA (Crossrail 2008a)**



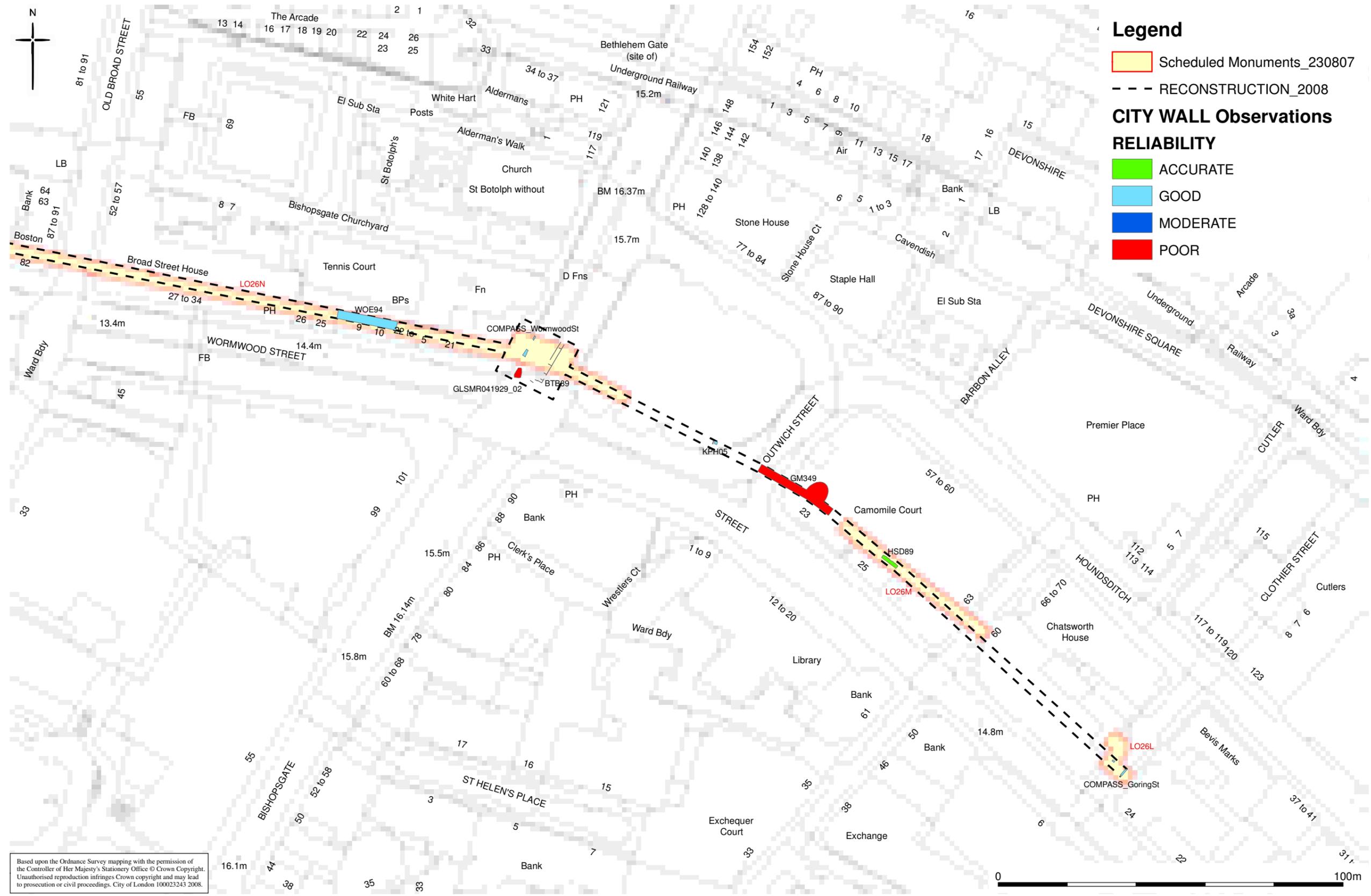


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City wall DBA: centre

### Legend

- Scheduled Monuments\_230807
- RECONSTRUCTION\_2008
- CITY WALL Observations**
- RELIABILITY**
- ACCURATE
- GOOD
- MODERATE
- POOR



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City wall DDBA: east



## **Appendix F      C503 – Liverpool Street Method Statement, Utilities Diversions – Excavation, Duct Installation, Backfilling.**



# C503 – Liverpool Street

## Method Statement

### Utilities Diversions – Excavation, Duct Installation, Backfilling

**CRL Document Number: C503-VIN-C-GMS-C101-50010**

**Supplier Document Number: VCUK-C503-MST-00015**

**Document Submittal History:**

Rev.:	Date:	Prepared by:	Checked by:	Approved by:	Reason for Issue:
1.0	31/08/11	Andreas Michael	Rob Scheele	Lucy Penman	For CRL acceptance
2.0	09/09/11	Andreas Michael	Lucy Penman	Lucy Penman	For CRL acceptance following comments
3.0	16/09/11	Andreas Michael	Rob Scheele	Lucy Penman	For CRL / LU acceptance
Signatures:					

Please see VCUK document review / authorisation page for signatures.

	<b>Project Manager/Supervisor (PDP) Review and Acceptance Decal</b>	
	This decal is to be used for submitted documents requiring acceptance by the <i>Project Manager/Supervisor (PDP)</i> .	
<input checked="" type="checkbox"/>	Code 1.	Accepted. Work May Proceed
<input type="checkbox"/>	Code 2.	Not Accepted. Revise and resubmit. Work may proceed subject to incorporation of changes indicated
<input type="checkbox"/>	Code 3.	Not Accepted. Revise and resubmit. Work may not proceed
<input type="checkbox"/>	Code 4.	Received for information only. Receipt is confirmed
Reviewed/Accepted by:(signature)		
Print Name:	C. SAMPLES	Date: 22/09/11
<small>Acceptance by Project Manager/Supervisor (PDP) does not relieve the designer/supplier from full compliance with their contractual obligations and does not constitute Project Manager/Supervisor (PDP) approval of design, details, calculations, analyses, test methods or materials developed or selected by the designer/supplier.</small>		



	Name	Position	Signature	Date
Prepared	Andreas Michael	Engineer		16/09/2011
Checked	Rob Scheek	Production Manager		16/09/2011
Approved	Lucy Penman	Project Manager		16/09/2011

**Crossrail Acceptance**

	Name	Position	Signature	Date
Supplier's Representative	C. SHARPLES	SM		21/09/11

**Acceptance by London Underground Ltd**

	Name	Position	Signature	Date
Applicable: Yes	C. BAINBRIDGE	CA -		22/09/11

**Comments**

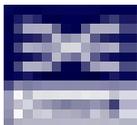
Revision 3 – submission to Crossrail addressing LU comments from rev. 2.0

The acceptance of this Method Statement by Crossrail does not in any way absolve the contractor from their responsibilities. Furthermore acceptance does not confirm or suggest that documentation fully meets legal or other relevant requirements.

Check to ensure that this method statement is a quality document.

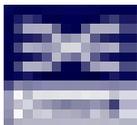
Check	Producer	Producer check	VCUK Mgr check
Is the method statement complete and in order? Are all the referenced appendices included, and all the required information contained within them?	/	✓	✓
Are the risk assessments signed by the appropriate person?	/	✓	✓
Are the revision numbers and method statement references correct in the header?	/	✓	✓
If required, has the OAN and a SABRE number been requested?	N/A	-	-
Has this method statement been submitted before? If yes, write details in the "Comments box" on this page	Yes	Yes	Yes

Now sign the front cover in the correct place



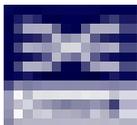
**CHECK LIST (tick box as appropriate)**

Additional Information	Applicable	Not Applicable
General	✓	
Procedure	✓	
Scope of work	✓	
Labour force	✓	
Training	✓	
Lifting equipment	✓	
Portable tools	✓	
Mechanical plant	✓	
Track mounted vehicles and plant		✓
Protection of LUL assets	✓	
Materials	✓	
Storage and handling of hazardous substances and materials	✓	
Temporary structures / False work	✓	
Working at heights	✓	
Work permits and licences	✓	
Temporary lighting and power	✓	
Control of work with hazardous substances and processes	✓	
First aid	✓	
Fire Prevention	✓	
Excavation	✓	
Personal Protective Equipment (PPE)	✓	
Incidents and Reporting of Injuries, Diseases and Dangerous Occurrences (RIDDOR)	✓	
Housekeeping	✓	
Access and egress to authorised personnel	✓	
Emergency procedures	✓	
Transportation	✓	
Signs and notices	✓	
Systems / Codes of practice	✓	
Statutory records	✓	
Noise and vibration	✓	
Air quality and dust	✓	
Waste management	✓	
Protection of water quality	✓	
Archaeology	✓	
Nature protection		✓
Management of pests and weeds		✓
Traffic management	✓	
Contaminated land	✓	
Inspection and environmental auditing	✓	
Records and documentation	✓	
Live working		✓
Manual handling	✓	



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## **1. SCOPE OF WORKS**

### **1.1 Scope of works**

This method statement covers the civil engineering works required for the diversion of public utilities away from the footprint of the future Liverpool Street Crossrail ticket hall at Liverpool Street C503 project as detailed in section 1.2 of this document. The purpose of this method statement is to outline safe systems of work and methodology to allow the sub-contractor (TBC) to undertake the works.

The works are programmed to be undertaken from the start of September 2011 until early January 2012. The works will take place in Eldon Street, Liverpool Street, Sun Street, New Broad Street, Old Broad Street and Blomfield Street. Drawing ref CRL1-XRL-U-DDA-C101-00109 is given in Appendix 3 showing the streets affected by these works.

The public utilities diversions require excavations for joint bays, duct routes, cable pits and access chambers in Eldon Street, Liverpool Street, New Broad Street, Old Broad Street and Blomfield Street, and include backfilling and reinstatement of the highway. The archaeology works on Liverpool Street will require initial breaking of the ground for 500mm.

If during the course of the works it becomes evident that certain activities fall outside of the scope described in this document, these activities will not be allowed to proceed until an addendum has been agreed to the existing Method Statement or a separate Method Statement and Risk Assessment has been produced to cover a significant change in scope.

This method statement does not cover:

- the site establishment works for the main worksites in Liverpool Street and 11-12 Blomfield Street which take place before the utilities diversions;
- traffic management installation
- follow on works by the utilities companies
- construction of manholes
- installation of water or gas pipes
- works internal to buildings

### **1.2 Methodology / Sequence of works**

#### **Pre-works commencement**

The VCUK and all Sub-contractor works supervisors must have read and understood this document and be prepared to brief the team and start works as follows:

- They must ensure all competency checks, briefings, issue of permits and licences, and all other checks and systems are in place as defined in this RA/MS
- They must ensure that this RA/MS is signed off by VCUK, Crossrail and LU. However work may proceed when they are more than 6m away from LU assets once the MS is signed by CRL and VCUK.
- They must continually ensure that all operatives have read and understood the parts of this Method Statement applicable to their works, and have had the opportunity to review the entire document before signing to indicate they have been instructed correctly.
- They must carry out a STARRT briefing at the beginning of each shift which fully briefs the team on the information required to carry out each element of work safely and efficiently in adherence with the MS. This will include confirming the stage the operations have reached, and what stage they are expected to reach in the shift concerned.



- In particular the briefing must focus on the key operational and safety risks which are highlighted in sections 1.7 and 1.8
- The supervisors must be prepared so that any changes in circumstances can be quickly identified and reported to mitigate any risks undetected to date.

### **Commencement of works:**

All works listed below must be carried out in compliance with the conditions stated in this full MS. Example of this include Lifting operations must follow guidance on lifting plans, manual handling must be assessed, PPE must be worn as outlined for each task. To avoid repetition the conditions imposed by these other sections of the MS are not repeated here – but must be referred to before each operation commences.

The works described below are programmed to take place in Blomfield Street, Eldon Street, New Broad Street, Old Broad Street, Sun Street and Liverpool Street. The works will be undertaken the sub-contractor (TBC) who will be appointed by VCUK.

### **Works element 1) Site set-up**

The Traffic Management (TM) will be established by others and a separate approved MS will be in place prior works starting. The first activity will be to install heras fencing panels with support bases within the TM boundaries. No pedestrian access will be allowed into the area whilst this activity is going on. Fencing will be brought to the site using a flatbed or tipper truck and offloaded manually one by one. This will be done by a minimum of 2no operatives. Once installed, fences will be double-clipped for the full length. Support struts will be installed at every other panel to provide stability.

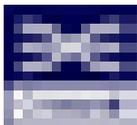
No length of fencing will be installed longer than 40m without a temporary works design being in place.

For the duration of excavation and breaking out works, acoustic blankets will be attached to the heras panels.

The heras panel fence will be visually checked daily by the VCUK Supervisor and weekly by the VCUK Temporary Works Co-ordinator and VCUK Temporary Works Supervisor to ensure stability of the fence. They will be checking for the connections between panels to be tightly fixed in place and the panels to be securely in their bases.

### **Works element 2a) Excavation for non LU-affected areas**

- 1) Permit to penetrate (VCUK) and permit to dig (sub-contractor) need to be in place and checked by the VCUK Supervisor.
- 2) Prior to the ground being broken the excavation area will be scanned by a trained subcontractor operative with a CAT and signal generator and checked against the Permit to Penetrate. Existing service records will be cross-checked.
- 3) Services detected will be marked on the surface using line spray within and 2m beyond the footprint of the area to be excavated wherever possible.
- 4) Based on the utilities agree with the VCUK Supervisor a suitable location for starting excavation. If location for excavation is moved, then start again from step 1.
- 5) The tarmac will be saw-cut using floor saw and broken out using a 6t excavator with hydraulic breaker attachment. Where this is not possible, a hand-held breaker will be used.



- 6) The 300mm mass concrete sub-base will be broken out by using the excavator. A banksman will be in attendance at all times whilst plant is in operation. Where this is not possible, a hand-held breaker will be used by the operatives.
- 7) In the case that human remains are found or suspected to exist in the initial excavation, all works will be stopped and the archaeology subcontractor will be called on-site. Works only to recommence after the VCUK Site Supervisor has given authorisation.
- 8) The works on the archaeological pits will stop at a maximum of 500mm depth.
- 9) The utilities excavations will continue past this depth of 500mm and be re-scanned by a trained subcontractor operative with a CAT and signal generator for every 500mm of excavation depth to reconfirm location of services.
- 10) Made ground will be excavated by hand around the services to form trench. No excavation will be undertaken using mechanical excavator within 500mm of known or suspected services.
- 11) Waste material will be transferred to the Liverpool Street compound using a dumper where it will be stored before it is tested and removed by the appointed subcontractor.
- 12) Where an inspection deems the ground unstable, temporary ground support will be installed to an design approved by VCUK. A VCUK Engineer will carry out inspections of all excavations on a daily basis.
- 13) If services further to the ones known are identified, works will stop and refer back to VCUK supervision and management for guidance.

