C154 – Victoria Dock Portal

Written Scheme of Investigation
Victoria Dock Portal and DLR Realignment

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1 Executive Summary

1.1.1 This document forms the Site-Specific Written Scheme of Investigation (WSI), for the Victoria Dock Portal and DLR realignment works as part of the Crossrail development. This WSI was compiled using information available at the Gate 3 Submission (RIBA F Design) and from previous versions of the Victoria Dock Portal WSI (doc no .CR-SD-PRWX-IS-00002). The assessments of impacts and mitigation measures will need to be refined or determined as the works continue.

1.1.2 This document only considers works at the Victoria Dock Portal.

1.1.3 The Victoria Dock Portal will be located approximately 110m east of Royal Victoria DLR station, adjacent to Victoria Dock Road. The Victoria Dock Portal worksite is shown in Figure 1 below.

1.1.4 The works involve the excavation and construction of a tunnel portal, diversion of the Docklands Light railway (DLR), and associated construction compounds and worksites. The existing disused North London Line (NLL) will be demolished; the DLR stations at Royal Victoria and Custom House will remain (see Figure 1 below). This WSI will assess the impact of these works on the archaeological domain and where possible, advise on an appropriate level of mitigation. Where appropriate, it sets out the required mitigation, programme and scope for each contractor, Principal Contractor and Archaeological Contractor.

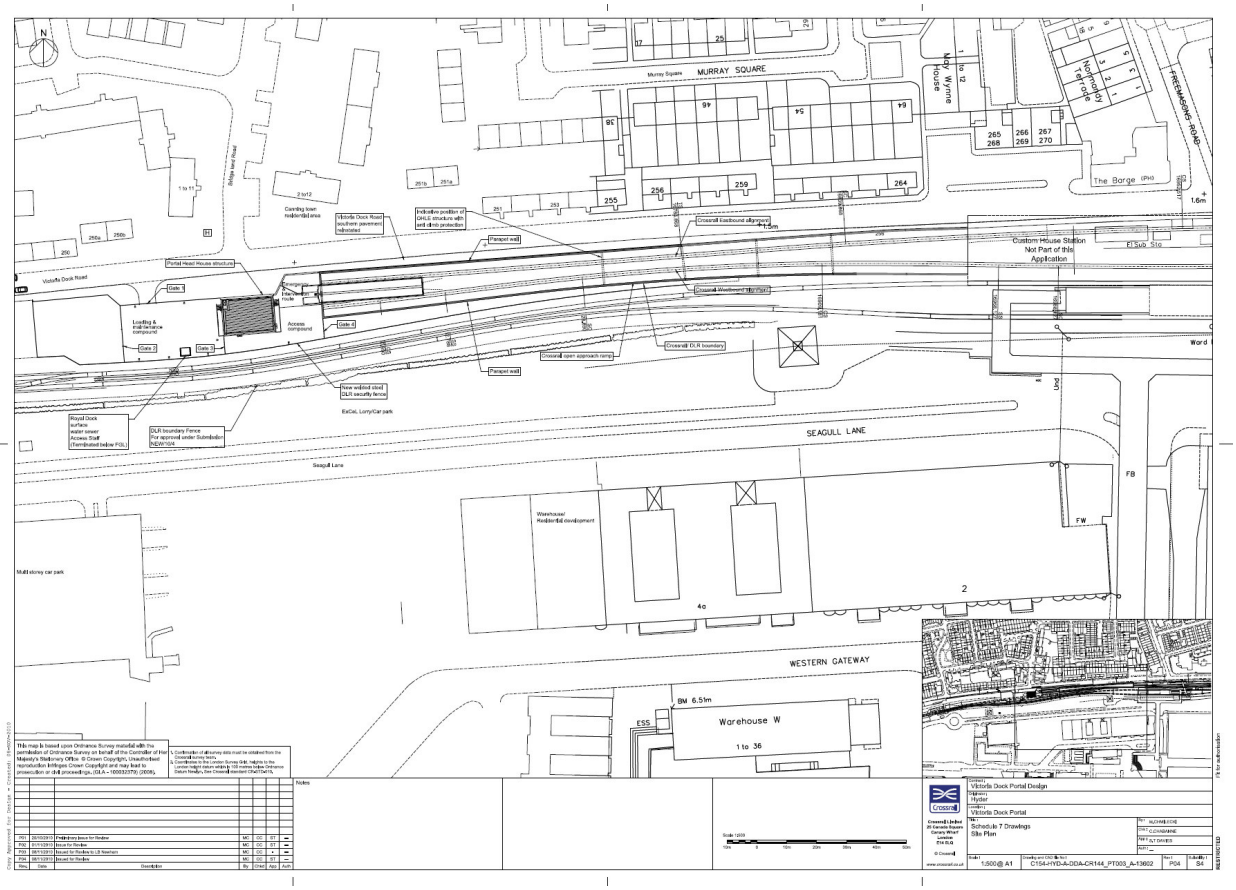

Figure 1: Victoria Dock Portal location Site Plan.

