



LIVERPOOL STREET STATION

ARCHAEOLOGY ADDENDUM TO WRITTEN SCHEME OF INVESTIGATION FOR LIVERPOOL STREET STATION: LIVERPOOL STREET UTILITIES CORRIDOR AND RELATED ACTIVITIES (C503)

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1 Introduction

- 1.1.1 This document provides details of the programme of archaeological investigation required to mitigate the impact of construction of the Liverpool Street utilities corridor and other C503 works on archaeological deposits. It is an addendum to the Written Scheme of Investigation for Liverpool Street Station (C138-MMD-T1-RST-C101-00001) and should be read in conjunction with that document.
- 1.1.2 The archaeological mitigation works relating to C503 activities (comprising the construction of the utilities corridor, the sewer shafts: MHS1 (west) and MHS2 (east), 100 Liverpool Street diversion and Phase 3 utilities diversions) set out in this document supersede those in the previous WSI addendum (C138-MMD-T1-RST-C101-00004).
- 1.1.3 This document outlines the requirements for the Principal Contractor (C503) that will be undertaking civils works on the site in liaison with the Crossrail Project Archaeologist and the C257 Archaeology Contractor (Museum of London Archaeology - MoLA).

2 Scope of Works

2.1 Aims and objectives of the investigation

- 2.1.1 The aim of archaeological mitigation is to preserve by record surviving archaeological deposits to be affected by C503 activities (comprising the construction of the utilities corridor, the sewer shafts: MHS1 (west) and MHS2 (east), 100 Liverpool Street diversion and Phase 3 utilities diversions). The two key phases of archaeology positively identified in Crossrail evaluation (XSM10) relate to the Roman period and post-medieval burials from the Bedlam burial ground.
- 2.1.2 Mitigation will be achieved through a programme of archaeological investigation to be conducted by the C257 Archaeology Contractor in liaison with the C503 Principal Contractor in accordance with the Site-Specific Written Scheme of Investigation for Liverpool Street (C138-MMD-T1-RST-C101-00001) and the Crossrail Generic WSI (CR-XRL-T1-GST-CR001-00003) and the standards listed therein.
- 2.1.3 A summary of the archaeological work carried out to date and the scope of further work is set out in Table 1 below:

Table 1 Summary of archaeological events relating to the utilities corridor

Event Type	Type	Event Code	Progress	Principal Contractor	C257 report reference
<i>Test pit and core in basement of Railway Tavern</i>	<i>General watching brief</i>	<i>XSM10</i>	<i>Complete</i>	<i>JB Riney</i>	<i>C257-MLA-X-RGN-CRG02-50064</i>
<i>1.25m piles and guide walls for utilities corridor</i>	<i>Sample excavation and general watching brief</i>	<i>XSM10</i>	<i>Complete</i>	<i>C503</i>	<i>C257-MLA-X-RGN-CRG02-50113</i>
<i>Diversion of utilities in footprint of Broadgate ticket hall and utilities corridor</i>	<i>General watching brief</i>	<i>XSM10</i>	<i>Complete</i>	<i>C503</i>	<i>C257-MLA-X-RGN-CRG02-50113</i>

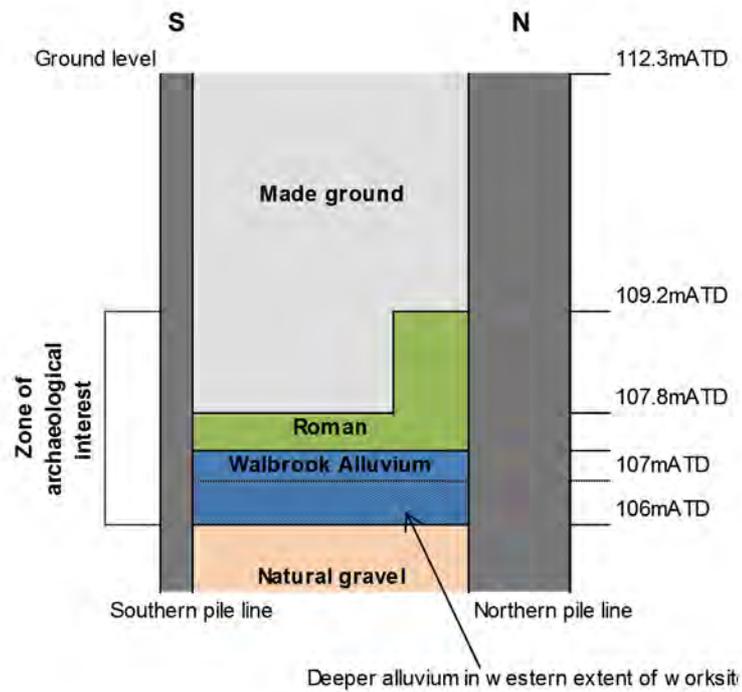


Excavation of utilities corridor and MHS1 (western sewer shaft)	<i>Trial trench evaluation</i>	XSM10	Complete	C503	C257-MLA-X-RGN-CRG02-50113 C257-MLA-X-RGN-CRG02-50064
	Detailed excavation to 107mATD (up to 106mATD at the western end)	XSM10	Planned	C503	Report to be prepared on completion of fieldwork.
Excavation of MHS2 (eastern sewer shaft)	General and targeted watching brief	XSM10	Planned	C503	Report to be prepared on completion of fieldwork.
100 Liverpool Street sewer diversion	General watching brief	XSM10	Ongoing	C503	Report to be prepared on completion of fieldwork.
Phase 3 utilities diversions	General and targeted watching brief	XSM10	Planned	C503	Report to be prepared on completion of fieldwork.

2.2 Summary of results from Crossrail archaeology works

- 2.2.1 A general watching brief on an exploratory test pit in the Railway Tavern to determine the location of a coal cellar in advance of pile design, determined that all archaeology at that location was truncated by the construction of the building in the 1870s.
- 2.2.2 Evaluation trial trenches 1, 1A and 2 were located partially within the northern pile line of the utilities corridor. Trial trenches 1 and 2 were excavated to the base of archaeological deposits and 1A was stopped at approximately 1.5m below ground level due to the high concentration of services restricting access.
- 2.2.3 Evaluation trial trench 1A exposed 20th century utilities that had truncated burials along the length of Liverpool Street within the pile line and northern part of the utilities corridor. These utilities were located adjacent to the backfilled cellars of former buildings at 1-14 Liverpool Street. Consequently the likelihood of encountering *in situ* burials during the excavation of the utilities corridor is very low. However, disarticulated human bone may be present in the made ground.
- 2.2.4 A series of pits were also excavated along the length of the 1250mm pile line to approximately 109.5mATD to remove human remains. Refer to Appendix A, Drawing 1 for the location of previous investigations.
- 2.2.5 An area of higher archaeological survival 600mm wide is present intermittently along the northern edge of the corridor from approximately 109.3m ATD – c. 107.8mATD, refer to Figure 1 and Drawing 2 – Appendix A.
- 2.2.6 Roman archaeological deposits are predicted from 107.8m ATD down to 107m ATD along the length of the corridor. Deposits deepen (to approximately 106mATD) in the western 15m of the utilities corridor towards the course of the former River Walbrook.
- 2.2.7 Evaluation trial trench 5 and pile line pit 1 both encountered the backfilled remains of a 20th century below ground lavatory to 108.17mATD. Roman archaeology may survive in pockets beneath the lavatory, but a tunnelled sewer that also passes beneath it has removed large areas of Roman deposits across the length of the site. The extent of the lavatory is uncertain, however, all archaeological remains in its footprint have been removed to 107.17mATD.
- 2.2.8 Exploratory test pits to identify existing utilities were excavated at the planned locations of the MHS1 and MHS2 at either end of the utilities corridor. At the western end (MHS1) excavation to a depth of 1.2m below ground level showed total truncation of archaeology to that depth by existing utilities. The made ground contained disarticulated human bone, inferring that the burial ground continues beyond the western edge of the Broadgate Station Ticket Hall. The test pit in the planned location of MHS2 (the eastern end) was also excavated to 1.2m below ground level, and no archaeological deposits were encountered. Additionally no disarticulated human bone was identified, which confirms that the boundary of the burial ground lies further west than MHS2.
- 2.2.9 The western extent of the utilities corridor and MHS1 are located in proximity to the former Walbrook channel. As such, the depth of alluvial deposits in the western end of the worksite is expected to be down to approximately 106mATD.
- 2.2.10 In the footprint of the Broadgate ticket hall human burials survive across the majority of the site beneath a significant number of utilities. Burials are present between 111.52mATD and 109.45mATD but the upper level of the burials varies across the site.