The main hazards arising from these works and their controls include

Hazard: Striking live services

Controls:

- Service records on site
- Permit to penetrate and permit to dig in place
- CAT scan of area prior to and throughout excavation
- Hand dig within 500mm of known or suspected services
- Banksman with excavator at all times

Hazard: Incorrect use of mechanical plant and/or unsuitable equipment causing damage to property

Control:

- Site Briefing and Tool Box Talks will be given to all personnel.
- Supervision at all times.
- Plant Certification, Trained Operatives (CPCS)
- Use of banksmen, traffic marshals, traffic management.

### **Works element 2b) Excavation for LU-affected areas**

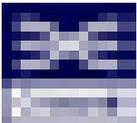
**No mechanical excavation will be undertaken within 6m of known LU assets.**

- 1) The areas where LU assets are located and clearly shown on the LU SED drawing attached in Appendix 3. On the same drawing, 'restricted areas' are marked in light red colour that requires LU approval prior to commencing work activities in these areas. Works in and around LU infrastructure will be undertaken as per the LU Infrastructure Protection Plan and LU WPP. Works classed as LUL Interface Trenches will be undertaken as per the Appendix C of the LU Streetworks Assessment Report for Utilities Diversions. The proposed arrangements have been incorporated in the points below.
- 2) LU assets include the LU tunnels (Metropolitan and Circle lines) on Blomfield Street and Old Broad Street; the QVT; the LU substation and the LU ticket hall in Old Broad Street.



Any works which could 'potentially impact' LU infrastructure will be agreed/approved by LU before any works commence.

- 3) Permit to penetrate (VCUK) and permit to dig (sub-contractor) need to be in place and checked by the VCUK Supervisor.
- 4) Works to trenches which are indicated as 'LUL Interface' trenches (i.e. within 3.0m of LU assets) shall only be undertaken with the attendance of the LU inspector. No works shall commence or continue in the absence of the LU Inspector except for carriageway reinstatement, or with the express permission to carry out works from LU.
- 5) In the event of an emergency the LU Inspector will be the first point of contact on site for VCUK and their Subcontractor and co-ordination between the site works and LU. If the LU Inspector is not available at the time, a competent person i.e. VCUK Supervisor (VCUK Emergency Controller as per C503 Emergency Preparedness Plan) will take control of the event.
- 6) Prior the ground being broken the excavation area will be scanned by a trained subcontractor operative with a CAT and signal generator and checked against the Permit to Penetrate. Existing service records will be cross-checked.
- 7) Services detected will be marked on the surface using line spray within and 2m beyond the footprint of the area to be excavated wherever possible.
- 8) Based on the marked utilities and location of LU assets agree with the VCUK Supervisor a suitable location for starting excavation. If location for excavation is moved, then start again from step 1.
- 9) The carriageway surface breakout method shall be as per the following conditions:
  - Within and up to 3.0m plan distance of the edge of a LU asset (tunnel), the breakout method shall be limited to use of hand-held heavy duty road breaker type equipment.
  - From 3.0m to 5.0m plan distance from the edge of a LU asset (tunnel), the breakout method shall be limited to a 3-ton mini-excavator with breaker attachment.
  - Beyond 5.0m distance from the edge of a LU asset (tunnel), the breakout method shall be by normal and appropriate means. This includes where assets are greater than 5.0m deep below the bottom of the trench excavations but may be within 5.0m plan distance.
  - In all instances, the breakout method shall take in to account all other considerations specific to the location.
- 10) The tarmac will be saw-cut using a floor saw and broken out using a a hand-held breaker.
- 11) The 300mm mass concrete sub-base will then be broken out using a hand-held pneumatic breaker or otherwise as described above.
- 12) In the case that human remains are found or suspected to exist in the initial excavation, all works will be stopped and the archaeology subcontractor will be called on-site. Works only to recommence after the VCUK Site Supervisor has given authorisation.
- 13) The works on the archaeological pits will stop at a maximum of 500mm depth.
- 14) The utilities excavations will continue past this depth of 500mm and be re-scanned by a trained subcontractor operative with a CAT and signal generator for every 500mm of excavation depth to reconfirm location of services.
- 15) Made ground will be excavated by hand around the services to form trench. Where a suspected LU asset is encountered during excavation, operatives will cease work and seek further instruction from VCUK Supervisor.
- 16) Where unexpected concrete obstructions are located within the trench, these shall not be broken out. Where the excavation works cannot proceed as a result of such obstacles, the works will cease. All such obstacles will be recorded and reported and works are not to proceed until the obstacle function is known and relevant parties agree upon the removal, or an agreed diverted route agreed.



- 17) The excavation depth shall not extend to reveal the waterproofing membrane to a LU tunnel or other structure. Excavation shall cease at approximately 100mm depth above the expected depth of the structure. Excavations, if necessary, shall continue by hand below this depth with agreement of the LU Inspector.
- 18) If, in the unlikely event the waterproofing membrane is revealed and penetrated or damaged, this will be suitably sealed with a waterproof bitumen sealer before the trench is reinstated.
- 19) Any such repairs will be completed to the satisfaction of the LU Inspector.
- 20) Waste material will be transferred to the Liverpool Street compound using a dumper where it will be stored before it is removed by the appointed subcontractor.
- 21) Where an inspection deems the ground unstable, temporary ground support will be installed to a design approved by VCUK. A VCUK Engineer will carry out inspections of all excavations on a daily basis.
- 22) If services further to the ones known are identified, works will stop and refer back to VCUK supervision and management for guidance.

The main hazards arising from these works and their controls are described in works element 1 above and in full in the Risk Assessment in Appendix 2. However, additional risks for this element include:

Hazard: Damage to LU assets

Controls:

- Service and LU records on site
- Permit to penetrate and permit to dig in place
- Marking out of known LU assets in area prior to excavation
- Hand dig within 6m of known LU assets

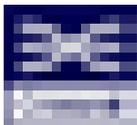
Hazard: Exposure to high levels of vibration causing serious injury including Hand Arm Vibration

Controls:

- Avoid use of hand-held breakers when possible
- Ensure that hand held tools are vibration dampened, regularly serviced and maintained.
- Minimise exposure to individual operatives by rotating the workforce and keeping an HAVS register

### **Works element 3) Duct Installation**

- 1) Pipe bedding, ducts and other materials will be delivered to and stored in the Liverpool Street site compound. If the storing area is far from the working site, a dumper will be used to handle the material. Manual handling of the ducts, considered to be long load, will require 2no operatives minimum to carry with a banksman leading the group.
- 2) Pipe bedding will be laid to a minimum of 100mm in the base of the trench in line with the HAUC specification or Utility specification if different. Material will be installed using an excavator wherever possible, pouring into the trench from the bucket. No operatives will be permitted within 2m of this activity within the trench, controlled by the banksman.
- 3) The bedding material will be manually spread and levelled by the operatives using a shovel.
- 4) Ducts will be laid in the trench in required configuration and joined together as necessary using dry joints generally but if chemicals are required to be used, the COSHH sheets will be checked and approved by VCUK prior to works. Ducts will be



installed to within 1m of any live manholes. No works will be undertaken on live cables or manholes without prior authorisation from the utility provider. If work is to proceed on these, an additional approved Method Statement and/or Risk Assessment for the works will be in place.

- 5) Pull-cord will be threaded through each duct to ensure utility companies are able to pull cables through at a later stage.

Hazard: Installation of the bedding material into trench

Controls:

- Banksman to be in attendance at all times when placing the material and will ensure that no person comes within 2m of the works and that no lifting operations take place over people on site.

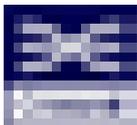
Hazard: Manual handling of the bedding material and the ducts

Controls:

- Avoid manual handling where possible and use mechanical aids (e.g. excavator to lay bedding material)
- Conduct specific manual handling assessment for each occasion identifying any additional PPE required
- Method Statement briefing, Toolbox talks, Supervision

#### **Works element 4) Reinstatement of highway**

- 1) Trench will be backfilled around ducts with bed and surround material in accordance with HAUC specification or Utility specification if different. This will be done using an excavator bucket to pour in material and moved around and compacted by hand using a shovel.
- 2) The remainder of the trench will be backfilled with granular fill, compacted in accordance with the specification for highway works, using a hand-held compactor ("wacker plate").
- 3) Marker tape will be installed in the backfill about 300mm above the ducts and a text on the tape will identify the type of service below.
- 4) For carriageways, mass concrete sub-base will be cast as per City of London's highway reinstatement specification (300mm depth for tarmac carriageway, 150mm for granite sett carriageway). For footways, sub-base will be installed as per the City of London's highway specification. Concrete will be transported to the site using a concrete truck when the pour will be sufficiently large and if there is space available for the truck on site. Due to space limitations, concrete will need to be mixed on site when small quantities of concrete are required and will be transferred from the main site compound to the remote worksites by using the dumper accompanied by a banksman. Mixing of concrete works will be covered by a separate approved MS which will be in place prior to any mixing of concrete on site.
- 5) Road surface will be reinstated as per the City of London's highway reinstatement specification (wearing course 50mm deep or granite setts for carriageways; wearing course 25mm deep or yorkstone pavers for footways). Tarmac will be delivered to the site compound using a tipper truck, then will be moved around the site manually for small quantities and using a JCB Airmaster or similar for large quantities; and hand-held rollers will be used to compact it.
- 6) Road markings will be reinstated as required to replicate existing. This will be done temporarily by hand using line marking paint. This will be replaced with permanent marking when it is required for a substantial area by a specialised sub-contractor and will be covered by a separate approved MS.



Hazard: During mixing and placing of concrete; and placing of tarmac – use of incorrect procedures causing serious injury including concrete burns, burns or blindness

Controls:

- Only trained and competent operatives to place/work with concrete and tarmac
- Task specific PPE: gauntlets, overalls, long sleeves, goggles, Wellington boots for concrete works, specialist boots for tarmac laying works to be used

Hazard: Vehicle movements around site

Controls:

- All unnecessary personnel to be excluded from the area with barriers
- A person will be stationed to direct unnecessary personnel away from the operations
- Safety and traffic management signage will be in place
- A banksman will be on site all the time

Hazard: Spillage of concrete on the highway during transport of material with dumper

Controls:

- The dumper will only be partly filled
- The banksman accompanying the dumper will be aware of the concrete spillage risk and should inform the site supervisor if there is any spillage in order to have the highway cleaned
- Whenever possible, concrete to be delivered directly into satellite site

Hazard: Exposure to high levels of vibration causing serious injury including Hand Arm Vibration

Controls:

- Avoid use of hand-held breakers when possible
- Ensure that hand held tools are vibration dampened, regularly serviced and maintained.
- Minimise exposure to individual operatives by rotating the workforce and keeping an HAVS register

### **Other Routine Arrangements**

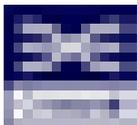
The worksites will be maintained clean, tidy and in good condition at all times. Materials and waste will be stacked tidily with power leads and cables kept tidy to prevent trips.

During the course of the works site operatives will give full consideration to the Health & Safety of all 3<sup>rd</sup> parties working on or adjacent to the work location. The work site will be kept in an orderly state to avoid endangering any such person.

Upon completion of the work, at the end of each shift the Site Supervisor shall inspect the worksite to ensure that it is left in a clean and tidy condition, all plant and equipment shall be removed and any waste materials will be either stored or taken off site. A road sweeper will be available if required to clean the site compound and highway.

For any period that works will not be taking place in any of the remote worksites, all plant will be removed and the site boundaries will be secured to prevent unauthorised access.

For LU-affected sites, the LU inspector will attend weekly LU liaison meetings and can regularly liaise with the VCUK Supervisor to attend works on-site. The LU inspector will make himself known to the VCUK Supervisor prior to entering the site.



## Closing Actions

- Sign out from site
- VCUK engineer will take as-built records information prior to backfilling
- ITP check sheets will be signed by relevant parties at each stage
- Any anomalies will be reported to relevant authority e.g. CoL or Utilities companies
- CoL to accept road back into use

### 1.3 Programme

The works are programmed to be undertaken from the start of September 2011 until early January 2012.

Hours of working are:

Monday - Friday: 08:00 – 18:00 hours  
 Saturday: 08:00 – 13:00 hours

Some work will take place outside of these hours and they will be subject to confirmation.

The first deliveries relating to these works are planned to arrive to site on 31<sup>st</sup> August 2011.

For the initial phases of the works the following outline is supplied:

Period	Activities
September	Works in Blomfield Street, Eldon Street and Liverpool Street
October	Works in Blomfield Street, Eldon Street, New Broad Street and Liverpool Street
November	Works in New Broad Street, Old Broad Street, Sun Street and Liverpool Street
December	Utility connections in Blomfield Street, Eldon Street, New Broad Street, Old Broad Street, Sun Street and Liverpool Street

### 1.4 Access and egress / Signing In Procedure

All personnel must be signed in and out, appropriate to when they are on site.

No-one is to pass into or out of the site boundary without doing this, as it may present an unnecessary search and rescue operation having to take place.

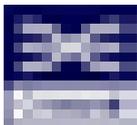
Control of access / egress will be effected by the installation of a Crossrail approved electronic access control system. This is supplemented by the use of biometric readers at all access points, and card swipe readers at all egress points to site in conjunction with site issued passes. Passes will be issued to and carried by all persons, according to the purpose of their presence on site.

Where access cannot be controlled by the electronic access control system, such as the satellite sites, passes will be shown to an identified authorised person when entering or leaving the site and their details recorded on the signing in / out log.

Any changes will be notified by the VCUK Site Supervisor at the start of the shift.

### 1.5 Work permits – licenses – other plans required

The following permits, licenses and other plans will be required as part of works covered under this method statement and will need to have been approved as defined on each VCUK standard



permit / license / plan format. An outline of what is required is supplied here, please check with the VCUK Supervisor if in doubt:

Non-LU Hot Works Permit	✓	Non-LU Permit to Penetrate	✓	Non-LU Permit to Enter Confined Space	N/A
Non-LU Permit to Load & Unload	N/A	Non-LU Drill & Fix Permits	N/A	LU Access Permits (LONO)	✓
Non-LU Lifting Plan	✓	Non-LU Storage Licenses	✓	Non-LU Utility Provider Permits	✓
Non-LU Traffic Approvals	✓	Consents (incl. Section 61)	✓	Other	N/A

### 1.6 Temporary Works

Element	Status	Notes for sub-contractors
Excavations – ground support	To be designed and installed	A temporary works design will be produced where the excavation and ground conditions require one. The design will be approved by VCUK Temporary Works Coordinator.
Excavations – support of exposed utilities	To be designed and installed	A temporary works design will be produced where utilities are exposed and need to remain in place and uninterrupted. The design will be approved by VCUK Temporary Works Coordinator and Utilities
Remote sites establishment – stability of heras fencing	To be designed and installed	A stability check needs to be undertaken for the heras fence with acoustic blankets attached to it. A temporary works design will be produced if required. The design will be approved by VCUK Temporary Works Coordinator.