1.1.5 The site lies within an Archaeological Priority Zone defined by the LB Newham as areas GLAAS believe have particular interest or value, or sites where it can reasonably be shown from existing sources (i.e. Greater London Historic Environment Record) that remains of archaeological importance may survive. There are no scheduled ancient monuments or listed buildings within the site.

1.1.6 The desk based investigation has shown that there is a high potential for prehistoric and later palaeo-environmental remains, including peat beds, and moderate potential for prehistoric remains, including structures such as timber track ways. There is also high potential for industrial and railway archaeology. Any remains of structures such as prehistoric track ways would be of high importance; other less well-preserved or extensive resources would be of moderate importance. The overall mitigation strategy for the site is preservation by record as set out in the Crossrail ES (2005). A Non-Listed Built Heritage and Street Furniture survey was undertaken as part of design development for the construction of the DLR realignment, which established the presence of a number of structures of local significance. An appropriate level of mitigation has been suggested, which comprise of methods to preserve the structures by record in line with standard archaeological/ built heritage practice.

1.1.7 A programme of archaeological monitoring of borehole excavation has been undertaken as part of the ground investigation works. Five window samples within the Excel Centre Lorry Park were monitored as part of this investigation. The results suggest that the marginal marshland of LZ4 (indicated in the deposit model) may have extended further south than previously thought, as well as sand and gravel islands either very close to or within the boundary of the portal excavation area. Further boreholes were monitored during the ground investigation Package 30. The possibility of undertaking trial trenching prior to construction of the portal has been considered. However, prior to the construction of the secant pile walls for the portal, the de-watering that might result from trial trenching could risk the destabilisation of the adjacent DLR to an unacceptable degree. Time will therefore be made in the construction programme to undertake the trial trenching once the portal area is water-tight from groundwater ingress. Subsequent mitigation will therefore be dependent on the results of the trial trenching and may consist of either nothing (if no remains are found in the trial trenches), or a targeted archaeological watching brief during phases of the works which are likely to produce observable archaeological faces, or an archaeological excavation to deal with particularly significant remains.

1.1.8 This document is subdivided into nine sections as follows:

- project background;
- construction impact summary and outline mitigation design;
- research design objectives of the investigations and research aims;
- scope of the investigation;
- programme for the investigation;
- specification for the investigation;
- description of required deliverables;
- results of consultation and required site monitoring; and
- personnel requirements.

2 Project Background

2.1 Project background and site location

2.1.1 Crossrail is a new cross London rail link project which will provide transport routes in the south east and across London. The line will provide a range of both new and improved rail journeys across London and its immediate surroundings. The proposed development will include the construction of seven stations within central London which will have interchange with other public transport modes including the London Underground, National Rail and the London Bus service; the development will also include the renewal and/or upgrade of existing stations outside central London. The route itself will link Maidenhead and Heathrow in the west with Shenfield in the northeast and Abbey Wood in the south-east. As part of the south-east spur works a portal at Victoria Dock will be required. The DLR will be realigned to accommodate the portal.

2.1.2 The Victoria Dock Portal is centred on National Grid Reference (NGR) 540460 180910. It will be located approximately 110m east of Royal Victoria DLR station, adjacent to Victoria Dock Road. It will be constructed on the current alignment of Network Rail's disused NLL. The eye of the tunnels will be located opposite 245 Victoria Dock Road from where a ramp will be contained within a cut-and- cover box to the portal opposite 2 to 12 Bridgeland Road as detailed in Annex 3. From this point, Crossrail will run in a retained cut to join existing track levels immediately to the west of Custom House station (ES, Volume 3,2005, p373).

2.2 Summary of previous assessment work

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

2.2.2 The Environmental Statement and supporting Specialist Technical Report (STR), 'Assessment of Archaeology Impacts' (Crossrail, 2005) presents the outcomes of the archaeological studies undertaken as part of the Environmental Impact Assessment (EIA). The archaeological assessment has included an evaluation of the likelihood of archaeological resources being present in land affected by the project, their importance and the extent to which they will be physically affected by the construction and operation of Crossrail.