Figure 1 Utilities corridor sequence.



nb. The above diagram is based on the levels from the various investigations carried at the site. The diagram is not to scale and the locations of deposits are indicative.

3 General requirements

- 3.1.1 C503 to provide the attendances and facilities required to complete the specialist archaeological works agreed in the C503 Method Statement (C503-VIN-C-GMS-C101-50108) and C257 Method Statement (C257-MLA-X-GMS-C101-50001).
- 3.1.2 C503 will manage the Exhumation Contractor (TCS) as per the C503 Method Statement (C503-VIN-C-GMS-C101-50108), and in accordance with the Ministry of Justice Burial License.

4 Specific methodology for archaeological works

- 4.1.1 C503 will be responsible for facilitating the following archaeological works relating to the construction of the utilities corridor:

- General watching brief at removal of modern backfill within the utilities corridor.
- Detailed archaeological excavation within the utilities corridor.
- Detailed archaeological excavation of MHS1.
- General and targeted watching brief at the excavation of MHS2.
- General watching brief at the 100 Liverpool Street sewer diversion.
- General and targeted watching brief during Phase 3 utility diversions.

4.2 Interfaces

- 4.2.1 C503 will have the following interfaces for the specialist archaeological works:

C257 Archaeology Contractor: Museum of London Archaeology (MoLA)

Elaine Eastbury - Contract Manager

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Nick Elsdon - Assistant Contract Manager

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Employers Archaeologist: Crossrail Ltd

Jay Carver – Project Archaeologist

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Mike Court – Assistant Project Archaeologist

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4.3 Documentation and management

- 4.3.1 C503 will organise weekly progress meetings at 1-14 Liverpool Street throughout the duration of the archaeological works. The meetings will discuss safety, progress against programme and any other matters arising in relation to the archaeological works. Attendance is required from C503, the groundworks contractor, C257, a representative of the Crossrail site team and a representative of the Crossrail archaeology team.
- 4.3.2 Upon completion of the archaeological excavation the C257 Archaeology Contractor will issue a signed completion form countersigned by the Employers Archaeologist to C503.

4.4 C503 Procedure for detailed archaeological excavation

- 4.4.1 Refer to C257 Method Statement (C257-MLA-X-GMS-C101-50001) for the detailed excavation methodology.
- 4.4.2 Use of excavators or other plant within the area shown on drawing C138-MMD-C-DDA-C101_Z-89001 (Drawing 3 - Appendix A) shall only be undertaken with the agreement and under the observation of the C257 Archaeology Contractor.

Utilities corridor (Appendix A – Drawing 3: C138-MMD-C-DDA-C101_Z-89001)

- 4.4.3 Refer to C257 deposit sketch (Drawing 2 - Appendix A) for locations of the phases used in the following sequence.
- 4.4.4 C503 will allow for up to 10 No. archaeologists to be on site during detailed excavation.
- 4.4.5 The following sequence for archaeological excavation has been agreed with C257 and is the result of a series of meetings between Crossrail, C503 and their sub-contractors, and C257:

Phase 1

- 4.4.6 C503 excavate modern material down to construction level for 1st props (109.2mATD), under general watching brief by C257 to record the predicted upper 100mm of archaeological deposits against the northern side of the corridor.
- 4.4.7 If disarticulated human remains are identified in the made ground they will be removed by the C257 Archaeology Contractor and C503 will store them securely on site and provide them to the Exhumation Contractor in accordance with the Ministry of Justice burial license.

Phase 2

- 4.4.8 C503 insert first level of props at approximately 109.2mATD.

Phase 3



- 4.4.1 Where archaeological deposits have been truncated, C503 will excavate the modern material under C257 supervision using a smooth-edged ditching bucket down to a maximum of depth of 107.8mATD. Please note that the surface of archaeological deposits survives at different levels. The attending C257 archaeologist will supervise the machining process during this phase.

Phase 4

- 4.4.2 Where archaeological deposits have not been truncated, C257 will hand excavate and record down to a depth of approximately 107.8mATD.
- 4.4.3 Phases 3 and 4 will be conducted as a rolling programme of targeted watching brief along the corridor, with a safe demarcated distance between machine operations and areas for archaeological work.

Phase 5

- 4.4.4 C503 machine and/or hand excavate (as appropriate) any remaining modern material to approximately 107.8mATD under archaeological supervision.

Phase 6

- 4.4.5 C503 Insert second level of props at 107.8mATD.
- 4.4.6 The insertion of the second level of props creates a series of twelve/thirteen 3.2m x 2m areas along the length of the utilities corridor. These areas will be hand excavated by C257 in two stages (Figure 2): Stage 1: areas 1, 3, 4, 6, 7, 9, 10 and 12; Stage 2: 2, 5, 8 and 11. During Stage 1 the Stage 2 areas will be used for spoil removal and vice versa in Stage 2.
- 4.4.7 The following phases (7 to 9) set out the C257 excavation process within each 3.2m x 2m area. These phases will be facilitated by C503:

Phase 7

- 4.4.8 C503 facilitate the C257 excavation and recording of Roman archaeological deposits.

Phase 8

- 4.4.9 C503 facilitate the C257 excavation and recording of the northern half of the Roman archaeological deposits, to produce a composite East–West section.

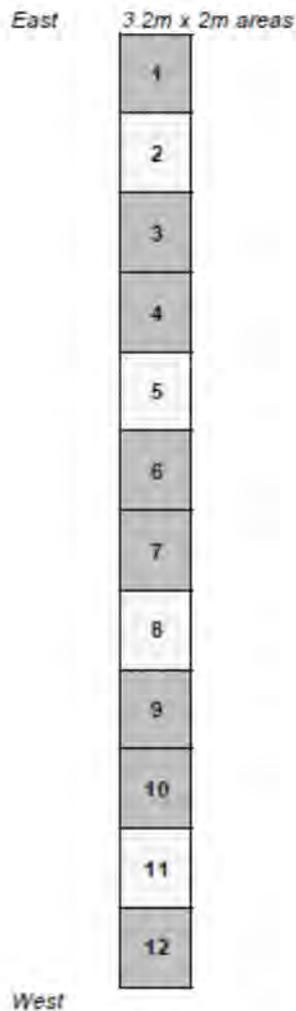
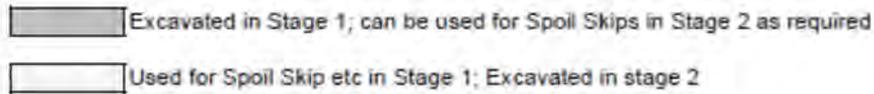
Phase 9

- 4.4.10 C503 facilitate the C257 excavation and recording of the northern half of the alluvial deposits, continuing the composite East–West section. Where the section is more than c. 1.2m deep or is unstable, it will be carried out in 2+ stages (and/or hand augered).
- 4.4.11 If Roman structures/features are identified in the alluvial deposits which continue into the unexcavated half, these will be locally excavated by C257.

Phase 10

4.4.1 C503 remove remaining alluvial deposits under C257 general watching brief and then, once the C257 hand excavation completion certificate is signed off, continue with bulk excavation with no further archaeological requirements.

Figure 2 C257 planned sequence for archaeological excavation of the utilities corridor (phases 7-9)



MHS1 excavation (Appendix A – Drawing 4)

4.4.2 The procedure for C503 regarding archaeological excavation of the MHS1 area differs from the above due to the likely presence of *in situ* and disarticulated human remains relating to the Bethlem burial ground.

4.4.3 Where works involve the exposure and exhumation of human remains by C257, C503 will provide covering for the exposed area to prevent public observation of the works, these should be:

- large enough to allow safe working;

- waterproof;
- translucent (to provide sufficient light); and
- be of a type that can be quickly erected and removed to facilitate access for plant when required.