The items of temporary works for installation or alteration are further described below and drawings and supporting information will be included in Appendix 5 and copies will be available on-site.

Ground support – timber ground retaining structure  
 Utilities support – bulk timber spanning across excavation

The temporary works design is currently under development. **Excavation works will not proceed past the point where any temporary works are required until an approved temporary works design is in place.**

All temporary works shall be installed/modified/maintained in line with the VCUK Temporary Works Procedure for the project. In addition to daily checks by the sub-contractor, Temporary works will be recorded on the temporary works register and inspected at a minimum on a weekly basis. Inspections will be undertaken and recorded by the Temporary Works Supervisor or Co-ordinator. Additionally all site supervisors will inspect the work area prior to the start of work near temporary works.



## 1.7 Key Operational risks and control measures

Key messages to supervision and workforce as part of method statement briefing, refer to RA for full assessments:

**Hazard:** Damage to LU assets from plant or tools

**Control:** hand dig only within 6m of LU assets

LU Supervisor on site to discuss works and mark out location of LU assets

MS approved by LU

**Hazard:** Services struck by errant vehicle causing loss of services function, explosion, fire

**Control:** Traffic management measures will be put in place prior to commencement of works

Signage will be provided to ensure pedestrians and vehicles are clear on diverted routes.

**Hazard:** Spillage of concrete on highway causing pollution and damage to highway and vehicles

**Control:** The dumper will only be partly filled

The banksman accompanying the dumper will be aware of the concrete spillage risk and should inform the site supervisor if there is any spillage in order to have the highway cleaned.

## 1.8 Key Health and Safety risks and control measures

Key messages to supervision and workforce as part of method statement briefing, refer to RA for full assessments:

**Hazard:** Striking live services causing serious injury or fatality

**Control:** Service records on site

Permit to penetrate and permit to dig in place

CAT scan of area prior to excavation

Hand dig around known or suspected services

Use of insulated tools

Good supervision

Visibly mark services on ground

**Hazard:** Exposure to high levels of vibration causing serious injury including Hand Arm Vibration

**Control:** Avoid use of hand-held breakers when possible

Ensure that hand held tools are vibration dampened, regularly serviced and maintained.

Use shock resistant gloves

Minimise exposure to individual operatives by rotating the workforce and keeping an HAVS register

**Hazard:** Flying debris produced during breaking the ground works causing serious injury or blindness

**Control:** Exclusion zones will be put in place to protect operatives from flying debris during breaking operations.

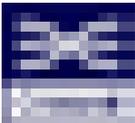
Acoustic blankets on heras fence.

Operatives taking part in the breaking operations will need to wear impact resistant goggles.

**Hazard:** Accident or incident involving site operatives working alone

**Control:** During the works operatives will not be permitted to work alone.

All gangs to ensure no member of the team is left working at end of shift or at break times



**Hazard:** Operatives struck by moving plant causing serious injury or fatality

**Control:** All unnecessary personnel to be excluded from the area with barriers, segregation of plant and pedestrians

A person will be stationed to direct unnecessary personnel away from the operations

Safety and traffic management signage will be in place

A banksman will be on site all the time

## **2. OPERATIONAL ISSUES**

### **2.1 Effects on operational utilities and road networks and other transport systems**

The works will have an effect on the operational road network on Eldon Street, Blomfield Street, Old Broad Street, New Broad Street and Finsbury Circus. A traffic management plan will be put in place prior the start of the works which will include where necessary diversions of buses and lane closures.

It is not envisaged that the works covered by this Method Statement will have an effect on operational utilities or other transport systems.

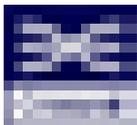
Access to all the buildings will be maintained at all times, unless a specific agreement is in place with the building owner. No building access will be restricted without the approval of VCUK Management.

Some temporary footpath closures may be required and they will be done in line with the agreed TM scheme installed by a specialised TM contractor. This work is not covered by this MS.

### **2.2 Protection / Disconnection / Alteration of Utilities / LU operational assets**

The following Utility / LU assets have been identified as being in the vicinity and require protection, disconnection or alteration as a result of the works covered by this method statement, and the following must be observed:

- Exposed utilities - will be protected and supported throughout the works using appropriate temporary works that the sub-contractor (TBC) will put in place. The temporary works design will be approved by the VCUK Temporary Works Coordinator.
- LU assets include the LU tunnels (Metropolitan and Circle lines) on Blomfield Street and Old Broad Street; the QVT; the LU substation and the LU ticket hall in Old Broad Street. LU assets in the proximity of the works are shown in the drawing attached in Appendix 3. The works related to LU assets will be discussed with an LU Inspector prior to the works start. A standard set of drawings will be reviewed with LU for the project prior to the permit composition to check that they are correct. All LU assets will be included on the permits to dig for the works. The LU tunnels will be marked up on site and no work will be undertaken within 6m without approval from the VCUK Site Supervisor. Trenches will be dug using hand tools only in these areas to firmly establish the location of the LU assets. No assets will be exposed unnecessarily and LU will be able to view the reinstatement or photos taken of the process.



### **3. LABOUR FORCE AND COMPETENCY**

The workforce and required competency envisaged for this section of work shall be structured but not limited to, the following, in addition to the training in section 4:

Sub-contractor	Trade	Competency	Number of each
TBC	Operative	CSCS qualification	3
TBC	Operative	CSCS qualification, NRSWA operative trained	1
TBC	Supervisor	CSCS qualification, NRSWA supervisor trained, First Aider, SSSTS	1
TBC	CAT scanning	CSCS qualification, NRSWA supervisor trained	1
TBC	Excavations checker	CSCS qualification, SMSTS	1
TBC	Temporary Works checker	CSCS qualification, SMSTS	1
TBC	Excavator operator	CPCS	1
VCUK	Site Supervision	CSCS qualification, NRSWA, SSSTS	1

This list is not exhaustive and must be checked by supervisors prior to any person starting work.

### **4. TRAINING**

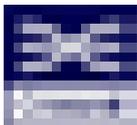
Requirement 1) Everyone working on the Vinci Construction site will be a minimum CSCS trained and carry their CSCS card at all times. All operatives will receive a formal Vinci safety induction presentation and briefing covering Vinci's Safety and Site Rules before commencing work on site.

Requirement 2) All site supervisors must have successfully completed an SSSTS course in line with Crossrail's requirements.

Requirement 3) On site instruction: Prior to works commencing, the supervisor will brief all operatives on the content of the method statement and associated documentation.

Requirement 4) Tool box talks will be given weekly by the sub-contractor supervisor, the following particular toolbox talks are relevant for these works:

- Abrasive wheels
- Archaeology
- Banksmen and Slings
- Cement
- Dust and Air
- Eye protection



- Good neighbour
- Hand tools
- Manual handling
- Material handling
- Noise and Vibration
- Plant washing down
- Segregation of waste
- Supervisors
- Temporary road works
- Understanding disability and access issues
- You and The Health and Safety at Work Act

This list is not exhaustive and further training may be identified during the lifecycle of the works.

## **5. PLANT, EQUIPMENT, MATERIALS AND PORTABLE TOOLS**

All Plant, Equipment, Materials and Portable Tools will be provided, checked, and maintained in line with PUWER, LOLER and any other regulation requirements specific to the equipment being used. The sub-contractors (as *The Employer*) have the duty to provide these items, observe the regulations, and provide sufficient evidence to VCUK that this process is being carried out correctly. Where VCUK provides these items, the same system will be adopted by VCUK staff.

### **5.1 Plant**

1 no 6t excavator fitted with hydraulic breaker attachment will be used to break up the concrete.

A floor saw and/or circular saw will be used to cut the tarmac surface prior to breaking up and excavating.

A 3t dumper will be used to move waste and equipment between the satellite site and the main compound, and within the sites.

A JCB Airmaster or similar will be used to move tarmac around the site when deemed necessary.

Vibratory roller and whacker plate will be used for the reinstatement of the ground.

All tools and plant will be checked for damage prior to use and any defective items will be removed from site and quarantined. No item of plant or equipment will be used without the required certificates being in place and checked.

Any item of plant will only be operated by suitably trained and qualified operators.

The excavator and dumper truck will be delivered to the Liverpool Street worksite and escorted by a banksman around to the area where the trenches are required. The dumper which will be road legal, may move between sites without the need for a banksman when not doing works. The machines will have a flashing beacon activated whilst on the public highway.



Excavation of the ground and reinstatement of the highway will require plant to operate without segregation from all personnel, the following control measures are therefore required:

- All unnecessary personnel to be excluded from the working area and directed away from the fenced off site
- A dedicated operative will be stationed to direct unnecessary personnel away from the operations
- Safety and traffic management signage will be in place
- A banksman will be in supervision all the time when plant is being operated.

## 5.2 Fuel handling / Storage

Fuel will be stored in the Liverpool Street main site compound in a dedicated area as per the COSHH regulations. Refuelling will only take place in a dedicated area where drip trays and spill kits will be in place.

## 5.3 Materials / Storage

Materials involved:

- Ducts and pipes (lengths and bends etc)
- Pipe bed and surround material
- Granular Fill
- Concrete
- Road Surfacing Materials

Deliveries of materials will be by Hiab lorry or flatbed truck to the Liverpool St worksite. Materials will then be transported to the satellite worksite by hand/dumper truck/tipper truck. All deliveries will be booked in with the Crossrail VMBS (Vehicle Movement Booking System). On their way to site, all lorries will follow the prescribed routes in accordance with Crossrail Lorry Routes attached in Appendix 3.

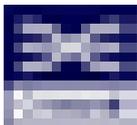
Concrete will be transported to the site using a concrete truck when the pour is sufficiently large. Due to space limitations, concrete may need to be mixed on site when small quantities are required and then transferred from the main site compound to the remote worksites using a dumper.

Tarmac will be delivered on site using a tipper wagon and will be moved around the site either manually or using a JCB Airmaster or similar. Rollers will be used to spread and compact the material.

## 5.4 Temporary power and lighting

The Liverpool Street worksite has temporary power supply provided by a 70 kVa generator. Within the satellite sites, power will be provided by mobile generators and will provide 110V supplies and compressors for pneumatic tools. No modifications to these installations will be undertaken unless by qualified and competent electricians.

Some works will take place outside of daylight hours. When night working is required task lighting will be provided, ensuring that surrounding vehicles and buildings are not adversely



affected. This will be done using generator-powered light units and the installation of these will be checked with the VCUK Supervisor prior to switching on.

### 5.5 Portable tools and equipment

Equipment without a valid calibration certificate shall not be used. All power tools and extension leads must be tested, certificated and comply with PUWER regulations.

Necessary tools and equipment for the works may include but are not limited to:

- Hand tools
- Pneumatic hand-held breaker and compressor
- Portable generator

Hand tools will be insulated. All tools will be inspected prior to use and any defective items will be removed from service and from site.

Note: No pick-axes are to be used in these works.

### 5.6 Access towers, platforms and scaffolding

Access towers, platforms and scaffolding are not envisaged to be used for these works.

## **6. LIFTING OPERATIONS**

All lifting operations will be carried out in accordance with LOLER and VCUK Lifting Procedures.

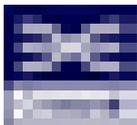
Lifting operation	Method	Lift Plan
Deliveries / Collections	Dependent on delivery type. All deliveries to be authorised by VCUK Supervision before commencing.	Low risk – completed by delivery company and must be available for VCUK checking A generic Lift Plan will be put in place which will be amended as per occasion
Lifting of excavated trench temporary works	The excavator will be used with certificates in place for excavator and lifting equipment.	Lift plan required, by sub-contractor Appointed Person and checked by VCUK Appointed person: Matt Houston

## **7. HEALTH & SAFETY – Routine Precautions**

### 7.1 COSHH

All COSHH substances will be procured, stored and used in accordance with the COSHH regulations.

COSHH substances will be co-ordinated on site by the sub-contractors authorised person: TBC and advised to the VCUK COSHH Co-ordinator Radim Prochazka.



COSHH substances likely to be used for the works are:

- Diesel and Petrol Fuel
- Ready Mix concrete
- Hand mix concrete
- Machine greases
- Tarmac (bituminous coated road materials)
- Line marking paint

Safety data sheets, and COSHH assessments are provided where available in Appendix 6, but as a minimum must be reviewed by the VCUK COSHH co-ordinator separately, and kept in the site file. Where COSHH assessments are required for the operations which were not planned at the time of this MS being compiled, the MS/RA must be reviewed by the sub-contractor and VCUK supervisor, to check no changes are required. Additional COSHH sheets will be produced and approved prior to works taking place.

Lead paint: if any surfaces are excavated which are suspected of containing lead paint, the works will cease and advice sought from VCUK Supervisor.

## 7.2 Asbestos

It is not envisaged that any asbestos exists in the ground where works are planned to take place. If asbestos is found or suspected to be found on-site, works will immediately stop, the site will be fenced off and cleared of all personnel. The VCUK Health and Safety Manager and VCUK Supervisor and Production Manager will need to be made aware immediately. Operatives may return to site only following instruction from VCUK Supervisor or Health and Safety Manager.

## 7.3 Excavations

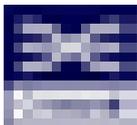
- No excavation is to take place without a permit to penetrate being in place
- No excavations without appropriate access and edge protection
- All excavations require an assessment of temporary works requirements to take place, based on the ground conditions. This can be authorised by any of the VCUK chartered civil engineers.
- Potential for confined space hazards to be examined by competent person
- All excavations to be checked daily by sub-contractor's appointed person and VCUK Supervisor, and recorded
- Any defects to be immediately rectified

Excavations required during this operation include:

- Trenches for the laying of utilities ducts in Blomfield Street, Eldon Street, New Broad Street, Old Broad Street and Liverpool Street – approximately 400m in length; width will vary.

## 7.4 Manual Handling

Manual handling should always be avoided by the use of mechanical means wherever reasonably practicable.



Personnel to be briefed on Manual Handling during toolbox talks and safety briefings. For any manual handling to take place, the person doing the manual handling, should ensure they have made an assessment of the operation, with the assistance of their supervisor if required. This assessment needs to reflect the nature of the load, where it needs to be handled to, the environment and the individual.

Manual handling will be required for certain tasks, including:

- Transfer of ducts from the storing area to the remote worksites and installation of ducts and bends
- Handling of the bedding material, concrete and tarmac

Guidelines are as follows:

- Teams should ensure manual handling is shared between team members wherever possible to avoid repetitive strains on any individual
- Individuals should not attempt to lift loads that they cannot comfortably lift.
- Individuals should not lift loads which exceed 20kg.
- Individuals should not lift loads which are difficult to handle due to their size or shape.
- Individuals should not lift heavy loads above shoulder height.
- Multiple persons should not lift loads exceeding 20kg between them where the resulting load carried by each person exceeds 20kg.
- Appropriate rests should be taken to minimise strains due to repetitive lifting.