2.2.3 A Detailed Desk Based Assessment (DDBA) has also been carried out for the Victoria Dock Portal titled 'Detailed Desk Based Assessment (DDBA) for Victoria Dock Portal & Custom House station' (doc no. CR-SD-PRW-X-IS-00001). DDBAs were undertaken on sites that required additional information to enable decisions to be made regarding an appropriate mitigation strategy.

2.2.4 A Written Scheme of Investigation (WSI) has previously been produced for the Victoria Dock Portal; Written Scheme of Investigation for the DLR realignment at Victoria Dock Portal and Custom House Station (doc no .CR-SD-PRWX-IS-00002). This document (C154-HYD-T1-JLT-CR144_PT003-00001) comprises an update of the aforementioned WSI, focusing on Victoria Dock Portal and the DLR realignment works. A separate SS-WSI has been produced for Custom House (C146-ATK-T1-RGN-CR145-00003)

2.3 Summary of previous Crossrail studies

2.3.1 Information on the existing boreholes, including historic third party boreholes and boreholes carried out as part of the Crossrail ground investigation packages, can be found in 'MDC4 Geotechnical Design Note — Victoria Dock Portal' (doc no. CR-DV-CT2-X-DG-00001) and 'MDC4 Geotechnical Design Note — Custom House Station' (doc no CR-DV-CUH-X-DG-00002).

2.3.2 Previous Crossrail studies, relevant to the Victoria Dock Portal site include:

- Crossrail, Environmental Statement — February 2005 (available to view here http://www.crossrail.co.uk/crossrail-bill-documents);
- Crossrail, Assessment of Archaeology Impacts, Technical Report. Part 4 of 6, South-East Route Section, 1E0318-E2E00-00001, February 2005 [Specialist Technical Report (STR)] (doc no. 1E0318-E2E00-00001);
- Crossrail, Supplementary Environmental Statement 2 (SES2) — January 2006 (available to view here http://www.crossrail.co.uk/crossrail-bill-documents);
- Crossrail, Assessment of Archaeology Impacts, Technical Report. Additional Provisions — January 2006 (Specialist Technical Report [STR]) (available to view here http://www.crossrail.co.uk/the-railway/getting-approval/parliamentary-bill/crossrail-bill-documents/specialist-technical-reports#tag/576);
- Crossrail, Amendment of Provisions 2 Environmental Statement – May 2006 (available to view here http://www.crossrail.co.uk/crossrail-bill-documents);
- Supplementary Environmental Statement 3 (SES3). November 2006 (available to view here http://www.crossrail.co.uk/crossrail-bill-documents);
- Crossrail, Archaeology Programming Assessment, November 2006;
- Crossrail, MDC4 Archaeology: Updated Baseline Assessment, MoLAS January 2008;
- Crossrail, MDC4 Archaeology Overview of ground Levels and Land Raising around the Docks in the MDC4 area, January 2008;
- Crossrail, MDC4 Archaeology — Geo-archaeological Deposit Model: Victoria Dock Portal. January 2008 (appendix to DDBA, doc no.CR-SD-PRW-X-IS-00001);
- Crossrail, MDC4 Archaeology DDBA Victoria Dock Portal Package Specific WSI Deliverable — 2008 (doc no.CR-SD-PRW-X-IS-00001);
- Crossrail, MDC4 Written Scheme of Investigation for the DLR realignment at Victoria Dock Portal and Custom House Station 2009 (doc no. CR-SD-PRW-X-IS-00002);
- Crossrail, Archaeological Monitoring of Ground Investigations: Limmo Peninsula and Victoria Dock Portal (Excel Car Park) 2010.
- Crossrail, Archaeological monitoring and deposit model of ground investigations GI package 30: Victoria Dock Portal, Custom House Station and Connaught Tunnel Worksites 2010 (doc no C122-OVE-T1-RGN-CRG01-50001)

2.4 Geological and topographical setting

2.4.1 The site lies on the reclaimed alluvial floodplain of the River Thames, approximately 700m to the north of the Thames. Overlying London Clay are the Floodplain sands and gravels deposited during the Pleistocene, approximately 2,000,000 to 10,000 Before Present (BP), during which the Thames was a fast flowing braided river, formed of interconnected channels interspersed with higher sand and gravel bars. These floodplain gravels form the 'Holocene Template' on which Mesolithic activity would have taken place, the areas around channels and lakes providing resources attracting a hunter-gatherer population.