4.4.4 Ground level (112.76m to 112.28m ATD) to surface of burial ground (111.52m to 110.70m ATD)

4.4.5 Remove, under supervision of the C257 Archaeology Contractor the road surface and modern overburden, to the predicted level of cemetery deposits. The surface of cemetery deposits is present at an average depth of 1.34m below ground level (highest level identified in trial trench evaluation: 111.52mATD).

4.4.6 If disarticulated human remains are identified in the made ground they will be removed by the C257 Archaeology Contractor and C503 will store them securely on site and provide them to the Exhumation Contractor in accordance with the burial license.

4.4.7 The burial ground (from c.111.52m to 109.45m ATD)

4.4.8 C503 will facilitate the excavation of the burial ground (present from approximately 111.52m to 109.45m ATD) by the C257 Archaeology Contractor.

4.4.9 Deeper archaeological deposits (c.110.64m ATD to 105.00m ATD)

4.4.10 Following the removal of cemetery deposits by the C257 Archaeology Contractor, C503 will facilitate the further excavation of archaeological deposits by the C257 Archaeology Contractor until the full sequence of deposits has been excavated. Due to the location of these works on the conjectured route of the River Walbrook the base of archaeological deposits may be as deep as 106-105mATD.

4.4.11 Upon completion of the archaeological excavation, and when the completion certificate has been signed off, bulk excavation by C503 may commence.

4.5 C503 Procedure for archaeological general watching brief and targeted watching brief

4.5.1 The removal of made ground by C503 will be carried out under archaeological observation (general watching brief) by the C257 Archaeology Contractor.

4.5.2 The C257 Archaeology Contractor will advise C503 if and when archaeological deposits are encountered. C503 will allow for archaeological deposits to be hand excavated/machined (as appropriate) in stages (targeted watching brief) by the C257 Archaeology Contractor to the maximum depth of impact (It is estimated that the trigger point will be at approximately 1.3-1.5m below ground level). NB. Human remains are likely to be encountered.

4.5.3 Where the construction methodology involves timber-headed tunnelling, C503 will allow access for the C257 Archaeology Contractor to record archaeological deposits in section where possible.

4.5.4 Material excavated by C503, which contains disarticulated human remains will be stored securely on site by C503 and provided to the Exhumation Contractor in accordance with the Ministry of Justice Burial License.



5 Instructions to C257 Archaeological Contractor and Specification

5.1 Detailed excavation and general watching brief

- 5.1.1 A programme of archaeological investigation comprising detailed archaeological excavation and targeted and general watching brief will be carried out on C503 construction activities comprising the construction of the utilities corridor, the sewer shafts: MHS1 (west) and MHS2 (east), 100 Liverpool Street diversion and Phase 3 utilities diversions.
- 5.1.2 Further details on the required standards for excavation and recording for the Archaeological Contractor are to be found in the Written Scheme of Investigation for Liverpool Street Station (C138-MMD-T1-RST-C101-00001).
- 5.1.3 The C257 Archaeology Contractor will ensure that the burial license for archaeological works is current and update the license as required.
- 5.1.4 The C257 Archaeology Contractor will, in liaison with C503, produce a programme for the archaeological works to be included in the C257 Method Statement.
- 5.1.5 Prior to commencing works on site the C257 Archaeology Contractor will provide a Method Statement inclusive of risk assessment and safe method of working, prepared in liaison with and countersigned by C503 and approved by Crossrail.
- 5.1.6 The C257 Archaeology Contractor will provide a team of suitably qualified archaeologists, experienced in archaeological site investigation and the nature of archaeological deposits which are expected on this site.
- 5.1.7 The C257 Archaeology Contractor will shall provide a suitably qualified buildings archaeologist as required.
- 5.1.8 During the excavation of in situ burials by C257 (MH-S1), the Archaeology Contractor shall give consideration to the osteo-archaeologist being present for the duration of the works to provide on-site assessment, thereby enabling the sampling and excavation strategy to be modified on-the-ground as required.
- 5.1.9 During detailed excavation, following the initial overall strip and clean, individual features are to be hand cleaned and defined by the C257 Archaeology Contractor, sufficient to determine type, plan form and relationships (e.g. for structures and rebuilds); and recorded. Sufficient archaeological features/structures are to be sample excavated either using a smaller machine with graded digging bucket (by C503 under archaeological supervision) or hand dug if appropriate.
- 5.1.10 During the excavation of the utilities corridor staffing levels will be based on one archaeologist per 3.2m x2m areas shown in figure 2. Staffing for targeted watching brief at MHS1 and MHS2 to be determined when the scope of works is available from C503.
- 5.1.11 The C257 Archaeology Contractor will develop a strategy for archaeological science in liaison with EH Regional Science advisor as appropriate. The strategy will be presented in the Method Statement and approved by the Employers Archaeologist.



- 5.1.12 The C257 Archaeology Contractor will carry out metal detector survey of archaeological features and spoil excavated by C503 from archaeological deposits.
- 5.1.13 The C257 Archaeology Contractor will give consideration to an appropriate methodology to retrieve worked bone waste (e.g. sample and sieve).
- 5.1.14 The C257 Archaeology Contractor will ensure that all site staff attend the C503 site induction a suitable period of time prior to the start of site works.
- 5.1.15 The C257 Archaeology Contractor will attend weekly progress meetings each week at 1-14 Liverpool Street to discuss safety during the works; progress against programme; and to discuss any other matters arising.
- 5.1.16 The requirement for extended hours working will be assessed throughout the duration of the archaeological works and instructed to C257 via a Project Managers Communication.

5.2 Deliverables

- 5.2.1 The fieldwork activities relating to the utilities corridor will be reported in an interim report. The fieldwork report will be produced at a later date and will comprise a combined report with further archaeological works being undertaken in relation to the Broadgate Ticket Hall.

5.3 Site Archives

- 5.3.1 Refer to the Site Specific Written Scheme of Investigation.

5.4 Post-excavation

- 5.4.1 Refer to the detail set out within the C257 Works Information and the Written Scheme of Investigation for Liverpool Street Station.

6 Provisional Timetable

Table 2 Provisional programme – utilities corridor

Phase	Organisation	Description	Start Date	Duration	C257 Staffing
1	C503 (C257 general watching brief)	Excavate down to construction level for 1st props.	4th March	1 week	[1] 1 Senior Archaeologist
2	C503	Insert 1st level of props			-
3	C503 (C257 supervision)	Excavate modern material in southern c.1400mm	11th March	2 weeks	[3] 1 Senior Archaeologist + 1 to 2 Archaeologists
4	C257	Record and excavate area of higher archaeology in rolling programme with above			
5	C503 (C257 supervision)	Excavate remaining modern material to surface of archaeology in rolling programme with above			
6	C503	Insert 2nd level of props			
7-9	C257 excavation	Excavate and record Roman features (Phase 7), northern half of Roman dumps (Phase 8), & northern half of alluvium (Phase 9)	Approx. 25th March (TBC)	3 to 4 weeks	[7] 1 Senior Archaeologist + 6 Archaeologists
10	C503 (C257 watching brief)	Removal of rest of alluvium and natural geology	Approx. 22nd April		[1 to 2] 1 Senior Archaeologist + 1 Archaeologist as required

NB. The above provisional programme is based on discussions between Crossrail, C503 and C257.