### 7.5 HAVs (Hand arm vibration)

HAV-causing activities to be avoided wherever possible. Use of excavator machine for the works will be the preferred method and use of hand-held breakers will be avoided where possible. When hand-held breakers need to be used, for example near LU assets, suitable equipment will be chosen to minimise the risk of hand arm vibration. A HAV assessment must then be carried out by the sub-contractor, and provided to VCUK, with the aim of choosing the best machinery and limiting exposure to the individual by rotating operatives. Hand checks are required as a minimum for any person using vibrating tools, to be done daily by the subcontractor Supervisor.

Assessment must also be made where operatives ride/sit in plant which is subject to vibration. Further control measures as part of a point of work Risk Assessment may be implemented as deemed necessary by the Site Supervisor.

Sub-contractor and VCUK supervision to monitor daily for compliance as part of STARRT briefing.

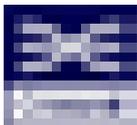
The following vibration activity risks have been identified:

- General minor drilling, cutting, fixing
- Breaking of ground with pneumatic hand held breakers – e.g. above LU assets is mandatory
- Full body vibration caused by excavator breaking ground

### 7.6 Occupational Noise

Mandatory hearing protection zones will be established where noise exposure would otherwise exceed standard levels.

Activities identified as being potentially noisy include:



- Saw cutting of tarmac
- Breaking of ground (especially the concrete sub-base) using excavator or hand-held breakers
- Fill compaction

### 7.7 Welfare facilities

Site welfare is located within the Liverpool Street site compound.

### 7.8 PPE

All PPE must be compliant to the appropriate British Standard. Advice can be sought from the VCUK H&S Manager: Tony Taylor.

The PPE which will be used as standard for works around excavations is:

- Steel toe capped and mid soled laced safety boots
- Hard hat (to comply with Crossrail policy below)
- Orange or Yellow Hi-Vis / Jacket
- Gloves
- Safety glasses
- Fire-retardant overalls

Crossrail hard hat policy is as follows.

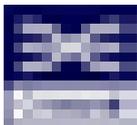
- Blue Hard Hats for Site Personnel
- White Hard Hat for Supervisors
- Orange Hard Hats for Banksman and Traffic Marshalls

In addition the following table outlines PPE which is expected to be worn for the following operations. As operations proceed the requirement for additional PPE must be reviewed, and the compatibility of PPE must be included in this review.

Operation	PPE	Notes
Concreting	Gauntlets Wellington boots Overalls Long sleeves Goggles	Mainly provide protection against burns during laying of concrete
Laying of tarmac	Gauntlets Safety boots Overalls Long sleeves Goggles	Mainly provide protection against burns during laying of tarmac
Breaking of ground	Shock resistant gloves Impact resistant goggles	Reduce risk of HAV and provide protection from flying debris

### 7.9 Safety equipment

Acoustic barriers will be provided to minimise the noise for pedestrians and surrounding businesses.



## 7.10 Signs & Notices

Access to the works will be controlled by VCUK as the Principal Contractor.

Signs and notices will be provided in line with H&S regulations and best practice.

Signage envisaged for these works includes:

- Danger Deep Excavations
- No unauthorised access
- Mandatory PPE – Hard Hat, Boots, Gloves, Eye Protection, Orange or Yellow Hi-visibility vest
- Mandatory hearing protection zones
- Emergency Exit

Site Operatives will adhere to all existing signs and notices

## 7.11 First aid arrangements

First aid facilities will be available on all sites, and the locations displayed on the site notice boards. These will be maintained by VCUK. First Aiders will be identified by a green cross on their helmets and on posters around the site.

All subcontractors must provide suitably trained First Aiders for each of their working groups and a mobile first aid point if operating outside of the semi-permanent site compounds at Liverpool St, Blomfield St and Broad Street avenue.

In the event of any injury (however minor), the first aid book must be completed and the site supervisor notified.

## 7.12 Fire Points

Refer to the fire emergency plan and fire warden poster located on the RAMS board.

Fire points will be located around the site in line with the site Fire Risk assessment.

Fire Points will contain foam & CO<sub>2</sub> fire extinguishers.

A competent person will inspect all fire fighting equipment periodically.

Additional coverage may be provided subject to the conditions of the hot works permit at the time of issue. For example, a hot works permit will be required for the laying of tarmac works.

## 7.13 Inclement weather

In the event of severe weather (i.e. wind/ rain/ snow), the VCUK Site Supervisor will assess the safety/ environmental implications that may arise due to the weather and will advise the VCUK Project Manager and temporarily cease the works if deemed necessary. The VCUK Project Manager will decide on the time period that works need to be ceased and what actions to be taken to secure vulnerable plant, equipment or materials and ensure the safety of all personnel. For example, in the event of high winds, temporarily cease works and remove acoustic blankets from heras fencing panels in order to reduce the wind load acting on the fence and therefore reduce the risk of the panels overturning.



## 7.14 Emergency

In the event of an emergency, operatives are advised to:

- Clear the area
- Raise the alarm
- Notify any of the VCUK site supervisors who will coordinate the emergency services and facilitate first aid if appropriate.

Emergency escape routes and assembly points are indicated on the RAMS board. Any changes to the assembly point will be notified in the STARRT briefing.

In the event of an emergency, the VCUK supervisor will follow the Emergency Preparedness Plan. The emergency contact details for the utility companies will be available in section 7.15 of this document and in Appendix 1 of the Emergency Preparedness Plan. Both documents will be displayed on the project's RAMS board.

In the event of an emergency in an LU-affected area the LU Inspector will be the first point of contact on site for VCUK and their subcontractor. If the LU Inspector is not available at the time, a competent person i.e. VCUK Supervisor (VCUK Emergency Controller as per C503 Emergency Preparedness Plan) will take control of the event.

The supervisor will notify the Vinci Safety Manager/Emergency Controller (Tony Taylor – 07816 517 070 or 02079 474 172) for assistance, who will ensure all incidents are reported on Crossrail's RIVO system.

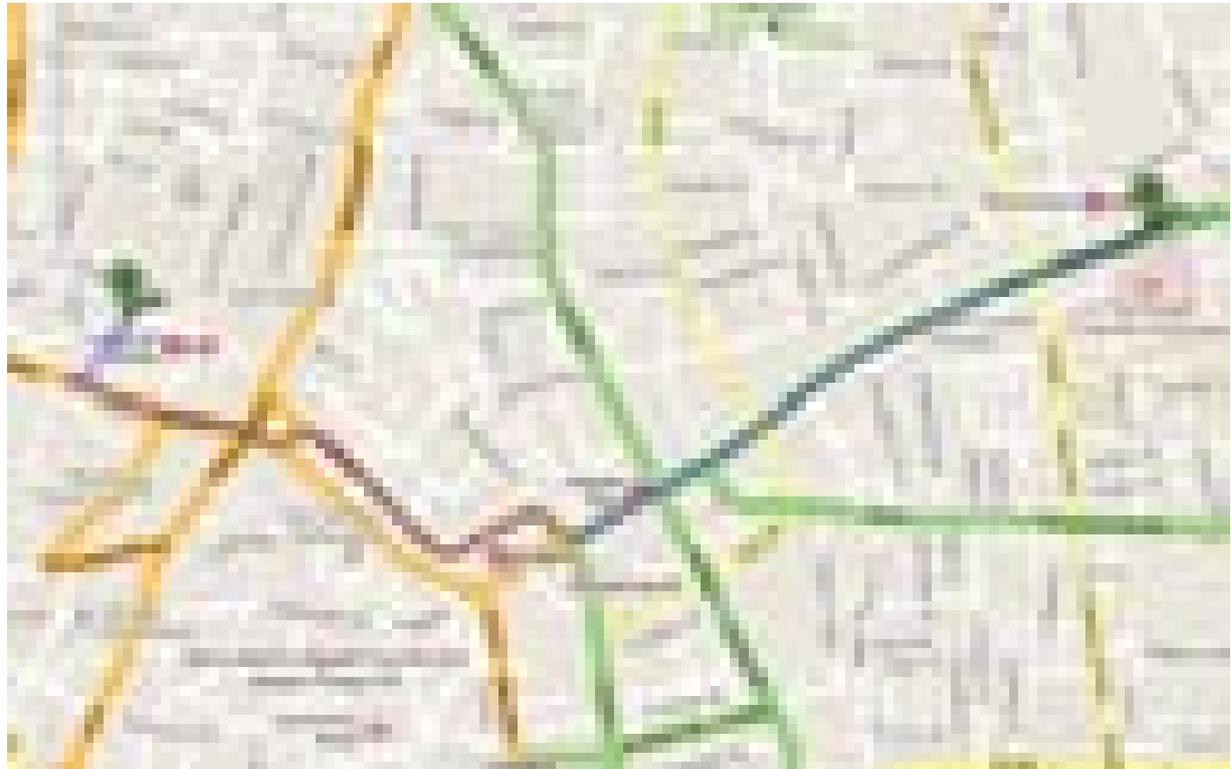
If any accident, incident or dangerous occurrence occurs, all operatives shall remain at the Assembly Point until authorised to leave by the Vinci Site Manager.

Investigations into incidents will be the responsibility of Vinci with the assistance of the site management.

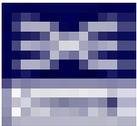


**Directions to Royal London Hospital, Whitechapel**

The nearest A&E Department is the Royal London Hospital, Whitechapel, London, E1 1BB.  
**Telephone: 020 7377 7000**



Distance	Direction	Time
0.1	Turn right onto Whitechapel Road	0:01
0.2	Turn left onto Whitechapel Road	0:02
0.3	Turn right onto Whitechapel Road	0:03
0.4	Turn left onto Whitechapel Road	0:04
0.5	Turn right onto Whitechapel Road	0:05
0.6	Turn left onto Whitechapel Road	0:06
0.7	Turn right onto Whitechapel Road	0:07
0.8	Turn left onto Whitechapel Road	0:08
0.9	Turn right onto Whitechapel Road	0:09
1.0	Turn left onto Whitechapel Road	0:10

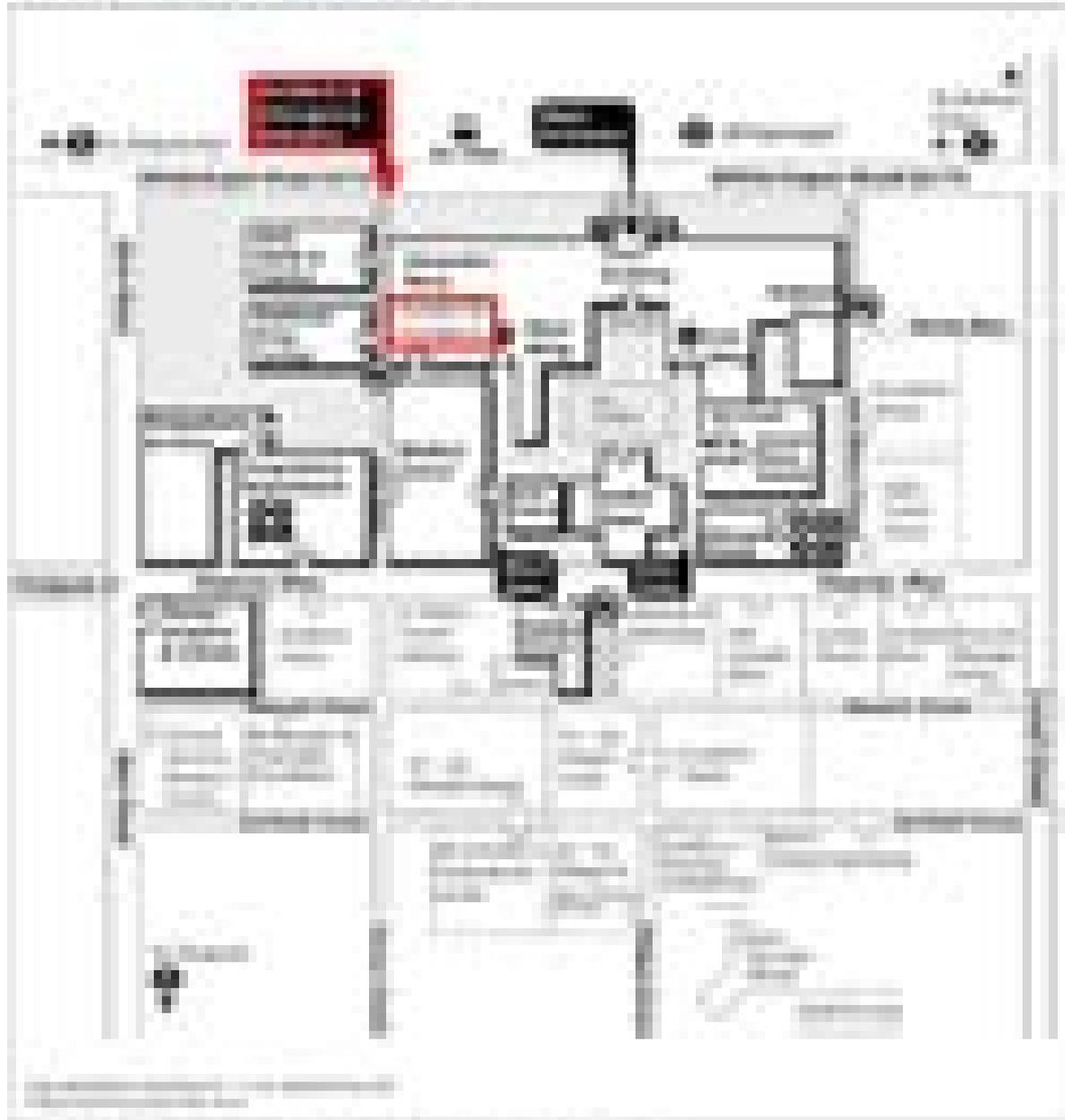


# Getting to The Royal London Hospital

Whitechapel, London E1 1BB

Whitechapel, London E1 1BB

www.vinci-construction.co.uk



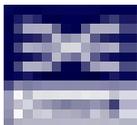
These are general directions of travel and are not intended to be used as a substitute for a detailed map. For more information on the site location, please refer to the site plan. The site is located in Whitechapel, London E1 1BB, and is situated on the corner of Whitechapel Road and Whitechapel Lane. The site is bounded by Whitechapel Road to the north, Whitechapel Lane to the east, and Whitechapel Road to the south. The site is situated in the Whitechapel area of London, which is a major transport hub. The site is located in the Whitechapel area of London, which is a major transport hub. The site is located in the Whitechapel area of London, which is a major transport hub.