2.4.2 During the early Holocene, sea levels rose and lower lying areas were inundated. By the time of the Mesolithic/Neolithic transition at approximately 4000BP, the level of the Thames is likely to have risen to approximately 97m ATD. From the Later Neolithic, the braided channels gradually silted up, and combined with the rising sea levels, the conditions were conducive to peat formation. The landscape became predominantly marshland, which was crossed by the Thames as a single meandering channel.

2.4.3 In the area of this site a geo-archaeological deposit modelling exercise (Crossrail DDBA, doc no.CR-SD-PRW-X-IS-00001) has identified four landscape zones (LZs) to enable analysis of underlying geology and the archaeological and palaeo-environmental potential from the later Mesolithic through to the early Bronze Age periods (C122-OVE-T1-RGN-CRG01-50001) as follows:

- Higher ground to the north (LZ1) does not extend to the Crossrail works;
- LZ2 consists of a network of braided channels of varying depths, cut into the Mesolithic land surface, and was previously modelled running through the central part of the portal site, for c. 200m but is not modelled within the portal site in the most recent report (C122-OVE-T1-RGN-CRG01-50001);
- LZ3 is higher gravel 'islands' with potential for dry-land Mesolithic and early Neolithic activity. There is one such island within the site, on the extended alignment of Bridgland Road, one some 50m to the west of the site and another immediately to the south east of the site; and
- LZ4 consists of marginal wetland, characterised by thick peat deposits and has potential for waterlogged later prehistoric remains such as timber trackways. This LZ is found at the westernmost 200m and easternmost 500m of the portal site although recent work suggests that this zone may extend into the area of the DLR re-alignment and portal (3.3.6).

This model is illustrated in Figures 1-5 of Annex 3. All figures have been sourced from C122-OVE-T1-RGN-CRG01-50001.

2.4.4 For further explanation of the archaeological potential see Section 2.5.1.

2.4.5 Modern ground level adjacent to the site lies at 101.5 to 101.6m ATD. The deepest observed alluvial/archaeological sequence extends 4.5m below ground level (C122-OVE-T1-RGN-CRG01-50001).

2.5 Archaeological and historical development of site

2.5.1 This section provides a brief overview of the archaeological and historical background of the site to enable the site to be seen within its wider context. More details are available within the Detailed Desk-Based Assessment. The Victoria Dock Portal lies within an Archaeological Priority Zone (APZ) as defined by the LB of Newham. There are no scheduled ancient monuments within the study area. Listed buildings do not fall within the remit of this report.

Prehistoric Period (approximately 500,000BP to AD50)

2.5.2 All areas of the site have a high potential for palaeo-environmental evidence, including the survival of material such as molluscs, insects and pollen, especially within the channel sediments of LZ2 and in LZ4.

2.5.3 The deep channel areas of LZ2, have a moderate potential for prehistoric remains, notably possible Mesolithic activity adjacent to any channels, and later remains such as boats or fish traps within the alluvium which subsequently sealed that horizon as water levels rose.

2.5.4 On the islands of higher ground (LZ3) there is a moderate potential for evidence of Mesolithic and early Neolithic semi-permanent dry land activity, such as flint working areas or ephemeral structural occupation remains. A Crossrail borehole at such an island at the western end of the DLR diversions, west of the portal, contained a sandy peat layer interpreted as a possible Mesolithic soil horizon, which may offer high potential for evidence such as lithic scatters, CH22, South end of Munday Road, see Section 1.4 of Crossrail 2008b 'MDC4 Archaeology, Geo-archaeological Deposit Model', referenced in section 11. The most recent deposit model also identifies an island within the site on the extended alignment of Bridgland Road and another to the immediate south east of the site. The elevation of the surface of the gravel islands is between 98m and 99m ATD.

2.5.5 The marginal marshland of LZ4 has potential for well-preserved waterlogged prehistoric archaeological remains such as timber trackways or jetties from the Neolithic and Bronze Ages, and other organic remains such as weirs, fish traps, revetments, causeways, peat deposits, and possibly boats. The most recent deposit model suggests that there is a humic layer across LZ4 at a fairly consistent level of c99m ATD. Previous deposit models suggested that this might be of Mesolithic date and was confined to the gravel islands but this new observation suggests that the deposit is Bronze Age.