Table 3 Provisional programme- other C503 activities

Activity	Archaeology required	Start	End	C257 attendance
Construction of MHS1 and MHS2 and 100 Liverpool Street sewer diversion	General watching brief and targeted watching brief	2012	May 2013	Intermittent attendance during diversion works
Demolition of QVT and Broad St Station ticket hall	Level 2 English Heritage Survey	Sept 2013	Sept 2013	1-2 days
Phase 3 utilities diversion (Diversion of utilities in footprint of Broadgate ticket hall)	General watching brief and targeted watching brief	Aug 2013	Aug 2014	Intermittent attendance during diversion works



Appendix A – Drawings

Drawing List
1. Location of archaeological investigations. From C257 Fieldwork Report: C257-MLA-X-XCS-CRG02-50015
2. C257 sketch phase diagram for utilities corridor archaeological works
3. C138-MMD-C-DDA-C101_Z-89001 Broadgate Ticket Hall - Enabling Works Utilities Corridor Site Plan
4. MCN12-007-1011 Liverpool Street Station Enabling Works Phase 2 Temporary Works Design For Utility Corridor Section B-B and Section C-C
5. C138-MMD-U-DDA-C101-50052 100 Liverpool Street Sewer Proposed Diversion Plan



**Drawing 1 : Location of archaeological investigations. From C257
Fieldwork Report: C257-MLA-X-XCS-CRG02-5001**



**Drawing 2 : C257 sketch phase diagram for utilities corridor
archaeological work**



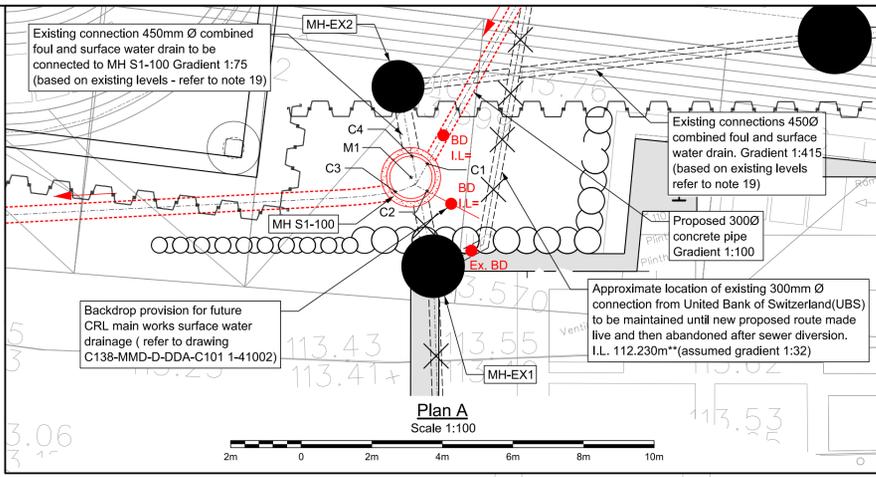
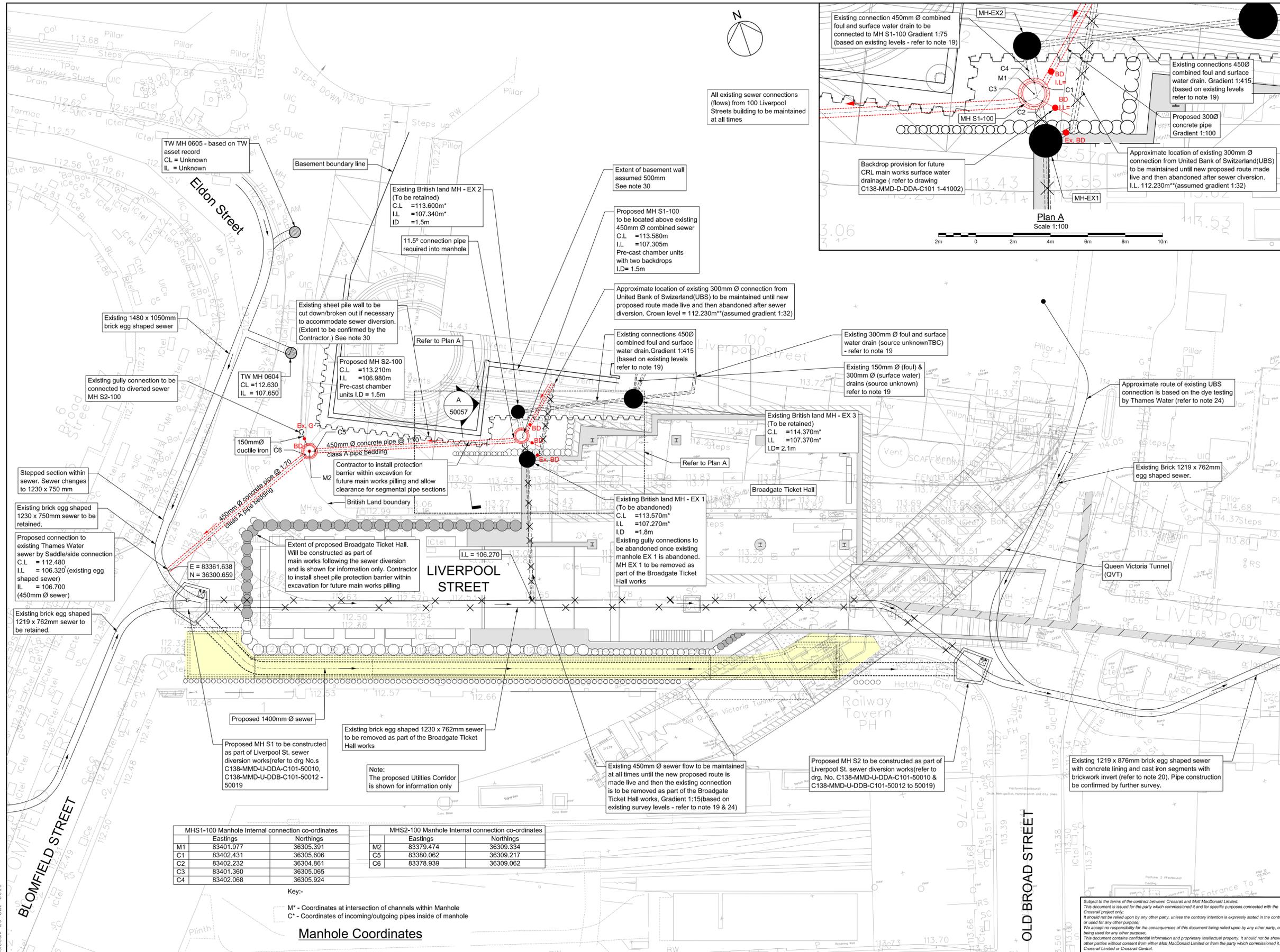
**Drawing 3: C138-MMD-C-DDA-C101_Z-89001 Broadgate Ticket Hall -
Enabling Works Utilities Corridor Site Plan**



**Drawing 4: MCN12-007-1011 Liverpool Street Station Enabling Works
Phase 2 Temporary Works Design For Utility Corridor Section B-B and
Section C-C**



**Drawing 5: C138-MMD-U-DDA-C101-50052 100 Liverpool Street Sewer
Proposed Diversion Plan**



- Safety, Health and Environmental Information**
 Notes below are additional to hazards/risks normally associated with this type of work:
- Construction**
 Ci. LIV-001 - Striking or damage to identified/ unidentified utilities
 Cii. LIV-003 - Working with or near a live sewer
 Ciii. LIV-010 Contaminated Land
- Operations**
 Oi. LIV-002 - Confined space working
 Oii.
 Oiii.
- Maintenance**
 Mi.
 Mii.
 Miii.
- Dismantling/Demolition (Future)**
 Di. LIV-004 - Damage to Thames Water Assets
 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.
- Notes**
- Do not scale from this drawing.
 - All dimensions are in metres unless specified otherwise.
 - 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 levels shown on this drawing are based on the existing Topographical survey drawing received by Crossrail File No. CRL1-XRL-G-DMA-CR088-00015
 - The drainage design is based on the Sewers for Adoption 6th edition
 - For proposed water main diversion plan refer to Drg. No. C138-MMD-U-DA-C101-50063.
 - For section between 100 Liverpool Street basement and proposed Broadgate Ticket Hall piling refer to Drg No. C138-MMD-U-DDB-C101-50057.
 - For construction details refer to Drg. No. C138-MMD-U-DDD-C101-50053 & 50054.
 - For sewer longitudinal section refer to Drg. No. C138-MMD-U-DDB-C101-50053.
 - This drawing shall be read in conjunction with all structural Liverpool Street utilities corridor works and other consultants drawings, reports and specifications.
 - Chamber/Manhole locations subject to position of existing sewer connections from 100 Liverpool Street and to be confirmed on site by the Contractor. Any changes on site to be checked with the Engineer.
 - All temporary works required for construction are the responsibility of the Contractor.
 - All incoming and outgoing pipes to be laid with level soffits.
 - All necessary approval/agreement to be obtained prior to commencement of works.
 - Detailed design to be agreed with Thames Water.
 - All existing sewer connections to be maintained in operation at all times
 - Internal diameter of existing & proposed pipe shown on drawing.
 - Existing Liverpool, Eldon & Blomfield Street sewer alignments are based on the Thames Water drg. No. A041-XX-00525-DES-A
 - All levels shown suffixed with an asterisk, thus *, are based on a site survey, report No. C138-MMD-U-RGN-C101-50008.
 - Pipe construction information is based on archive record drg. No. LE30-21/07
 - 100 Liverpool Street sewer diversion works to be completed in advance of Liverpool Street sewer abandonment. For Liverpool St. Sewer diversion drawing refer to drg. No. C138-MMD-U-DA-C101-50010, C138-MMD-U-DDB-C101-50012 to 50019.
 - All levels shown suffixed with double asterisk, thus**, are based on Drg. No. CRL1-XRL-U-DDB-C101-00008 received from Crossrail Central
 - MH S2-100 to be located within the British Land boundary.
 - Existing connection location and alignment is based on Thames Water/dye testing survey, and City of London survey drg. No. LSS/CS/01.
 - Levels shown suffix 1, are based on Thames Water line & level survey drg. No. A041-XX-00525-DES-A.
 - Other utility diversions from 100 Liverpool St. to be coordinated by Crossrail.
 - For combined utilities plan refer to drg. No. CRL1-XRL-U-DA-C101-00147.
 - For proposed highway arrangements refer to drg. No. C138-MMD-U-DA-C101-50062.
 - Existing cables and ducts need to be accommodated and protected during trench excavation for sewer installation
 - Contractor to confirm route can be constructed without impacting the existing structure of 100 Liverpool Street