### 7.15 Emergency Contacts

Contact	Name (if applicable)	Telephone Number
VCUK H&S Manager & Emergency Manager	Tony Taylor	07816 517 070
VCUK Site Supervisor	Paul Saunderson	07816650209
VCUK Site Supervisor	Mick Groh	07816 650 593
VCUK Environmental Manager	John Dwyer	07884 114 727
VCUK Utilities Manager	Rob Scheele	07816 515 324
VCUK LU Manager	Matt Houston	07816 514 607
VCUK Project Manager	Lucy Penman	07816 515 454
VCUK Warnford Court Office	Chemaine Myers	0207 947 9658
Sub-contractor Supervision	TBC	TBC
Sub-contractor H&S Manager	TBC	TBC
Crossrail Help Desk		0345 602 3813
LU CR	Chris Bainbridge	07739 869 771
Line Controller (LU)	N/A	Auto 905
Hospital with A&E	The Royal London Hospital	0207 377 7000
<b>Utilities Electricity</b>		
EDF London	N/A	0800 028 0247
<b>Utilities Gas</b>		
National Grid Gas / EDF Gas Emergency Services	N/A	0800 111 999
GPSS Pipelines	N/A	01169 712021 Blue 01405 839212 Red
<b>Utilities Fibres</b>		
Virgin Media	N/A	0800 052 0800
Cable & Wireless	N/A	0800 015 4160
Colt	N/A	0845 200 0214
Fujitsu	N/A	0870 242 7998
Verizon	N/A	0207 675 5400
Global Crossing	N/A	0845 000 1000
Abovenet	N/A	0800 169 1646
Fibrenet	N/A	0330 060 7080
<b>Utilities Water</b>		
Thames Water	N/A	0845 920 0800
<b>Utilities BT</b>		
Emergency	N/A	0800 917 3993



## **8. ENVIRONMENTAL PROTECTION**

### **8.1 Waste management**

Sub-contractors will be required to manage all wastes produced.

Wastes expected to be produced in the course of the works include:

- General packaging
- General wastes associated with occupied site – paperwork, kitchen waste, etc.
- Spoil from excavations
- Hazardous waste - residuals from concreting and tarmac laying works; contaminated land if discovered on site

No rubbish and surplus excavated materials arising from the works will be dumped on an area other than a public or private tip controlled or recognised by the Local Authority. Works will be in compliance with legislation including where appropriate the Control of Substances Hazardous to Health Regulations (COSHH) 1988, HSE Guidance Note EH 40/90, Occupational Exposure Limits 1990 and any amendments thereto, governing the removal and controlled tipping of refuse. Where carting away is sub-let, it will require carriers to state the location of their proposed tipping areas and to provide proof that the rubbish has been deposited there.

No stock piling of any excavated spoil material will be permitted within the worksite except with the prior agreement with the VCUK Supervisor. Further requirements for the handling and disposal of contaminated materials are contained in the Waste Management Plan.

Sampling will be undertaken to determine the nature of the material being removed from site.

It is not envisaged that contaminated land exists in the areas of work but due to the proximity of the works to the burial ground discovered in Liverpool Street believed to be approximately 1.5m below ground level, if material believed to be contaminated is encountered (e.g. human remains, strong smelling soil) the following actions will be taken:

- On the identification of contaminated land, stop works in the area and immediately, erect suitable fencing and appropriate safety signs enclosing the contaminated area;
- Ensure no further work is undertaken in the area;
- Install any protective measures to nearby sensitive receptors (water courses, other works etc);
- Notify the Site Supervisor, Production Manager and Environmental Manager;
- Identify measures required to prevent pollution;
- Once the site is secure, carry out testing of the contaminated land to determine the risk to the type of construction work and/or the impact upon the environment;
- Undertake or amend risk assessments, and submit the risk assessments and revised mitigation proposals to for acceptance;
- The type and extent of contamination will be identified and the material classified in accordance with the Waste Acceptance criteria;
- Designated areas will be established so contaminated materials can be separated from clean materials and stored appropriately.

### **8.2 Dust management**

Dust emissions will be monitored to confirm that they remain below the limit specified in Section 61. For the duration of the breaking the ground works, light damping down will take place unless weather conditions allow otherwise i.e. heavy rain removes the need for damping down.



### 8.3 Noise management

Best practicable means as defined in the Section 61 consents and operative noise awareness (no shouting) will be employed to ensure noise levels are kept at reasonable levels.

All people involved in this particular operation should be aware that the standard Section 61 working hours are 8am-6pm Monday to Friday, 8am-1pm Saturday. Work outside of these hours will not take place without a variation to the S61 consent, and the VCUK Supervisor having briefed the team on any conditions.

Noise or vibration levels shall not exceed levels permitted under the Section 61 consent in place for the works. The trigger levels contained therein are to be adhered to at all times, and any case where noise exceeds these levels should be reported immediately. Different noise trigger levels will apply for different time periods with the normal working hours being at 75 dB over a 12hr period. As per the Noise Trigger Action Plan for 100 Liverpool Street document, works taking place in the proximity of the 100 Liverpool street building (Eldon Street, Liverpool Street, Old Broad Street and Blomfield Street.) must not exceed noise level of 79 dB over a 1hr period.

Acoustic blankets will be installed on the heras fencing during the breaking of the ground works in order to reduce the noise levels produced. The noise reduction capability is approximately 15dB at 1m from the blankets.

Ad-hoc noise monitoring will be undertaken throughout the works, in line with the S61 consent in addition to strategic semi-permanent noise monitors.

### 8.4 Vibration management

No significant vibration risks are expected by these works.

### 8.5 Archaeology

There is known archaeology throughout the Liverpool Street area, including human remains and Roman artefacts.

Although the depth of the utility diversions is not anticipated to produce any significant archaeological finds, it should be noted that the area has yielded artefacts at shallow depths. MOLA (Museum of London Archaeology) will be available for a general watching brief and any finds or suspected finds will be highlighted immediately, and works stopped. In particular, if MOLA are not available for any reason, human remains will be covered again.

For the works in Liverpool Street itself and the surrounding area, any excavations where archaeology is expected will have a watching brief. In all other areas operatives should be alert to the potential of encountering archaeological materials and report any occurrences.

For any excavations in potential burial sites, the risk assessment reflects this and requires the following controls:

- Training for operatives on existing conditions and potential finds
- Washing facilities
- Good hygiene regime

### 8.6 Groundwater and surface water runoff

VCUK Supervisors will ensure drains on the sites to be worked on are marked on a drainage plan to be displayed on site. Sub-contractor supervisors to be aware of drainage and ensure:

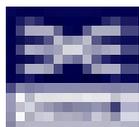


- Discharge into drains is in accordance with best practice
- Discharge volumes do not exceed consent applications

Emergency spill kits will be readily available on site in case of a fuel spillage during the works. Drip trays will be provided for refuelling of mobile plant and for preventing spills on smaller items of plant and equipment.

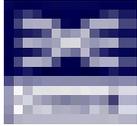
Road gullies will be protected with hessian sandbags from all run-off affected by the works and there will be no discharge to the sewer system without the required consent from Thames Water.

Measures required for concrete wagon wash out include discharging into the site settlement tank or a concrete wash out skip to prevent ground contamination.

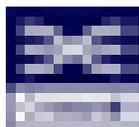


**APPENDIX 1) OPERATIONAL RISK ASSESSMENT (MS Ref: C503-VIN-C-GMS-C101-50010 rev 2.0)**

ACTIVITY	HAZARDOUS EVENT	PERSONS AT RISK	UNCONTROLLED RISK			RISK CONTROL MEASURES	RESIDUAL RISK		
			P	S	Risk		P	S	Risk
Working in close proximity to moving traffic	Services struck by errant vehicle causing loss of services function, explosion, fire, delay to traffic network	Operatives carrying out the works, the public and surrounding properties/businesses	2	5	10	<ul style="list-style-type: none"> <li>- Traffic management measures in place prior to commencement of works</li> <li>- Signage and fencing off of works</li> </ul>	1	5	5
Use of mechanical plant	Incorrect use and/or unsuitable equipment causing damage to property	Property owners and users	2	3	6	<ul style="list-style-type: none"> <li>- Site Briefing, Tool Box Talks, Supervision</li> <li>- Plant Certification, Trained Operatives (CPCS)</li> <li>- Use of banksmen, traffic marshals, traffic management.</li> </ul>	1	3	3
Working around live services	Striking live services causing damage to service provision	Surrounding properties	2	4	8	<ul style="list-style-type: none"> <li>- Service records on site</li> <li>- Permit to penetrate and permit to dig in place</li> <li>- CAT scan of area prior to and throughout excavation by a competent NRSWA trained person</li> <li>- Hand dig within 500mm of known or suspected services</li> <li>- Good supervision</li> <li>- Visibly mark services on ground</li> </ul>	1	4	4
Working above LU assets	Damage to LU assets from plant or tools	LU staff / customers and assets	3	5	15	<ul style="list-style-type: none"> <li>- Hand dig only within 6m of LU assets</li> <li>- LU Supervisor on site to discuss works and mark out location of LU assets</li> <li>- MS approved by LU</li> </ul>	1	5	5
Transfer of concrete from mixing site to remote site	Spillage of concrete on highway causing pollution and damage to highway and vehicles	Public	3	3	9	<ul style="list-style-type: none"> <li>- The dumper will only be partly filled</li> <li>- The banksman accompanying the dumper will be aware of the concrete spillage risk and should inform the site supervisor if there is any spillage in order to have the highway cleaned</li> </ul>	2	3	6

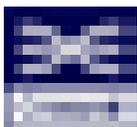


<u>Originator (Subcontractor Engineer)</u>		<u>Signed .....</u>	<u>Date.....</u>
<u>Originator (Subcontractor Manager)</u>		<u>Signed .....</u>	<u>Date.....</u>
<b><u>CHECKED BY</u></b>	<u>Tick</u>		
<u>VCUK Engineer (Low Risk 1 to 4)</u>	<input type="checkbox"/>		
<u>Matt Houston/ Rob Scheele (Medium Risk 5 to 15)</u>	<input type="checkbox"/>	<u>Signed .....</u>	<u>Date.....</u>
<u>Project Manager/H&amp;S Manager (High Risk 20 to 25 )</u>	<input type="checkbox"/>	<u>Signed .....</u>	<u>Date.....</u>

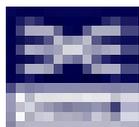


**APPENDIX 2) OPERATIVE AND THIRD PARTY RISK ASSESSMENT (MS Ref: C503-VIN-C-GMS-C101-50010 rev 2.0)**

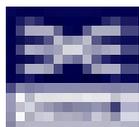
ACTIVITY	HAZARDOUS EVENT	PERSONS AT RISK	UNCONTROLLED RISK			RISK CONTROL MEASURES	RESIDUAL RISK		
			P	S	Risk		P	S	Risk
Lone working	Accident or incident involving site operatives	Operatives	4	5	20	<ul style="list-style-type: none"> <li>- During the works operatives will not be permitted to work alone</li> <li>- All gangs to ensure no member of the team is left working at end of shift or at break times</li> </ul>	2	5	10
Leptospirosis (rats) Psittacosis (pigeons)	Illness caused by the disease	Operatives	2	5	10	<ul style="list-style-type: none"> <li>- Operative briefing</li> <li>- Avoid working in areas of standing water.</li> <li>- Use correct PPE and wash hands and face before eating, drinking or smoking.</li> <li>- Ensure work areas are clear of pigeon waste prior to start</li> </ul>	1	5	5
Slips trips and falls	Injury	Operatives	3	4	12	<ul style="list-style-type: none"> <li>- Good housekeeping</li> <li>- Operatives to remain vigilant</li> </ul>	2	4	8
Working at height	Fall into excavation causing serious injury or fatality	Operatives	2	5	10	<ul style="list-style-type: none"> <li>- Work only to take place where edge protection is in place.</li> <li>- Signage to be in place warning of excavations</li> <li>- Operatives to remain within worksite limits set by PM.</li> </ul>	1	5	5
Excavation	Excavation collapse causing serious injury or fatality	Operatives	3	5	15	<ul style="list-style-type: none"> <li>- Temporary works design will be checked by VCUK Temporary Works Coordinator</li> <li>- Inspections will be carried out by a competent person at the start of every shift and after any event.</li> <li>- Adequate ground support will be installed where required</li> <li>- Visual inspections throughout the shift and recording of excavation and temporary works condition</li> </ul>	1	5	5
Working in close proximity to moving traffic	Operatives struck by errant vehicle causing serious injury or fatality	Operatives	3	5	15	<ul style="list-style-type: none"> <li>- Traffic management measures in place prior to commencement of works</li> <li>- Signage will be provided to ensure pedestrians and vehicles are clear on diverted routes.</li> <li>- Toolbox talks</li> </ul>	1	5	5



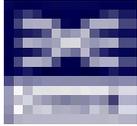
Use of mechanical plant	Incorrect use and/or unsuitable equipment causing serious injury or fatality	Operatives and/or members of public	2	5	10	<ul style="list-style-type: none"> <li>- Site Briefing, Tool Box Talks, Supervision</li> <li>- Plant Certification, Trained Operatives (CPCS)</li> <li>- Use of banksmen, traffic marshals, traffic management.</li> <li>- Additional task specific PPE: shock resistant gloves, impact resistant goggles, ear defenders</li> </ul>	1	5	5
Use of portable tools	Moving parts, incorrect use and/or unsuitable equipment causing: 1. Cuts, nips entanglement, eye injuries to operatives 2. Electrical shock, Electrocutation	Operatives	2	4	8	<ul style="list-style-type: none"> <li>- Use in accordance with manufacturers' instructions</li> <li>- PAT testing procedures, Tool Box talks, Supervision</li> <li>- Use insulated tools</li> </ul>	1	4	4
			2	5	10	<ul style="list-style-type: none"> <li>- Additional task specific PPE: impact resistant goggles</li> </ul>	1	5	5
Unauthorised access to the site	Fall into excavation, struck by plant, slip and trips causing serious injury or fatality	Members of the public	3	5	15	<ul style="list-style-type: none"> <li>- No members of the public will be allowed access to the sites</li> <li>- Fencing and signage in place</li> <li>- Pedestrian exclusion zone will be erected where possible by means of pedestrian barriers.</li> <li>- Pre-route inspection prior to manoeuvring, appointed traffic Marshal to be in place.</li> </ul>	1	5	5
Manual handling	Handling tools and materials with no manual handling assessment in place and insufficient guidance causing serious injury	Operatives	3	4	12	<ul style="list-style-type: none"> <li>- Avoid manual handling where possible and use mechanical aids.</li> <li>- Conduct specific manual handling assessment for each occasion identifying appropriate PPE to be used</li> <li>- Guidance, Toolbox talks, Supervision</li> <li>- Conformance with Manual Handling Operations Regulations</li> </ul>	1	4	4