Roman Period — AD50 to 450

2.5.6 The environment in the area of the site remained marshy open land throughout the Roman period, although there is evidence of dropping local water levels and therefore there may have been occupation in the previously marshy areas, see Crossrail 2008b 'MDC4 Archaeology, Geo-archaeological Deposit Model'. However the gravel islands forming LZ3 lay at 98 to 99m ATD and probably remained inundated during this period.

Medieval Period — AD450 to 1540

2.5.7 The site was inundated after the Thames levels rose again during the early medieval period, and much of the landscape would have returned to marshy areas unfit for permanent settlement. The marshy low lying areas were gradually drained and reclaimed during the later medieval period. The higher areas to the north of the site saw the origins of the manors of West Ham and East Ham. The medieval manor of Sudbury may have been located towards the south-east end of the Custom House worksite. Although its exact

location is not known, there is potential for associated features such as field systems or land boundaries within that worksite but not Victoria Dock Portal.

Post-medieval — AD1540 to 1900

2.5.8 The process of land reclamation continued into the Nineteenth Century. The North Woolwich Railway line, opened in 1847 was constructed across previously undeveloped marshland. The growth of the docks ensured the area altered in character significantly during the post-medieval period, with the Royal Victoria Dock constructed in 1850 to 1855. There is high potential for industrial, and possibly railway, remains from this period on the site. This period also saw a huge increase in the construction of housing throughout the area north of Victoria Dock Road, including The Barge Public House, formerly the Freemasons Tavern, parts of which were built approximately 1862. The Royal Victoria and Albert Docks Cut (now filled in) is shown on maps of the late Nineteenth Century, and there is potential for this drainage channel at the southern edge of both the portal and Custom House station, and along the DLR diversion. Two smaller channels ran southwards across the Custom House station site into the Docks Cut.

Modern — AD1900

2.5.9 Although badly damaged during bombing raids of World War II, the docks continued in use until after the war. From the 1960s onwards, the docks suffered from modern improvements in trade, and the move of large shipping to Tilbury docks further downstream. The Royal Victoria Dock ceased to accept commercial shipping in 1980.

2.6 Deposit survival

2.6.1 It is assumed that there is a depth of at least approximately 0.5m of modern disturbance below present ground level, overlying Nineteenth Century below ground archaeological remains, e.g. the former Royal Victoria and Albert Docks Cut, and elsewhere a depth of at least approximately 1.0m over earlier remains. Modern ground level is relatively level at approximately 101.5m ATD, suggesting that archaeological deposits may survive up to approximately 101 and 100.5m ATD, respectively.

2.6.2 There is likely to be up to a thickness of approximately 4.0m in LZ3 (97m ATD), and up to approximately 3.5 to 4m in the marginal ground of LZ4 (97m ATD). Natural features such as stream channels may extend below this level although none are currently modelled.

2.7 Archaeological potential

2.7.1 There is the potential for archaeological remains to be present in areas as follows:

- There is a moderate potential for remains on high gravel ‘islands’ (LZ3); and for Neolithic/Bronze Age wetland remains such as timber trackways or platforms preserved within peat deposits (LZ4) see Section 2.4 for the locations where such deposits are expected.
- There is high potential for supporting palaeo-environmental sequences across the site.
- There is a low potential for evidence of Roman activity in the marshes.
- There is a high potential for Nineteenth and Twentieth Century industrial archaeology, including the Royal Victoria and Albert Docks Cut, possible railway features.

2.8 Importance

2.8.1 With the exceptions of well-preserved prehistoric structures the majority of the potential archaeological remains within the site study area are likely to be of moderate importance if extensive, well-preserved remains are present. Less well-preserved or less extensive remains are likely to be of low importance.

2.8.2 Any well-preserved prehistoric structures such as track ways, boats or other evidence of prehistoric exploitation of the area might be of high importance.

3 Construction Impact Summary and Outline Mitigation Design

3.1 Impacts

Scheme review

3.1.1 The following sections describe the impacts as at Gate 3 Submission (RIBA F Design).

3.2 Victoria Dock Portal

Construction summary

The portal works, descending from ground level, consist of the portal approach ramp within a retained open cut and a length of cut-and-cover tunnel. The cut and cover TBM Chamber would be used during construction for the removal of TBMs. Access for emergency services and passenger escape facilities is provided in the cut-and-cover section. A construction compound, 'worksite', would extend along the proposed route, and service diversions are required. It should be noted at this stage that precise details of impact levels are not known and the impact will be refined further when this data is available.