MHS1-100 Manhole Internal connection co-ordinates				MHS2-100 Manhole Internal connection co-ordinates			
	Eastings	Northings		Eastings	Northings		Eastings
M1	83401.977	36305.391	M2	83379.474	36309.334		
C1	83402.431	36305.606	C5	83380.062	36309.217		
C2	83402.232	36304.861	C6	83378.939	36309.062		
C3	83401.360	36305.065					
C4	83402.068	36305.924					

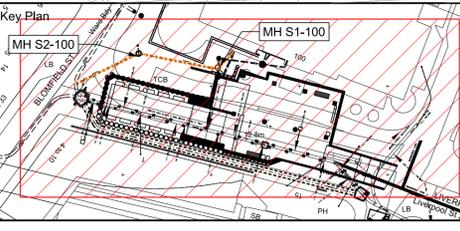
Key:-
 M* - Coordinates at intersection of channels within Manhole
 C* - Coordinates of incoming/outgoing pipes inside of manhole

Manhole Coordinates

Rev.	Date	Description	By	Chkd	App	Auth
P01	10/05/2011	Initial Design Submission	SC	DK	SA	
P02	22/08/2011	Final Detailed Design Submission (EA071)	JB	AC	DK	
P03	20/09/2011	TWDP Final Design Review Comments Resubmission	JB	AC	DK	

Legend

- Direction of flow
- Existing Thames Water manhole
- Existing sewer to be abandoned and removed as part of Ticket Hall works
- Existing sewer to be retained
- Surface water connection
- Existing sewer to be abandoned and removed
- Back Drop
- Existing Back Drop
- Existing British land Manhole
- Existing Gully



Legend Cont'd

- Proposed sewer diversion as part of Liverpool St. sewer diversion
- Utilities corridor
- Proposed 100 Liverpool Street sewer diversion (Ø1D)
- Existing sewer connection from 100 Liverpool St.

Crossrail
 25 Canada Square
 Canary Wharf
 London
 E14 5LQ

Contract:
 Liverpool Street Station Design
 Originator:
 Mott MacDonald Limited
 Location:
 Liverpool Street Stn

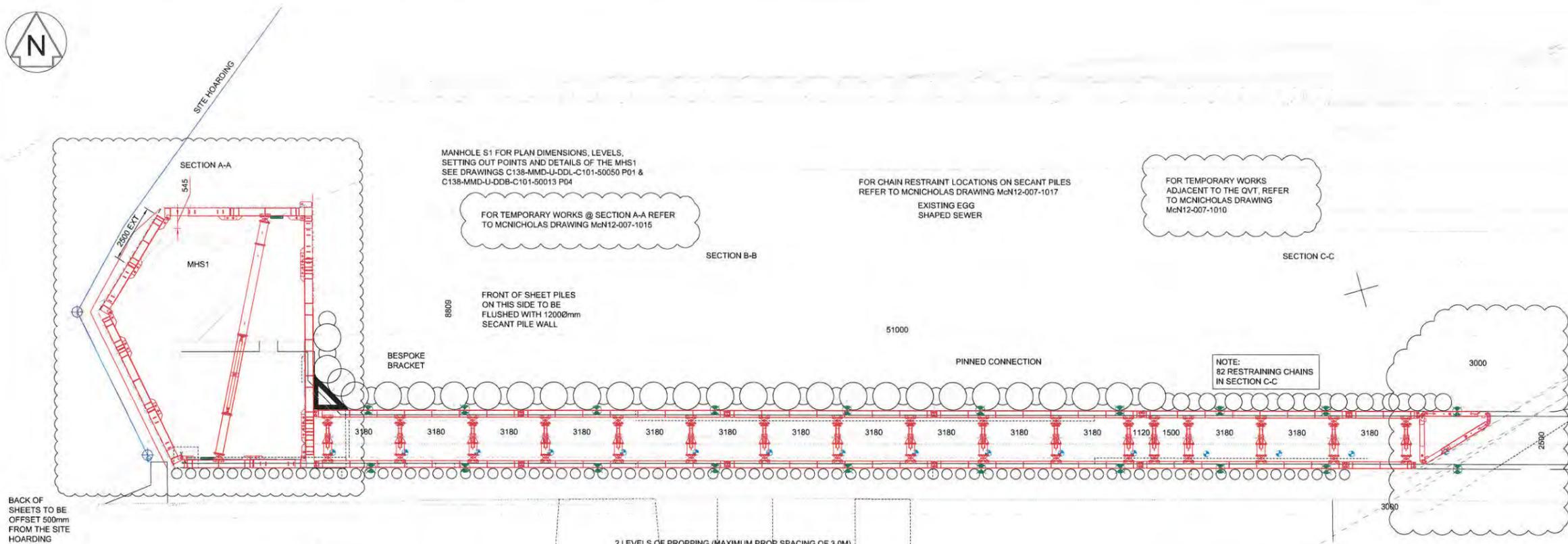
Title:
 100 Liverpool Street Sewer
 Proposed Diversion
 Plan

By: J.BHAMBRA
 Chk: A.CHAUDHRY
 App: D.KEOGH
 Auth: ...

Scale: 1:200@A1
 Drawing and CAD file No.: C138-MMD-U-DA-C101-50052
 Rev: P03
 S4

Copy Approved for Design - Created: 20-SEP-2011

RESTRICTED



BACK OF SHEETS TO BE OFFSET 500mm FROM THE SITE HOARDING

MANHOLE S1 FOR PLAN DIMENSIONS, LEVELS, SETTING OUT POINTS AND DETAILS OF THE MHS1 SEE DRAWINGS C138-MMD-U-DL-C101-50050 P01 & C138-MMD-U-DDB-C101-50013 P04

FOR TEMPORARY WORKS @ SECTION A-A REFER TO MCNICHOLAS DRAWING McN12-007-1015

FOR CHAIN RESTRAINT LOCATIONS ON SECANT PILES REFER TO MCNICHOLAS DRAWING McN12-007-1017 EXISTING EGG SHAPED SEWER

FOR TEMPORARY WORKS ADJACENT TO THE QVT, REFER TO MCNICHOLAS DRAWING McN12-007-1010

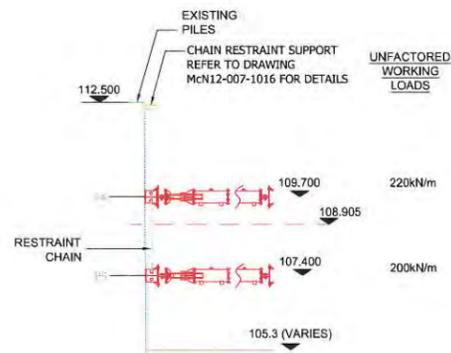
FRONT OF SHEET PILES ON THIS SIDE TO BE FLUSHED WITH 12000mm SECANT PILE WALL

2 LEVELS OF PROPPING (MAXIMUM PROP SPACING OF 3.0M)

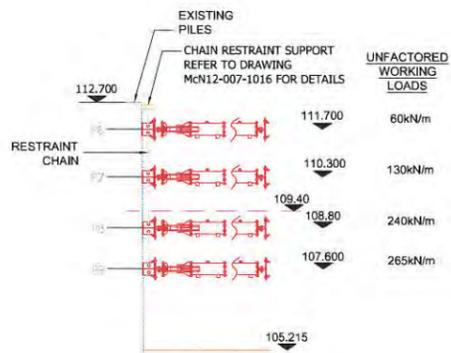
4 LEVELS OF PROPPING - A MINIMUM CLEAR SPACING OF 2720 BETWEEN PROPS MUST BE MAINTAINED (3180 C/C), OVERALL LENGTH OF PIPES IS 2625