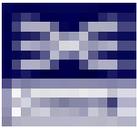
Working around live services	Striking live services causing serious injury or fatality	Operatives	5	5	25	<ul style="list-style-type: none"> <li>- Service records on site</li> <li>- Permit to penetrate and permit to dig in place</li> <li>- CAT scan of area prior to and throughout the excavation works by a competent trained person</li> <li>- Hand dig around known or suspected services</li> <li>- Use of insulated tools</li> <li>- CAT scan as excavation progresses</li> <li>- Good Supervision</li> <li>- Visibly mark services on ground</li> </ul>	2	5	10
Mixing and placing of concrete	Use of incorrect procedures causing serious injury including concrete burns or blindness	Operatives	3	4	12	<ul style="list-style-type: none"> <li>- Only trained and competent operatives to work with concrete</li> <li>- Task specific PPE: gauntlets, Wellington boots, overalls, long sleeves, goggles to be used</li> </ul>	1	4	4
Placing of tarmac	Use of incorrect procedures causing serious injury, burns to the operatives	Operatives	3	4	12	<ul style="list-style-type: none"> <li>- Only trained and competent operatives to work with tarmac</li> <li>- Task specific PPE: gauntlets, Safety boots, overalls, long sleeves, goggles to be used</li> </ul>	1	4	4
Use of hand-held vibration generating tools (i.e. hand-held breakers)	Exposure to high levels of vibration causing serious injury including Hand Arm Vibration	Operatives	5	4	20	<ul style="list-style-type: none"> <li>- Avoid use of hand-held breakers when possible</li> <li>- Ensure that hand held tools are vibration dampened, regularly serviced and maintained.</li> <li>- Minimise exposure to individual operatives by rotating the workforce and keeping an HAVS register</li> </ul>	2	4	8
Breaking the ground works	Flying debris produced causing serious injury or blindness	Operatives and public	5	4	20	<ul style="list-style-type: none"> <li>- Exclusion zones will be put in place to protect operatives from flying debris during breaking operations using heras fencing and debris netting.</li> <li>- Operatives taking part in the breaking operations to wear impact resistant goggles.</li> </ul>	2	4	8
Breaking the ground works	High noise levels produced causing serious injury	Operatives	5	3	15	<ul style="list-style-type: none"> <li>- Operatives taking part in the breaking operations will need to wear appropriate ear protection</li> <li>- Area of works will be established as ear protection zone where ear protection PPE will be mandatory for all people.</li> </ul>	2	3	6



Encounter archaeological materials during excavations	Disease or illness to operatives	Operatives	3	3	9	<ul style="list-style-type: none"> <li>- Training for operatives on existing conditions and potential finds</li> <li>- Washing facilities</li> <li>- Good hygiene regime</li> <li>- Toolbox talks</li> </ul>	1	3	3
Vehicle movements around the site	Operatives struck by moving plant causing serious injury or fatality	Operatives	4	5	20	<ul style="list-style-type: none"> <li>- All unnecessary personnel to be excluded from the area with barriers, segregation of plant and pedestrians</li> <li>- A person will be stationed to direct unnecessary personnel away from the operations</li> <li>- Safety and traffic management signage will be in place</li> <li>- A banksman will be on site all the time</li> </ul>	2	5	10
UXO	Exposure of unexploded ordnance causing serious injury or fatality	Operatives	2	5	10	<ul style="list-style-type: none"> <li>- Operative briefing, Toolbox talks</li> <li>- Evacuate site if UXO found or suspected to be found</li> </ul>	1	5	5
Lifting activities	Use of incorrect procedures causing serious injury	Operatives	4	4	16	<ul style="list-style-type: none"> <li>- Operative briefing, Toolbox talks</li> <li>- Lifting activities to be undertaken as per the specific approved Lifting Plan that will be in place for the works</li> <li>- Plant to be operated by competent people</li> <li>- All unnecessary personnel to be excluded from the area with barriers, segregation of plant and pedestrians</li> </ul>	2	4	8



<u>Originator (Subcontractor Engineer)</u>		<u>Signed .....</u>	<u>Date.....</u>
<u>Originator (Subcontractor Manager)</u>		<u>Signed .....</u>	<u>Date.....</u>
<b><u>CHECKED BY</u></b>	<i>Tick</i>		
<u>VCUK Engineer (Low Risk 1 to 4)</u>	<input type="checkbox"/>		
<u>Matt Houston/ Rob Scheele (Medium Risk 5 to 15)</u>	<input type="checkbox"/>	<u>Signed .....</u>	<u>Date.....</u>
<u>Project Manager/H&amp;S Manager (High Risk 20 to 25 )</u>	<input type="checkbox"/>	<u>Signed .....</u>	<u>Date.....</u>



**Hazard Severity:** The severity of the hazard or potential for harm should be evaluated as below:

Severity Evaluation		
1	Insignificant	First aid injury, slight property damage with minimal cost that is unlikely to impact upon works, insignificant environmental impact contained within site
2	Minor	Short term illness, lost time accident, minor damage to property involving minimal down time, minor environmental impact with no lasting effect
3	Serious	Instance of occupational ill health, over 3 day injury, localised damage to property, environment impact with possible public or media exposure
4	Critical/Severe/Major	Major injury or acute ill health, significant damage to property, major environmental impact involving potential prosecution
5	Catastrophic	Fatality, environmental disaster, collapse or destruction of property

**Hazard Probability :** The probability or likelihood of the hazard occurring should be evaluated using the applicable table provided below.

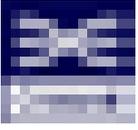
Probability Evaluation		
Score		General
1	Improbable	Expected to occur less than once in project lifecycle
2	Remote	Could occur once in project life cycle
3	Occasional	Could occur once in remit of operations
4	Probable	Could occur more than once in remit of operations
5	Frequent	Likely to occur regularly if controls are not implemented

**Risk Scoring:** The table below provides a matrix linking the Probability or Likelihood of harm occurring and the potential or severity of that harm. The evaluation scores, based upon the allocation of numerical values for these two matters, are calculated in order to provide a risk value or score.

Risk Scoring Matrix		Probability of Occurrence				
		1	2	3	4	5
Severity of Hazard	1	1	2	3	4	5
	2	2	4	6	8	10
	3	3	6	9	12	15
	4	4	8	12	16	20
	5	5	10	15	20	25

Utilising resultant **risk values** or **scores**, risk can be appropriately **ranked** in order to determine **mitigation** or **process requirements**.

Risk Ranking Table		
1 to 4	Low	Suitable attention to standard working procedures required
5 to 16	Medium	Corrective actions, improvement and control measures required
20 to 25	High	Elimination or reduction strategies required

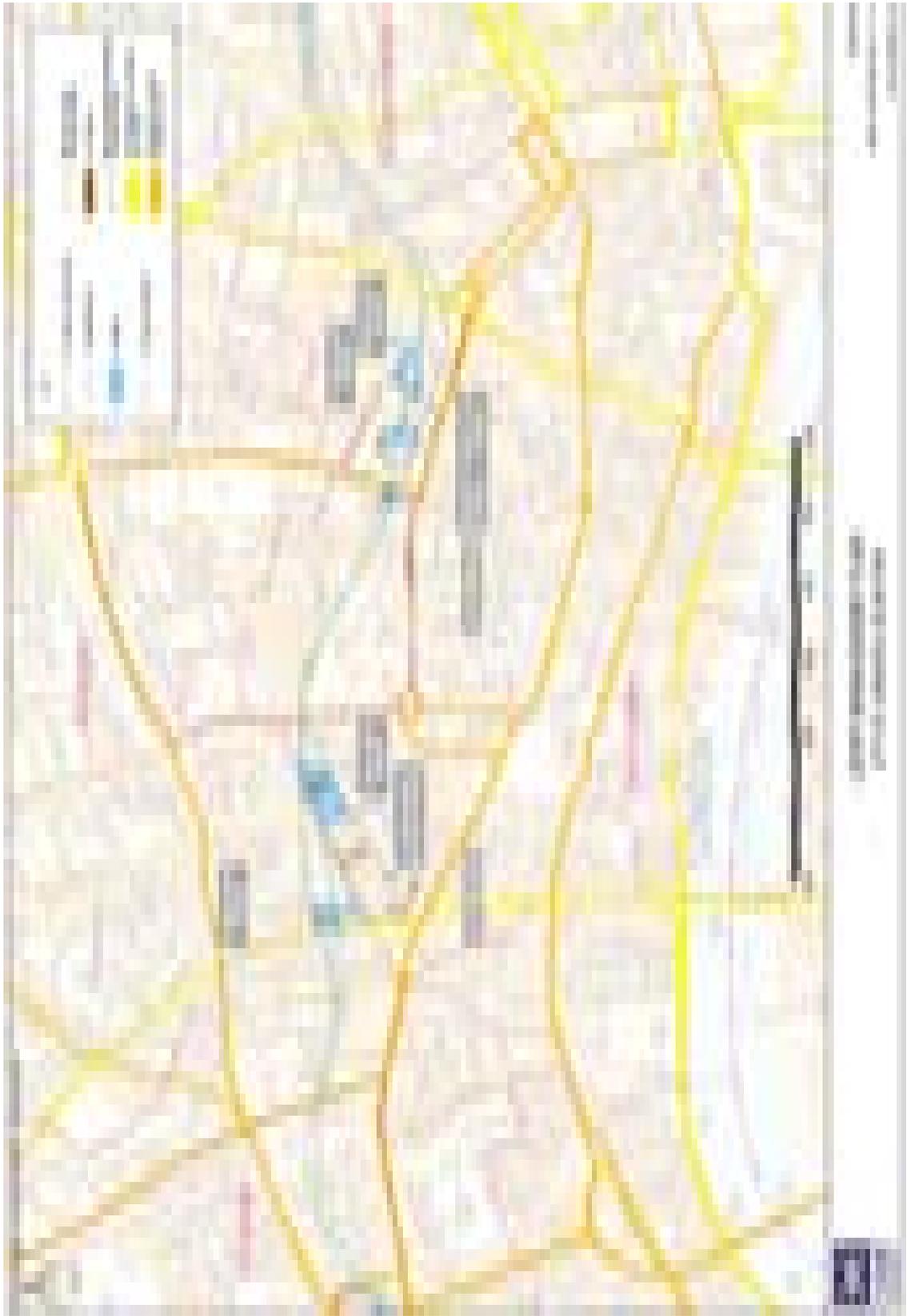
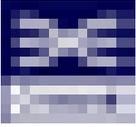


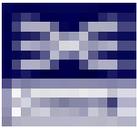
## **APPENDIX 3**

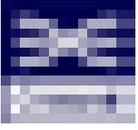
### **Drawings and Sketches**

- Site Boundary drawing
- Crossrail lorry routes drawing
- LU Assets





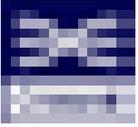




## **APPENDIX 4**

### **Lifting operation plan**

The lifting operation plan is currently under development. Lifting operations will not commence until an approved by VCUK lifting operation plan is in place.



## **APPENDIX 5**

### **Temporary works**

The temporary works design is currently under development. Excavation works will not proceed past the point where any temporary works are required until an approved temporary works design is in place.

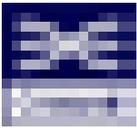
Note: VCUK retain copies of design calculations and design check certificate

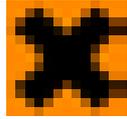
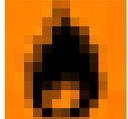
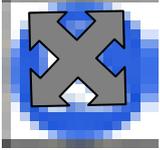
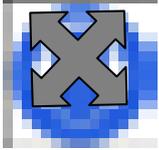
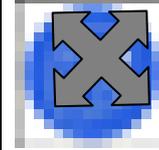
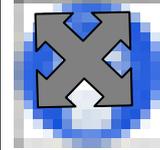
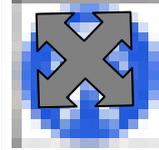


## **APPENDIX 6**

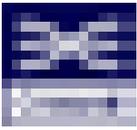
### **COSHH, HAVs, Occupational noise and manual handling assessments**

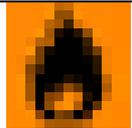
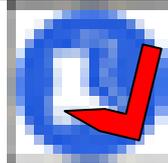
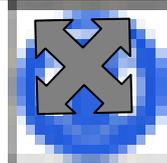
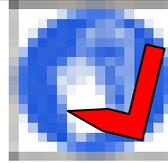
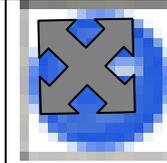
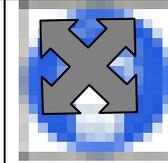
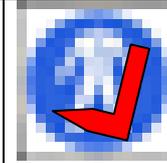
- COSHH sheets available for:
  - Diesel fuel/gas oil
  - Ready Mix concrete
  - Bituminous coated road materials
  - Line marking paint
  - Aggregates
  - Cement and Mortar containing cement
  
- HAVs – subcontractor to provide HAV assessment for all operatives
- Occupational noise – subcontractor to provide occupational noise assessment for all operatives
- Manual handling - subcontractor to provide manual handling assessment for all operatives

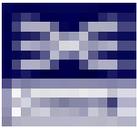


<b>COSHH HAZARD &amp; RISK ASSESSMENT SHEET</b>				<b>No.: 1</b>		
<b>SUBSTANCE/PRODUCT NAME AND DESCRIPTION:</b> <b>DIESEL FUEL/GAS OIL</b> Colour varies according to taxation - odour is typical hydrocarbon.						
<b>HAZARDOUS CONTENT</b>		<b>COMMENTS</b>	<b>CLASSIFICATION</b>			
Hydrocarbon mixture		See EH40 appendix 5 Reduce exposure to as low as reasonably practicable.	 Irritant	 Flammable	Risk Phrase - R45 May Cause Cancer	
<b>HOW IS SUBSTANCE SUPPLIED, USED?</b> Can be supplied in bulk or decanted into 45 gal. drums and smaller containers. Drums should be on a stillage with tap fitted to minimise spillage and contact with the skin. Suitable containers should be used to fill vehicles using funnels etc to minimise spillage. Tanks must be double skinned or bunded with a proper dispensing hose, isolating valve and lock.						
<b>ASSESSMENT OF RISK, AND PRECAUTIONS TO BE TAKEN</b> Low risk when used as above. Gloves should be used and splashes to the skin washed off - prolonged skin contact can cause dermatitis. Long term exposure to this product carries a cancer risk.						
<i>The PPE indicated below should be worn when working with this substance in the manner described. If site rules state other PPE must be worn <b>at all times</b> then the rules must be adhered to as well as the following recommendations.</i>						
						
<b>Eye Protection must be worn</b>	<b>Safety footwear must be worn</b>	<b>Ear defenders must be worn</b>	<b>Gloves must be worn</b>	<b>Face Masks must be worn</b>	<b>Respirators must be worn</b>	<b>Protective clothing must be worn</b>
<b>FIRST AID INFORMATION AND EMERGENCY ACTIONS</b> Eyes - Irrigate with plenty of water Skin – Remove splashes from the skin ASAP. Wash with soap and water Inhalation - Remove to fresh air Ingestion - Seek medical assistance, drink copious amounts of water, do not induce vomiting. Spillage management - Eliminate sources of ignition. Contain spillage in booms or sand or absorbents. Place recovered material in labelled container for disposal.						
<b>NB: If the product is being used in a manner different from the way described above, a separate risk assessment will be needed</b>						