Permanent works

3.2.1 The Victoria Dock Portal runs from part of the marginal marshlands of LZ4 at the tunnel eye, through the deeper channels of LZ2, to a further area of LZ4, towards the eastern end, possibly extending to a higher island of LZ3 towards Custom House station. The Victoria Dock Portal consists of:

- approximately 14m length of cut and cover TBM reception chamber using secant piling to approximate depth of 20m below ground level;
- a further length of cut and cover tunnel approximately 90m long; 38m length houses the M&E rooms at surface level. Secant piling is used to an approximate depth of 20m below ground level;
- approximately 70m length of retained cut using secant piling to an approximate depth of 14m below ground level;
- approximately 145m length of retained cut using temporary steel sheet piling to an approximate depth of up to 14m below ground level supported on bored piles to an approximate depth of up to 19m below ground level;
- major service diversions: 1,325mm diameter foul sewer, EDF cables, 15" diameter water mains and an intermediate pressure gas main;
- original installation of services is likely to have partially removed surviving archaeological remains if they extend more than c. 1m below current ground level, or c. 0.5m at the locations of Nineteenth Century structures; and
- the permanent diversion of DLR may partially remove archaeological remains. The laying of track should have no impact on potential archaeological remains where it lies within the existing track bed, but outside it may partially remove such remains if the works extend below a depth of c. 1m from current ground level, or c. 0.5m at the locations of Nineteenth Century structures, in particular the Royal Victoria and Albert Dock cut. Associated ducts and drainage may also have an impact on archaeological remains.

Temporary works

3.2.2 A construction compound, Victoria Dock/Custom House worksite, is proposed to serve both this site and Custom House station. It extends from east of the Prince Regent DLR station along the cutting, westwards to Royal Victoria DLR station. Although precise details are not known at this stage, the impact of works for preparatory ground reduction, hard standing and footings for plant, accommodation and a site footbridge, c. 1m deep, may partially remove potential archaeological remains. A tower crane base, supported on piled foundations, may completely remove such remains locally, depending on its depth.

3.2.3 Laying down of an area of hard standing between the ExCeL car park and the DLR is only likely to have an impact on any surviving remains of the late Nineteenth Century railway sidings if it requires general reduction of more than c. 0.5m. The removal of the existing NLL track on the line of the Victoria Dock Portal is unlikely to have an impact.

3.3 Outline mitigation design

3.3.1 The overall mitigation strategy for the site is preservation by record. The Non-Listed Built Heritage and Street Furniture survey identified and assessed the Non-Listed Built Heritage features present on the site, in order to determine the appropriate level of recording. There is no NLBH affected solely by Victoria Dock Portal C154 works.

3.3.2 Targeted watching briefs will be carried out during the proposed service diversions, and for works of limited impact within the construction compounds.

3.3.3 Unfortunately, it is not possible to excavate trial trenches prior to installation of the secant and sheet piled walls of the portal without risking de-stabilising the adjacent Docklands Light Railway due to the de-watering of the underlying deposits. Trial trenching will therefore be undertaken once the secant pile and sheet pile walls for the portal have been constructed. Three trenches will be excavated (see Figure 2 overleaf) which will focus on the areas of highest potential as it is currently modelled, namely the gravel islands at the west and east of the portal and the area of marshland between them

3.3.4 If the results from the archaeological trenches are positive then the C340 Construction Programme developed by FDC C154 for RIBA F Gate 3 allows for a reduced rate of excavation (300m3/day) to accommodate a targeted watching brief. However, this approach does not allow for recording of more substantial finds and therefore this potential increase in construction time has been added as a risk to the Risk Register. The C340 contractor will be expected to demonstrate in his Tender submission how he intends to manage this risk. See 6.4.2 below for a scenario for potential finds. If no archaeological remains are found in the trial trenches then, once the sequence has been recorded and appropriate geo-archaeological and palaeo-environmental samples have been taken, no further archaeological intervention will be required.