PLAN VIEW OF PROPPING ARRANGEMENT (ONLY TOP LEVEL OF FRAMES VISIBLE)

SCALE 1 : 100



SECTION B - B
SCALE 1 : 100



SECTION C - C
SCALE 1 : 100

PROPPING SCHEDULE FOR TOP LEVEL OF FRAMES (P4)

Schedule of Weights: Maxi Brace		
No.	Description:	Weight per Item (kg)
8	9.0m Long Extension	1185

Schedule of Weights: MP80 STRUTS		
No.	Description:	Weight per Item (kg)
12	MP80 - Type 0.5 Mech Strut	tbc

PROPPING SCHEDULE FOR BOTTOM LEVEL OF FRAMES (P5)

Schedule of Weights: Maxi Brace		
No.	Description:	Weight per Item (kg)
14	3.0m Long Extension	430
6	5.0m Long Extension	685

Schedule of Weights: MP80 STRUTS		
No.	Description:	Weight per Item (kg)
12	MP80 - Type 0.5 Mech Strut	tbc

PROPPING SCHEDULE FOR TOP LEVEL OF FRAMES (P6)

Schedule of Weights: Maxi Brace		
No.	Description:	Weight per Item (kg)
2	3.0m Long Extension	430
2	9.0m Long Extension	1185

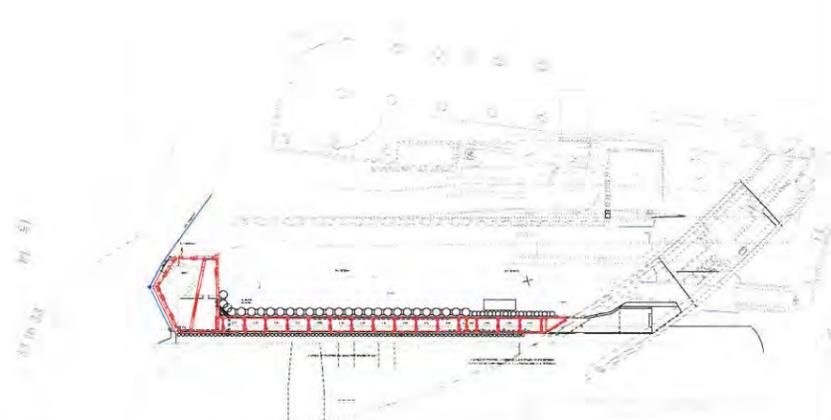
Schedule of Weights: MP80 STRUTS		
No.	Description:	Weight per Item (kg)
5	MP80 - Type 0.5 Mech Strut	tbc

PROPPING SCHEDULE FOR BOTTOM LEVEL OF FRAMES

Schedule of Weights: Maxi Brace		
No.	Description:	Weight per Item (kg)
12	3.0m Long Extension	430
8	5.0m Long Extension	685

Schedule of Weights: MP80 STRUTS		
No.	Description:	Weight per Item (kg)
15	MP80 - Type 0.5 Mech Strut	tbc

Schedule of Weights: 'Frame A'		
No.	Description:	Weight per Item (kg)
1	Double Acting Leg 490	350
2	Double Acting Leg 690	440
1	Articulation Adaptor (m&f)	55



SITE PLAN
1 : 500

SHEAR STOPS/CLAMPS
(To be attached at these locations in accordance with the installation instructions)
SHEAR STOPS/CLAMPS 8 No.

- NOTES**
- ALL DIMENSIONS IN mm UNLESS STATED OTHERWISE.
 - THE CONTRACTOR MUST UNDERTAKE A SERVICES SEARCH IN THE VICINITY OF THE WORKS BOTH VISUALLY AND USING APPROVED CAT EQUIPMENT.
 - MATERIAL ARISING FROM EXCAVATIONS NOT SUITABLE FOR SPREADING LOCALLY SHALL BE TAKEN OFF SITE TO A SUITABLY LICENSED TIP.
 - INSTALL TEMPORARY WORKS BY DIG / PUSH METHOD.
 - ALL EXISTING SERVICES ENCOUNTERED ARE TO BE SUPPORTED BY RATCHET STRAPS OFF TRENCH SHEETS OR ADDITIONAL WALERS LAID ACROSS EXCAVATION.
 - ANY WATER ENCOUNTERED TO BE PUMPED OUT.

CONCRETE
CONCRETE TO BE GRADE C40 WITH MINIMUM 325kg OF CEMENT PER CUBIC METRE. 20mm AGGREGATE SULPHATE RESISTING TO CLASS 2 OF TABLE 7 IN BS 5322 PART 1.

TOLERANCE
±2mm ON FINISHED SURFACE

Rev	Date	Description of Revisions	Drawn	Chkd	Appr
P07	26.01.13	NOTE IN PLAN REVISED	JT	MF	DP
P06	14.01.13	CHAIN RESTRAINT SUPPORT DETAILS ADDED	JT	MF	DP
P05	12.12.12	STRUT ARRANGEMENT & SCHEDULES AMENDED	JT	MF	DP
P04	04.12.12	STRUT CENTRES ALTERED TO 3.18m	LM	DP	JJ
P03	30.11.12	FRAME A & DETAILS ADDED	LM	DP	JJ
P02	19.11.12	SECTIONS AND PLAN REVISED - SEE CLOUDS	LM	DP	JJ
P01	09.11.12	FIRST ISSUE	LM	DP	JJ

FOR APPROVAL



Contractor(s)



Liamstone Industrial Park, Elmstree Road, Elmstree, Herts, WD6 3EA.
Telephone: +44(0) 208 953 4144 Website: <http://www.mcnicholas.co.uk>