<b>COSHH HAZARD &amp; RISK ASSESSMENT SHEET</b>				<b>No.: 18</b>		
<b>SUBSTANCE/PRODUCT NAME AND DESCRIPTION:</b>						
<u><b>BITUMINOUS COATED ROAD MATERIALS</b></u>						
HAZARDOUS CONTENT	LTEL	STEL	CLASSIFICATION			
Coal tar pitch	Under Review		 Flammable			
<b>HOW IS SUBSTANCE SUPPLIED, USED?</b>						
For use in the repair and construction of roads and paved areas. The material is machine laid but there is some requirement to use hand tools to handle and lay especially close to edges and in smaller areas. It is essential skin contact is minimised or even avoided.						
<b>ASSESSMENT OF RISK, AND PRECAUTIONS TO BE TAKEN</b>						
Main hazard are associated with heat. The bitumen is usually laid hot. Operatives have to work close to the newly laid surface and on hot days the raising heat from the bitumen can lead to heat stress. Gloves and long sleeve clothing should be use to minimise skin contact. Barriers creams should be used. Hand cleansers and washing facilities should be used before eating/drinking/smoking. It is preferably that smoking is banned whilst using the product. When handling hot liquid bitumen goggles must be worn.						
<i>The PPE indicated below should be worn when working with this substance in the manner described. If site rules state other PPE must be worn <b>at all times</b> then the rules must be adhered to as well as the following recommendations.</i>						
						
<b>Goggles must be worn</b>	<b>Safety footwear must be worn</b>	<b>Ear defenders must be worn</b>	<b>Gloves must be worn</b>	<b>Face Masks must be worn</b>	<b>Respirator s must be worn</b>	<b>Protective clothing must be worn</b>
<b>FIRST AID INFORMATION AND EMERGENCY ACTIONS</b>						
Eyes - wash with copious amounts of water and seek medical assistance Skin - wash with copious amounts of water and seek medical assistance Heat Stress – on hot days, rest periods and a supply of cool water is essential to reduce risk of heat stress. Fire - extinguish with dry powder/foam or water spray Spillage - absorb with dry earth or sand						
<b>NB: If the product is being used in a manner different from the way described above, a separate risk assessment will be needed</b>						



<b>COSHH HAZARD &amp; RISK ASSESSMENT SHEET</b>	<b>No.:</b>
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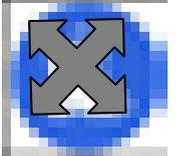
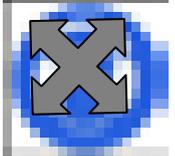
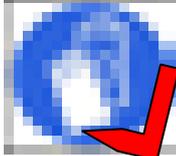
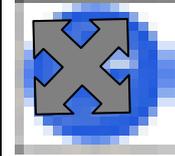
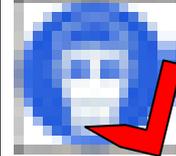
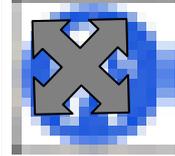
**SUBSTANCE/PRODUCT NAME AND DESCRIPTION:**  
LINE MARKING PAINT

HAZARDOUS CONTENT	LTEL	STEL	CLASSIFICATION	
Xylene, dichloromethane acrylic resin	100 ppm	150 ppm	 Flammable	 Harmful

**HOW IS SUBSTANCE SUPPLIED, USED?**  
 Supplied in aerosol containers varying from 500ml to 750ml

**ASSESSMENT OF RISK, AND PRECAUTIONS TO BE TAKEN**  
 There is a Medium risk to health when working for long periods with aerosol line marking paint.  
 Extremely flammable  
 Harmful by inhalation and in contact with skin  
 Limited evidence of a carcinogenic effect  
 Irritating to skin  
 May be harmful if ingested in quantity  
 May cause eye irritation  
 Do not breathe aerosol  
 When using, do not eat, drink or smoke  
 Avoid contact with skin and eyes

*The PPE indicated below should be worn when working with this substance in the manner described. If site rules state other PPE must be worn **at all times** then the rules must be adhered to as well as the following recommendations.*

						
<b>Eye Protection must be worn</b>	<b>Safety footwear must be worn</b>	<b>Ear defenders must be worn</b>	<b>Gloves must be worn</b>	<b>Face Masks must be worn</b>	<b>Respirators must be worn</b>	<b>Protective clothing must be worn</b>

**FIRST AID INFORMATION AND EMERGENCY ACTIONS**  
 Eye contact - wash with copious amounts of water. If irritation persists seek medical assistance  
 Skin contact - wash with hand cleanser - use gloves and or barrier creams  
 Ingestion – do not induce vomiting, give plenty of water in sips, seek medical attention  
 Inhalation - move to fresh air - seek medical attention



### **Spillage**

Not applicable when intact

In case of leakage or loss of containment:

Ventilate area and exclude all sources of ignition

Wear protective clothing if whole container is split

Allow to dissipate

Ensure area is safe before re-entry

### **Fire**

Isolated small scale fire

Water fog – carbon dioxide – powder – foam

Do not use water jet

Large fire: evacuate area, call fire brigade or follow site procedure

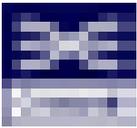
Wear self-contained breathing apparatus and protective clothing

Toxic fumes are produced when substance is involved in a fire

Keep aerosol cans cool, do not burn for disposal

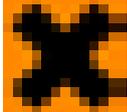
Risk of explosion if involved in a fire

**NB: If the product is being used in a manner different from the way described above, a separate risk assessment will be needed**



<b>COSHH HAZARD &amp; RISK ASSESSMENT SHEET</b>	<b>No.: 9</b>
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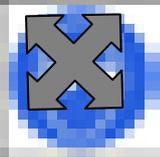
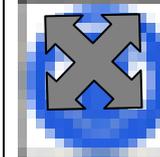
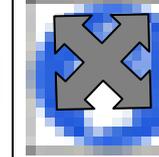
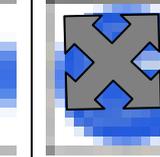
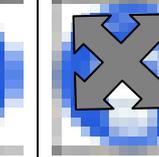
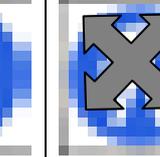
**SUBSTANCE/PRODUCT NAME AND DESCRIPTION:**  
AGGREGATES  
 Crushed rock, sand and gravel aggregates

HAZARDOUS CONTENT	LTEL	STEL	CLASSIFICATION	
Quartz (Silica) Total dust - this is a <b>Maximum Exposure Limit</b>	0.3mgm <sup>3</sup>		 Irritant	 Harmful
Quartz (Silica) Respirable dust	0.1mgm <sup>3</sup>			

**HOW IS SUBSTANCE SUPPLIED, USED?**  
 Delivered in bulk and tipped from lorry. Basic construction material for filling and levelling or laying of roads and drives. Small quantities are shovelled, large quantities are moved using machines. Depending on the rock type the hazard will vary. If the rock type is rich in silica there could be some free silica in the dust. If the rock type is limestone risk is eliminated. With all types minimise exposure to dust by staying upwind of tipping operations and so out of any dust. If there is a lot of dust use water sprays to suppress and control..

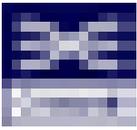
**ASSESSMENT OF RISK, AND PRECAUTIONS TO BE TAKEN**  
 Risk to health from inhalation of dust is not significant, as personnel normally stand up-wind of delivery vehicle during tipping operations and exposure time is very short. In very dry weather spray aggregates with water to suppress dust. Respirators may be provided (BS EN 149) to personnel working in poorly ventilated areas when tipping or handling.

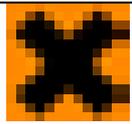
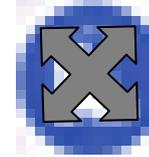
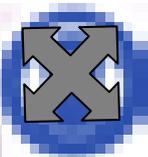
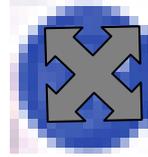
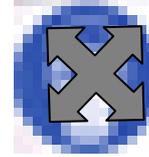
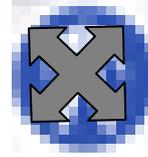
*The PPE indicated below should be worn when working with this substance in the manner described. If site rules state other PPE must be worn **at all times** then the rules must be adhered to as well as the following recommendations.*

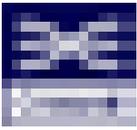
						
<b>Eye Protection must be worn</b>	<b>Safety footwear must be worn</b>	<b>Ear defenders must be worn</b>	<b>Gloves must be worn</b>	<b>Face Masks must be worn</b>	<b>Respirators may be worn</b>	<b>Protective clothing must be worn</b>

**FIRST AID INFORMATION AND EMERGENCY ACTIONS**  
 Eyes - irrigate with copious amounts of water for 15 minutes. If irritation persists seek medical advice.  
 Skin - Wash with soap and water before meals.

**NB: If the product is being used in a manner different from the way described above, a separate risk assessment will be needed**



<b>COSHH HAZARD &amp; RISK ASSESSMENT SHEET</b>				<b>No.: 14</b>		
<b>SUBSTANCE/PRODUCT NAME AND DESCRIPTION:</b>						
<b><u>CEMENT and MORTAR containing cement.</u></b> Dry mixture of Calcium Silicate/Alumina/Gypsum mixed with water.						
<b>HAZARDOUS CONTENT</b>		<b>LTEL</b>	<b>STEL</b>	<b>CLASSIFICATION</b>		
Calcium Silicate Total dust Calcium Silicate Respirable dust Chromium as Chromium vi.		10mg m <sup>3</sup> 4mg m <sup>3</sup> 0.05 mg m <sup>3</sup>	MEL		Risk Phrase 43 – May cause sensitisation	
<b>HOW IS SUBSTANCE SUPPLIED, USED?</b>						
Supplied preferably in 25 Kg sacks though 50Kg sacks are still available but these can cause manual handling problems. Mixed on site for mortars, concrete and other bonding agents.						
At present cement does contain more than 2ppm (typically 15ppm) chromium vi present in the raw materials, and as such packaging must carry the warning – May cause allergic reaction or risk phrase R43. As of 15 <sup>th</sup> January 2005, all cement produced in UK will have the chromium vi content reduced to less that 2 ppm, (to comply with new EU standards).						
<b>ASSESSMENT OF RISK, AND PRECAUTIONS TO BE TAKEN</b>						
Wet cement releases strong alkalis which can cause irritant dermatitis, burns and damage to eyes. Because of the chromium vi content, there is also a risk of allegoric dermatitis. This risk will be significantly reduced when the content is reduced to below 2ppm. Skin contact and eye contact should be minimised or avoided by using PPE. Inhaling small quantities does not present a significant health risk. Use P.P.E. such as gloves and long sleeved clothing to minimise skin contact is required. If wet mixing or in windy conditions wear light eye protection. Good washing facilities with warm water soap and towels are essential. It is important to wash cement and mortar off the skin as soon as practicable.						
<i>The PPE indicated below should be worn when working with this substance in the manner described. If site rules state other PPE must be worn <b>at all times</b> then the rules must be adhered to as well as the following recommendations.</i>						
						
<b>Eye Protection must be worn if wet mixing or windy</b>	<b>Safety footwear must be worn</b>	<b>Ear defenders must be worn</b>	<b>Gloves must be worn</b>	<b>Face Masks must be worn</b>	<b>Respirator s must be worn</b>	<b>Protective clothing must be worn</b>
<b>FIRST AID INFORMATION AND EMERGENCY ACTIONS</b>						
Skin - wash off any splashes on the skin immediately using soap and warm water Eyes - splashes in eyes should be treated with copious amounts of water for 15 minutes. If irritation persists seek immediate medical assistance.						
<b>NB: If the product is being used in a manner different from the way described above, a separate risk assessment will be needed</b>						



**Appendix 7: Briefing Sheets**

**STARRT Briefing**



Safety Task Analysis Risk Reduction Talk  
STARRT

Contract: .....

Date: .....

Time: .....

Supervisor (Print Name): .....

Contractor - Subcontractor (Print): .....

Job Description: YES                  NO

**1) Safety Planning - Checklist (Supervisor)**

- |   |       |       |
|---|-------|-------|
| a) Method Statement/Risk assessment received and understood | ..... | ..... |
| b) Employees suitable & competent                           | ..... | ..... |
| c) Materials suitable                                       | ..... | ..... |
| d) Tools/Equipment suitable                                 | ..... | ..... |

**2) Task Briefing**

- |                       |       |       |
|-----------------------|-------|-------|
| a) Toolbox talk given | ..... | ..... |
|-----------------------|-------|-------|

**3) Safety Checklist (Employee)**

- |   |       |       |
|---|-------|-------|
| a) Task instruction received and understood                 | ..... | ..... |
| b) Risk assessment control measures received and understood | ..... | ..... |
| c) PPE suitable for task and issued                         | ..... | ..... |
| d) Emergency action received and understood                 | ..... | ..... |
| e) Tools & equipment issued and in good order               | ..... | ..... |
| f) Housekeeping requirements understood                     | ..... | ..... |

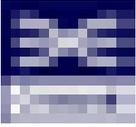
Note: Any 'no' answers and operation must not proceed without authorisation from Works Manager

**Commitment**

I/we will stop work and report if operation becomes unsafe  
 I/we will ensure all involved follow safety rules  
 I/we accept responsibility for health and safety and environmentally acceptable behaviour for myself and my co-workers during this task

Employee Signature: .....

Suggestions for improved health and safety and environmental performance:  
 .....  
 .....  
 .....



## Safety Task Analysis Risk Reduction Talk STARRT

### **Purpose**

To establish to procedure for systematically identifying all the hazards/risks associated with a task or job and to implement appropriate control measures. STARRT compliments any existing controls for the assessment of Health and Safety risks and the identification of the preventative and protective measures.

### **Scope**

The STARRT process applies to all Vinci Construction UK employees who work on the project. STARRT takes the planning process one stage further by ensuring that the workers are briefed by their “ganger”/supervisors and that the workers have an opportunity to contribute to the process.

The STARRT cards and their monitoring, form a record of the effectiveness of the process.

### **Definitions**

**Safety Task Analysis Risk Reduction Talk (STARRT)** - a process that utilises employees to identify and resolve health and safety hazards associated with a task prior to it being performed.

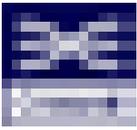
**Foremen/Ganger** - a work team’s front line supervisor who puts the job task team to work.

**STARRT Card** - a two part card completed by the “ganger” and job task personnel before start of work which forms a record of the talk and action items.

### **Requirements**

Foremen/Ganger will ensure:

- All employees under his/her charge are trained in the STARRT process.
- That there is a system to follow-up with all of his/her team to verify the STARRT process is being correctly implemented.
- His/her employees participate in an individual STARRT review prior to the start of each shift for each new task.
- That STARRT cards are reviewed for proper usage/completion by the Principal Contractor H&S Supervisor and maintained on file for program review in their H&S Office.