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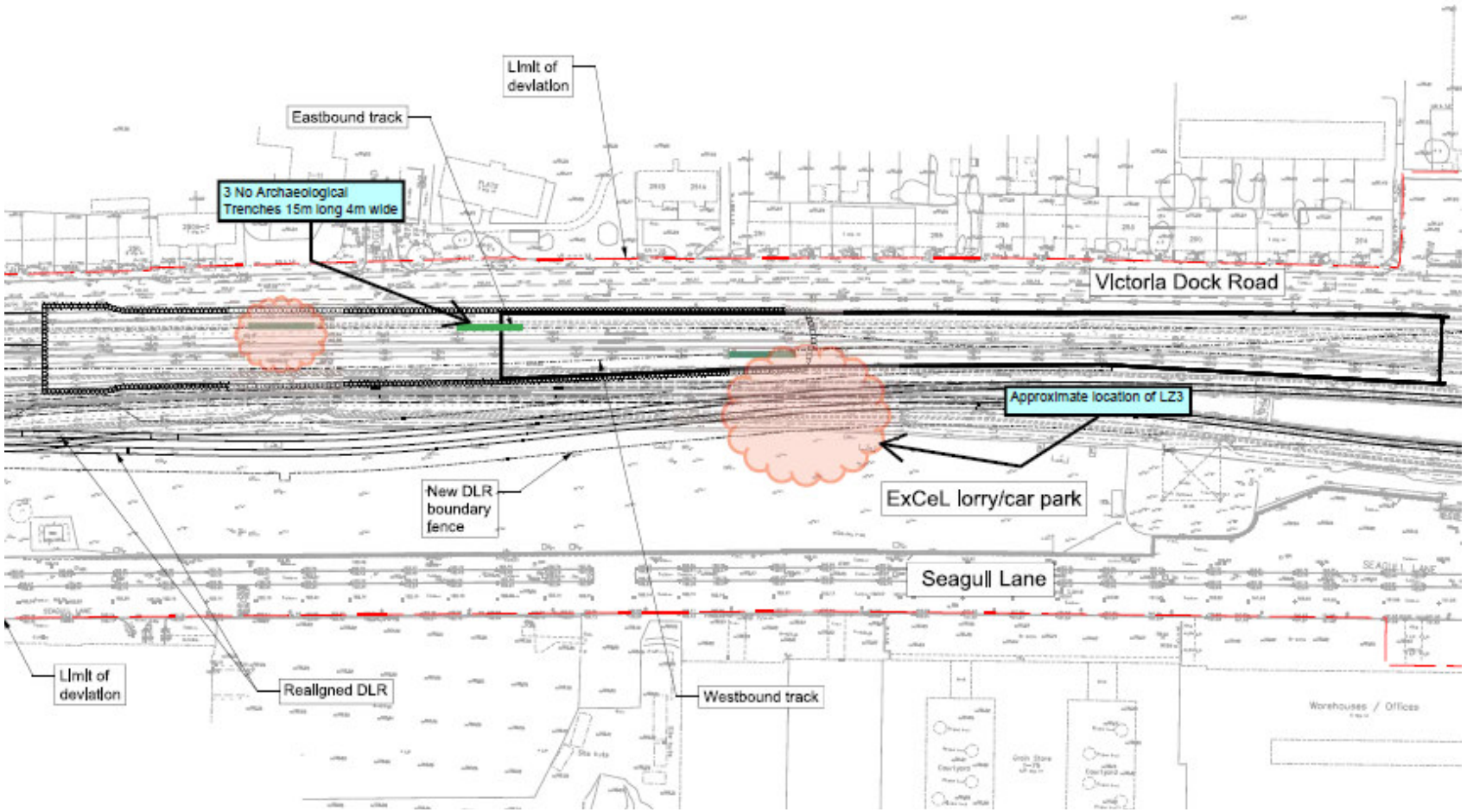

Figure 2: Victoria Dock Portal – Archaeological Trench Location Plan (Exact location of trenches to be agreed on site by CRL/C340)

4 Research design objectives of the investigation and research aims

4.1 Aim of proposed investigations

4.1.1 The purpose of a Non-Listed Built Heritage and Street Furniture survey was to identify any historic elements associated with historic railway or industrial structures that may survive within the site. This survey, in conjunction with the detailed designs, determined appropriate mitigation measures where impacts have been identified.

4.1.2 The precise aims, and types, of any watching briefs will be determined as the detailed design stage continues, but in general they will be to investigate, record, and where appropriate sample, any archaeological remains encountered by works where the extent of the impact is limited, and/or there is only a low potential for the works to encounter archaeological remains. The watching briefs may include geo-archaeological recording and sampling.