Project

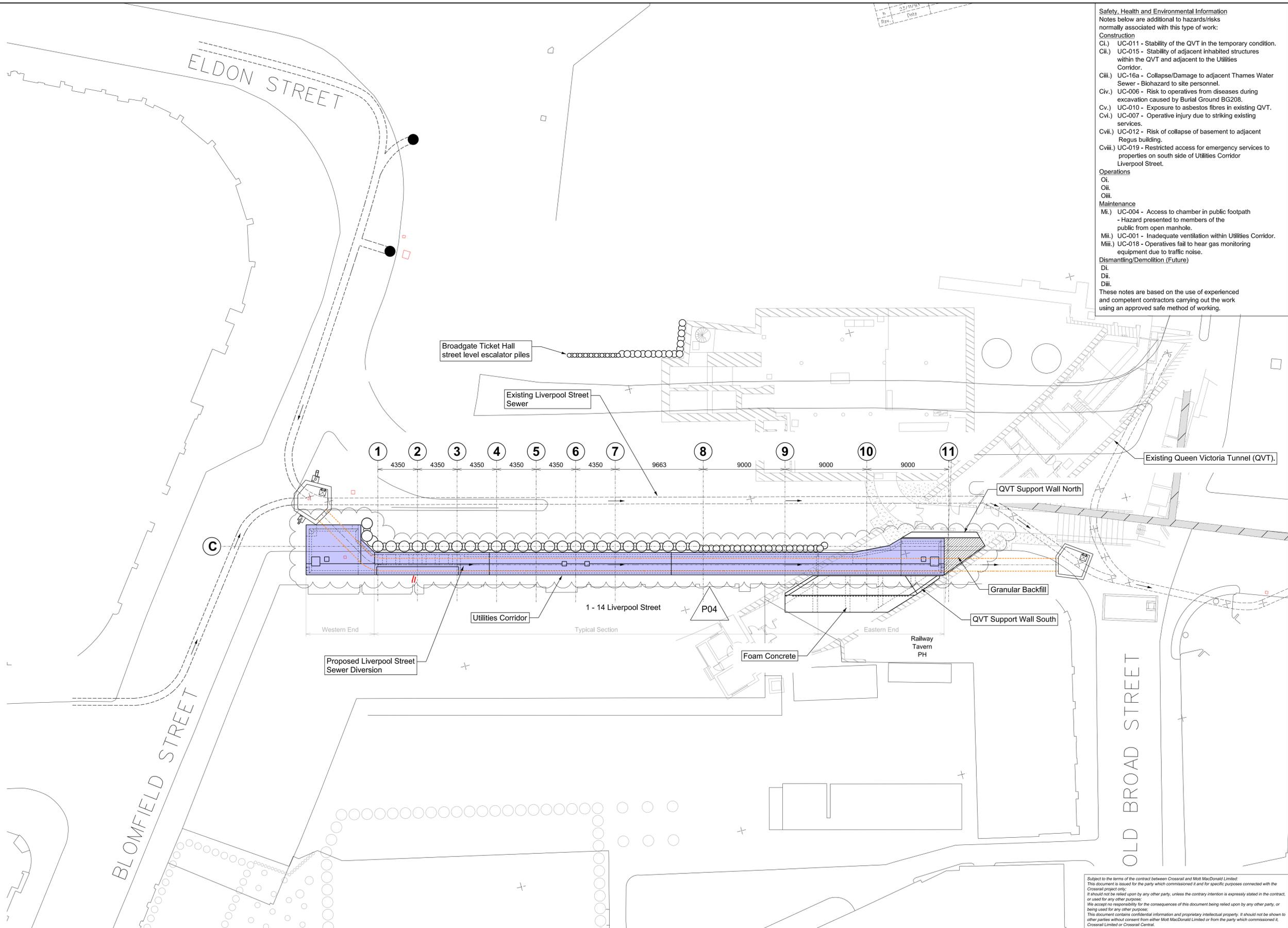
LIVERPOOL STREET STATION ENABLING WORKS PHASE 2

Drawing Title

TEMPORARY WORKS DESIGN FOR UTILITY CORRIDOR SECTION B-B & SECTION C-C

Designed	Signed	Date
M FAMILY		09.11.12
Drawn	Signed	Date
L MARTINS		09.11.12
Checked	Signed	Date
D POWERS		09.11.12
Approved	Signed	Date
J JEFFERS		09.11.12

Scale(s)	As Shown	ELR & Millage	N/A
Alternative Reference	MCN12-007-1011	Sheet	1 of 1
Drawing Number		Revision	P07



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

Construction
 Ci.) UC-011 - Stability of the QVT in the temporary condition.
 Cii.) UC-015 - Stability of adjacent inhabited structures within the QVT and adjacent to the Utilities Corridor.
 Ciii.) UC-16a - Collapse/Damage to adjacent Thames Water Sewer - Biohazard to site personnel.
 Civ.) UC-006 - Risk to operatives from diseases during excavation caused by Burial Ground BG208.
 Cv.) UC-010 - Exposure to asbestos fibres in existing QVT.
 Cvi.) UC-007 - Operative injury due to striking existing services.
 Cvii.) UC-012 - Risk of collapse of basement to adjacent Regus building.
 Cviii.) UC-019 - Restricted access for emergency services to properties on south side of Utilities Corridor Liverpool Street.

Operations
 Oi.
 Oii.
 Oiii.

Maintenance
 Mi.) UC-004 - Access to chamber in public footpath - Hazard presented to members of the public from open manhole.
 Mii.) UC-001 - Inadequate ventilation within Utilities Corridor.
 Miii.) UC-018 - Operatives fail to hear gas monitoring equipment due to traffic noise.

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

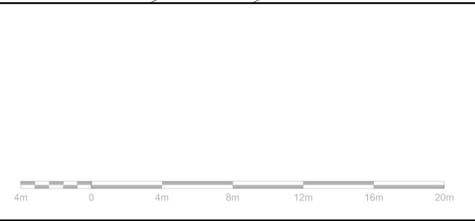
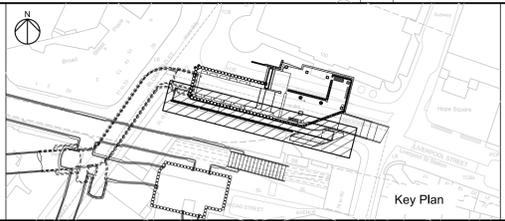
These notes are based on the use of experienced and competent contractors carrying out the work using an approved safe method of working.

Subject to the terms of the contract between Crossrail and Mott MacDonald Limited. This document is issued for the party which commissioned it and for specific purposes connected with the Crossrail project only. It should not be relied upon by any other party, unless the contrary intention is expressly stated in the contract, or used for any other purpose. We accept no responsibility for the consequences of this document being relied upon by any other party, or being used for any other purpose. This document contains confidential information and proprietary intellectual property. It should not be shown to other parties without consent from either Mott MacDonald Limited or from the party which commissioned it, Crossrail Limited or Crossrail Central.

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Rev.	Date	Description	By	Chkd	App	Auth
P01.1		First Issue				
P01	27/08/2010	RIBA E Submission	PJ	BH	SA	
P02	17/02/2011	C503 RIBA F Submission	IW	BH	SA	
P03	14/07/2011	C503 RIBA F Submission	JB	AC	DK	
C01	25/07/2011	Issued as Fit for construction	JB	AC	DK	SS
P04	25/09/2012	Update to incorporate City of London and UKPN requirements	PC	DB	DK	
C02	17/10/2012	Issued as Fit for construction	PC	DB	DK	LE

Notes
 1. For General Notes, refer to drg no. C138-MMD-C-DDJ-C101_Z-89004.
 2. Denotes footprint of Utilities Corridor.





Crossrail Limited
 25 Canada Square
 Canary Wharf
 London
 E14 5LQ

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www.crossrail.co.uk

Contract:
Liverpool Street Station Design

Originator:
Mott MacDonald Limited

Location:
Liverpool Street Stn

Title:
**Broadgate Ticket Hall - Enabling Works
 Utilities Corridor
 Site Plan
 CC503**