**Appendix 8 : Responsible Persons Contacts List**

**Client**

Company:	Crossrail Ltd	Address:	25 Canada Square Canary Wharf London E14 5LQ
Name:	Hani Rizkallah		
Title	Project Manager		
Tel	020 3229 9100		
Email	<a href="mailto:hanirizkallah@crossrail.co.uk">hanirizkallah@crossrail.co.uk</a>		

**Client Responsible Manager**

Company:	Crossrail Ltd	Address:	25 Canada Square Canary Wharf London E14 5LQ
Name:	Matt White		
Title			
Tel	0203 329 9100		
Email	<a href="mailto:matthewwhite@crossrail.co.uk">matthewwhite@crossrail.co.uk</a>		

**Designer**

Company	Mott MacDonald	Address:	Mott MacDonald House 8-10 Sydenham Road Croydon CR0 2EE
Name:	Alex Graham		
Title			
Tel	020 3229 9765		
Email	<a href="mailto:alexgraham@crossrail.co.uk">alexgraham@crossrail.co.uk</a>		

**Principal Contractor**

Company	Vinci Construction Ltd	Address:	Warnford Court 29 Throgmorton Street London EC2N 2AT
Name:	Lucy Penman		
Title	Project Manager		
Tel	07816 515 454		
Email	<a href="mailto:lucy.penman@vinciconstruction.co.uk">lucy.penman@vinciconstruction.co.uk</a>		

**Principal Contractor: Work Manager**

Company	Vinci Construction Ltd	Address:	Warnford Court 29 Throgmorton Street London EC2N 2AT
Name:	Rob Scheele		
Title	Construction Manager & LU Interface Manager		
Tel	07816 515 324		
Email	<a href="mailto:robert.scheele@vinciconstruction.co.uk">robert.scheele@vinciconstruction.co.uk</a>		

**Contractor**

Company	TBC	Address:	
Name:			
Title			
Tel			
Email			

**Works Supervisor**

Company	TBC	Address:	
Name:			
Title			
Tel			
Email			



**Appendix G      Minutes from English Heritage Consultation (14  
October 2011)**



## **Appendix H      JB Riney Utility Trial Trench Report: Trial Hole Number 19, Old Broad Street**

# **Liverpool Street Area – Trial Hole Number : 19 – Old Broad Street**

Utility Trial Trench Report

Front Pages to be supplied by Client

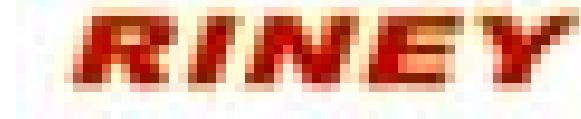
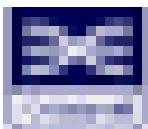
**Liverpool Street :**  
**Trial Hole No. 19**  
**Old Broad Street**



# Liverpool Street Area – Trial Hole Number : 19 – Old Broad Street

## Utility Contacts List

<b>Electricity</b>		<b>Water</b>	
EDF (East of England)	0800 780078	Anglian water	0345 145145
EDF (South East)	0800 0963766	Bristol Water	0845 7023797
EDF 24 Seven	0800 780078	Essex Water	0845 7820999
Scottish & Southern	0345 708090	North Surrey	01784 426800
GPU Power	0845 7331331 Ext 6061	North West	0845 462200
Norweb	0800 1954141	South West	0800 1691144
Yorkshire Elec	0113 2415151	Southern Water	0845 2788045
Western Power	0800 365900	South East Water	0800 3010845
National Grid	0800 404090	South Staffs Water	0800 3891011
		Seven Trent	0800 7834444
<b>Gas/Oil Pipelines</b>		Three Valleys	01784 426800
Transco	0800 111999	Thames Water	0845 9200800
GPSS Pipelines	01169 712021 Blue 01405 839212 Red	Wessex Water	0845 6004600
Esso Pipelines	0800 800333	Yorkshire Water	0845 124 2424
Total/Fina	0800 592240		
Fisher German	0800 136812	<b>Telecoms</b>	
<b>Fibres</b>		British Telecom	0800 917 3993
NTL/Telewest	0870 888 3116		
C&W	0800 015 4160	<b>Traffic</b>	
Colt	0845 200 0214	Transport for London	0207 126 1024
Energis	01322 295245	Trafficmaster	0870 5561 712
Easynet	0800 0277 277		
Torch	0800 138 4858		
Eurobell	01392 200222		
Fujitsu	0800 435112		
MK International (Worldcom)	0207 675 5400		
THUS	0800 027 1280		
NII	01924 508368		



# Liverpool Street Area – Trial Hole Number : 19 – Old Broad Street

## Location

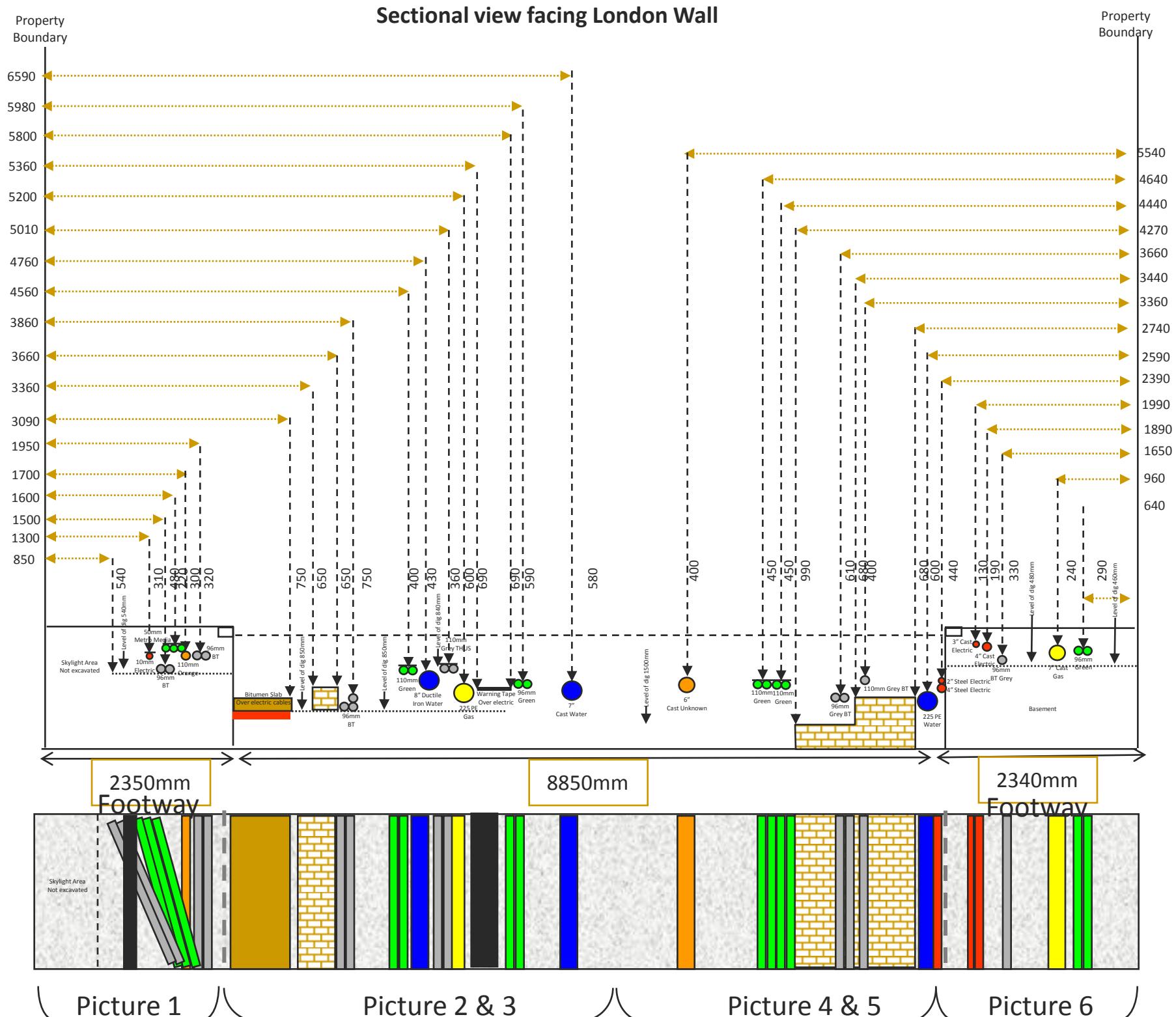


**Liverpool –  
Old Broad Street  
Trial Hole No. 19**

To the centre of trial hole:  
Easting : 533076  
Northing : 181479

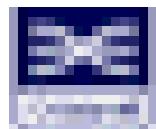


# Liverpool Street Area – Trial Hole Number : 19 – Old Broad Street



Not to scale

All measurements in MM, Utility ownership is assumed only and should be verified



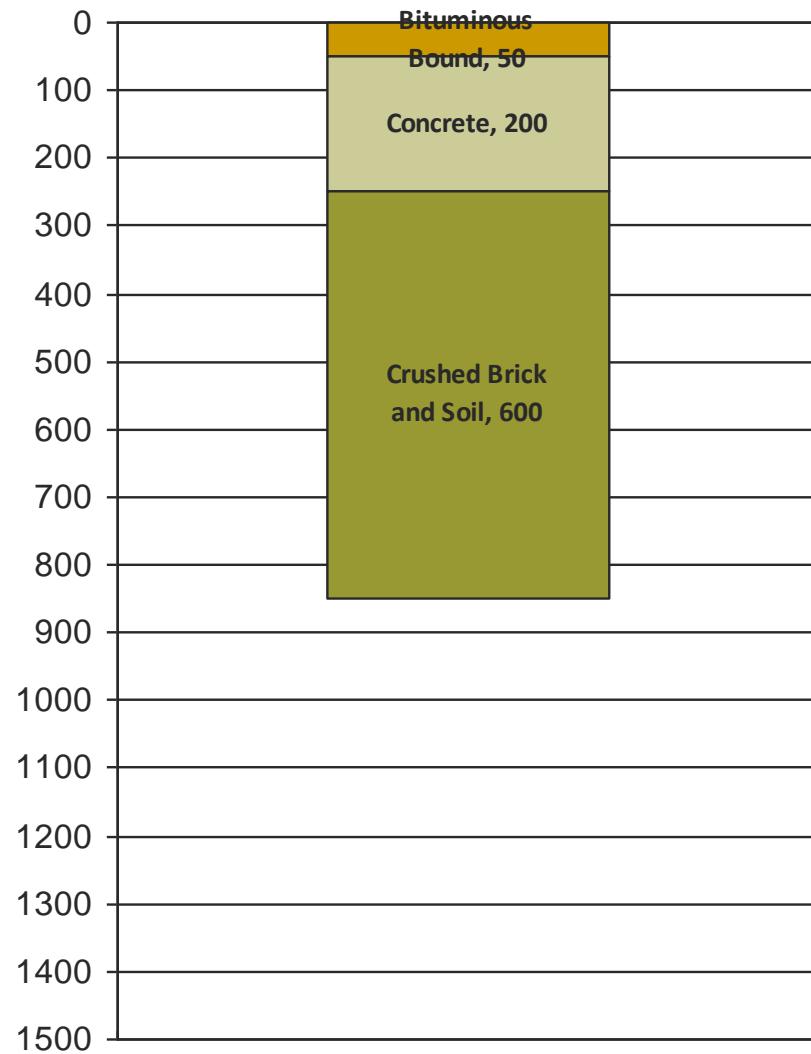
	British Telecom/THUS/Metro Media/Cable & Wireless		EDF
	Colt / Energis / CATV / Verizon		Water
	Gas		Unknown



# Liverpool Street Area – Trial Hole Number : 19 – Old Broad Street

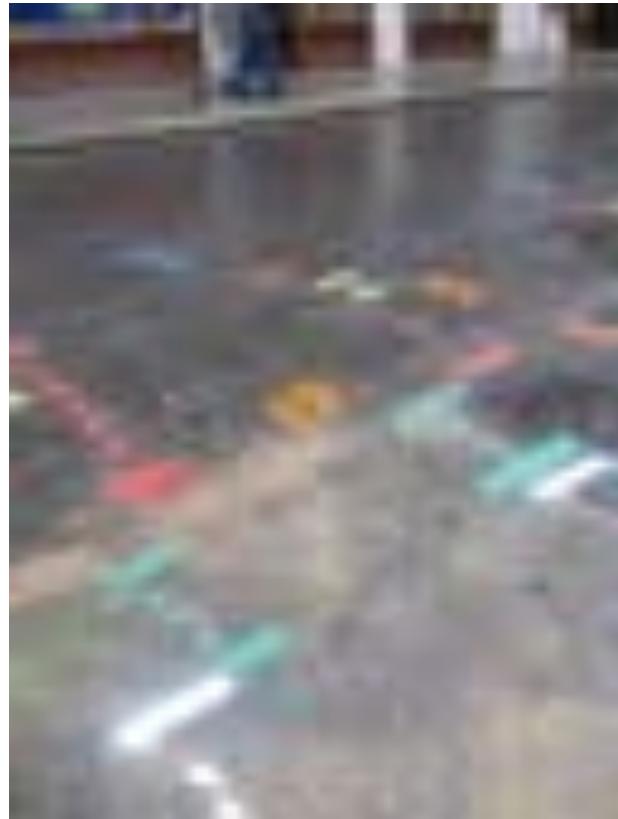
## Composition

Road Structure



<b>Surface Type :</b>	Bituminous Bound Material
<b>Ground Conditions :</b>	
<b>Ground water (m) :</b>	N/A
<b>Excavation stopped (m) :</b>	850mm
<b>Ground Contamination :</b>	None
<b>Tree Roots :</b>	None Found
<b>Composition (m) :</b>	
<b>0 – 50mm</b>	Bituminous Bound Materials
<b>50 – 250mm</b>	Concrete
<b>250 – 850mm</b>	Crushed Brick and Soil

# Liverpool Street Area – Trial Hole Number : 19 – Old Broad Street



Pre-excavation Preparation

# Liverpool Street Area – Trial Hole Number : 19 – Old Broad Street



Picture 1



Picture 2



Picture 3



Picture 4



Picture 5



Picture 6

During Excavation

## Liverpool Street Area – Trial Hole Number : 19 – Old Broad Street



Excavated and Reinstated

# Liverpool Street Area – Trial Hole Number : 19 – Old Broad Street

## Health and Safety file information :

**Description of Works Undertaken** – Trial trench in carriageway and footway on 6, 7, 13 & 14/06/2009.

**Residual Hazards** – No contaminated ground or water table found.

**As-Built Drawings** – See main document.

**Details of Construction Methodology and Materials** – Machine assisted hand dig to 1.5m deep.

**Details of Approved, Non-Standard or Alternative Materials used** – Sand, type 1 roadstone, C40 concrete, Hot rolled asphalt.

**Details of Highway Structures** – See main document.

**Operation & Maintenance** – No maintenance.

**Details and Location of Services or Apparatus Identified** – See main document.