By: P.CRUTTENDEN
 Chk: D.BARTLES
 App: D.KEOGH
 Auth: L.EDGE

Scale:
1:200 @ A1

Drawing and CAD file No:
C138-MMD-C-DDA-C101_Z-89001

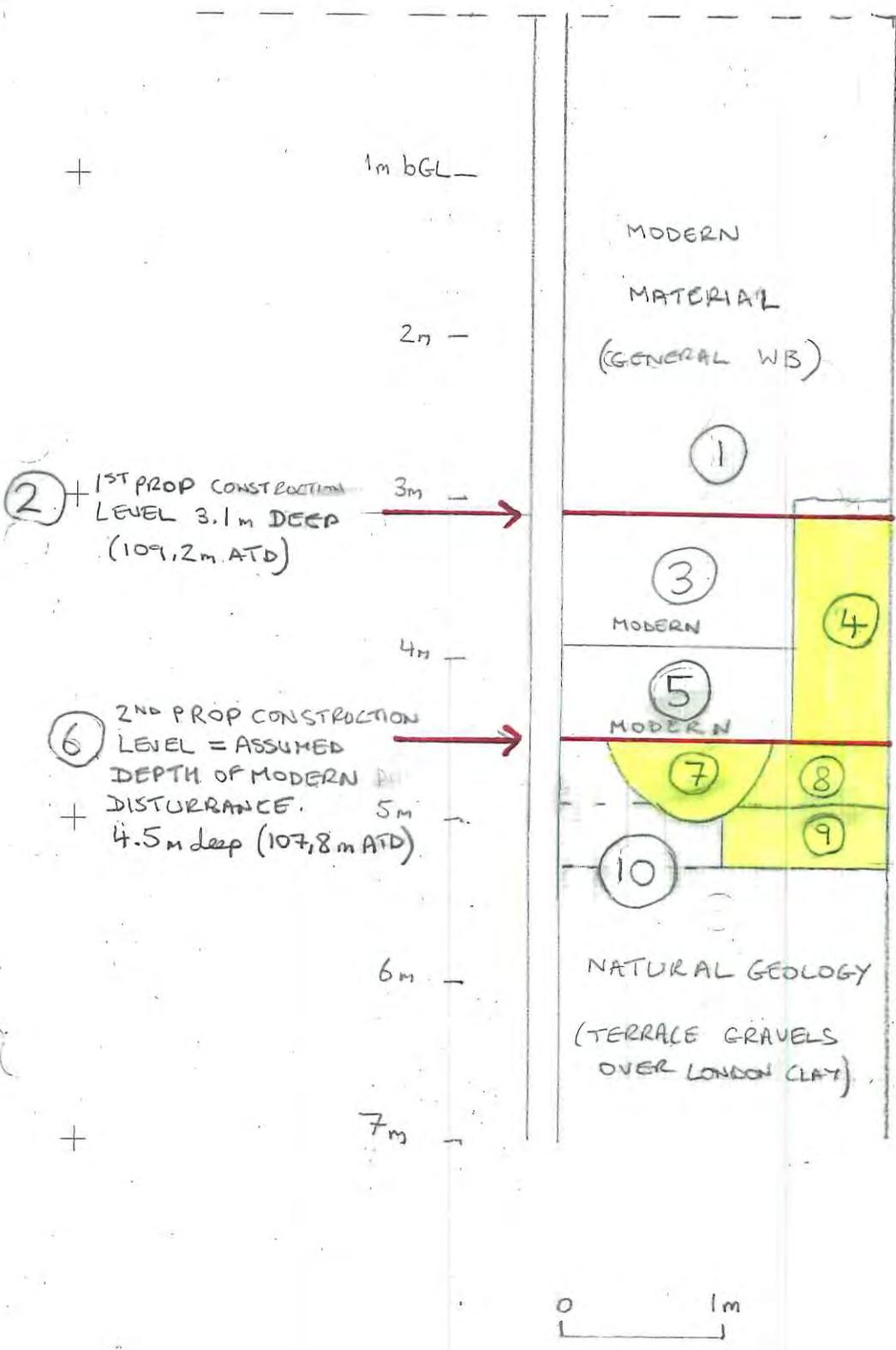
Rev: **C02**
 Suitability: **A**

RESTRICTED

S

N

AVERAGE GROUND LEVEL 112,3m ATD



② 1ST PROP CONSTRUCTION LEVEL 3.1m DEEP (109,2m ATD)

⑥ 2ND PROP CONSTRUCTION LEVEL = ASSUMED DEPTH OF MODERN DISTURBANCE. 4.5m deep (107,8m ATD)

ASSUMED LEVEL OF MODERN DISTURBANCE (NORTHERN) c. 0,6m

AREA OF HIGHER SURVIVAL ON N. SIDE
ROMAN & POST-ROMAN
c. 1,5m THICK

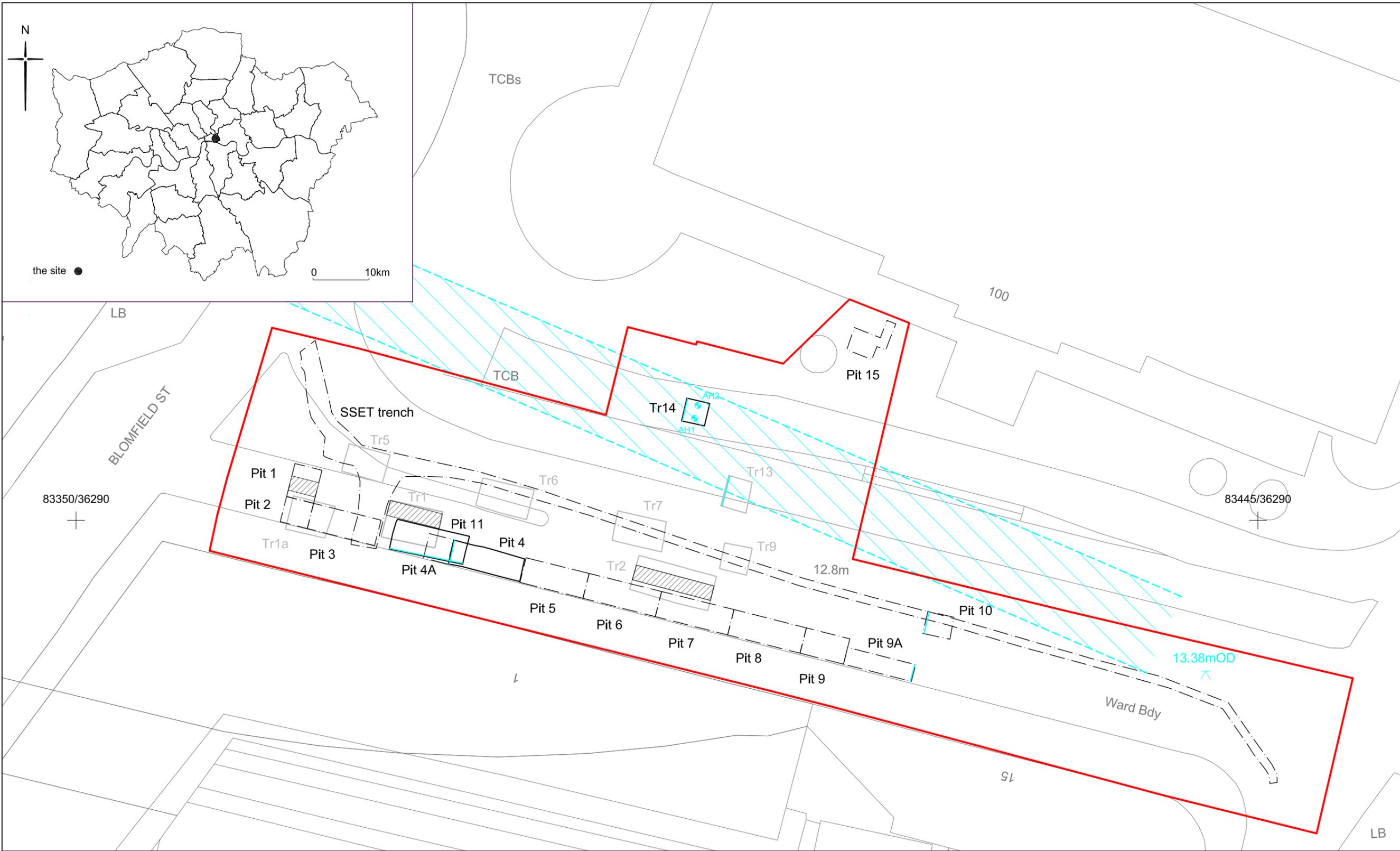
* ROMAN PITS + DITCHES ETC, CUT INTO ...
* ... ROMAN RECLAMATION DUMPS, c. 0,3-0,4m THICK
* WALBROOK ALLUVIUM, c. 0,3-0,4m THICK GENERALLY.
* ASSUMED BASE OF ARCHAEOLOGY (BUT DEEPER TO WEST + NR. T12)
(5,3m deep / 107,0m ATD OR LOWER)

PHASES

- ①-③ C503
- ④ MOLA
- ⑤+⑥ C503
- ⑦-⑨ MOLA (⑦ INDICATIVE)
- ⑧+⑨ NORTH HALF ONLY
- ⑩ C503

N.B. ALL LEVELS AND EXTENTS OF ARCHAEOLOGY ARE APPROXIMATE PREDICTIONS, AND WILL VARY.

PLAN/SECTION NO.		NOTES
DRAWN BY		BTU UTILITIES CORRIDOR SKETCH SECTION v2
CHECKED BY		
DATE		
SCALE		
MUSEUM OF LONDON		SITE



Location of archaeological investigations

- Site outline
- Evaluation and targeted watching brief areas
- General watching brief areas
- 2011 trench edges
- 110mATD TBM in mATD (for mOD, subtract 100m)
- 110mATD Section line
- 110mATD Auger holes
- 110mATD Roman road conjecture
- Sewer [535]

1:300 @ A3
 0 15m

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