4.2 Site specific research aims

4.2.1 The following specific research aims for the works at Victoria Dock Portal have been identified at this stage:

- What is the development of the local landscape, topography and environment of the Thames floodplain? Can buried peat deposits be identified? If they can be dated what activity is contained within them, and how does this help to refine knowledge of prehistoric activity, occupation and settlement in the marginal wetland habitats?
- Is there any evidence for Mesolithic activity at the base of the alluvium/surface of the gravels? Is there any evidence of Mesolithic activity on the higher gravel areas of LZ3? If so, what form does this activity take, e.g. fishing, hunting, flint working etc?
- Is there any evidence for later prehistoric activity or occupation? What is the nature of activity in the marginal marshlands of LZ4? Is there evidence of prehistoric water management or subsistence fishing? What is the nature of activity on the higher grounds of LZ3? Is there evidence of semi-permanent occupation?
- Is there any evidence for Roman activity, in particular for water management, flood defences and/or fishing?
- What can be learned about the process of land reclamation and management of the area from the medieval period until the construction of the docks?
- What can be learned about the development of the docks during the recent historic period? Can details about London's growth as a 'world city' and the contribution of the Docks to this economic growth be further elucidated?
- Are there any surviving remains of the Royal Victoria and Albert Docks Cut, and the channels that fed into it? If so, what can be learned about the methods, materials and techniques employed in its construction?

4.3 Relevant regional research aims

4.3.1 The site has potential to address several general research aims identified in the regional research agenda: 'A Research Framework for London Archaeology' — Museum of London, 2002. The specific regional research themes are outlined below (page numbers are in brackets):

- understanding the significance of geomorphology, ecology, ecosystems and climate, hydrology, and vegetational and faunal development, on human lives (79);
- understanding London's hydrology, river systems and tributaries particularly the role of the Thames (as boundary, communication route, resource, ritual focus etc) in shaping London's history, and the relationships between rivers and floodplains (79);
- understanding the relationship between landscape, river and settlement, and the influences of the Thames in particular on communications and social interaction (79);
- understanding the origins of the prehistoric metalwork sequence from the Thames, and examining the links between the metalwork hoards deposited at the headwaters of river tributaries and other activities (79);
- studying the correlation between sites associated with watercourses and meander bends, so as to understand the origin of settlements (80);
- understanding the relationship between the Bronze Age wooden trackways and the settlements to which they presumably led, and what the trackways represent in terms of woodcraft and woodland management (82);
- understanding the development of London's Docklands and Waterways (82);
- examining breeding programmes and wildlife management, and marine and riverine exploitation, to understand the strategies used, their success or otherwise, and their consequences (83);
- understanding the nature and meaning of the deposition of metalwork in the Thames and at the headwaters of river tributaries (86); and
- The Mesolithic to Neolithic transition: understanding the significance of horticultural experimentation at this time, and the transition from hunter-gatherers to farmers (87).

5 Scope of the investigations and Field Methodology

5.1 Introduction

5.1.1 Mitigation methods required for the Victoria Dock Portal worksite are listed below.

5.2 Victoria Dock Portal

5.2.1 Targeted Watching briefs will cover the excavation of the portal. These will include; ground reduction and footings within the construction compounds (worksites), shallow service diversion trenches, and those parts of the DLR diversion works which are deep enough to have a possible impact, see Section 4.0. The responsible contractors and proposed dates are detailed below.

5.2.2 Watching brief requirements for Enabling works are as follows.

5.2.3 A watching brief will be required during some of the works associated with the Enabling Works (currently C233)for Victoria Dock Portal. The works include:

- M4CUHS2015: Lay connect 1325mm Sewer
- M4CUHS2075: Lay and connect 600mm Gas Main IP .

The watching briefs are targeted to observe any archaeological deposits within the alluvial deposits which might be revealed.

5.2.4 A watching brief will not be required during the Main Track Re-Alignment Works for Victoria Dock DLR Realignment. All works will be within made ground.

5.2.5 Once the secant pile wall has been constructed, three archaeological trial trenches will be excavated. These will be 15m in length by 4m in width at their base and will be aligned east-west. Their positions are shown on Figure 2 above, with the exact position agreed on site by CRL and C340. The trenches will evaluate the complete archaeological sequence– down to the gravel where it exists and also sampling any archaeological features which may be cut into the gravel. They could, therefore, extend to a depth of up to 4.5m below the existing ground surface. How the sides of the trench will be supported will be a matter for C340 (in consultation with C263) but either sheet piling or drag boxes would seem to provide the most obvious solutions. Liaison on the best methodology between the main Contractor (C340) and the archaeological Contractor (C263) will be crucial to the success of the exercise.

5.2.6 A targeted watching brief may be required during some of the main civil works for Victoria Dock Portal to observe and record any archaeological remains which may be revealed within the alluvial deposits or the gravels beneath. If this is the case, so as to ensure that any archaeological remains can be observed and recorded, excavation through the alluvium and any archaeological deposits on or cutting the river terrace deposits below will be undertaken by a large 360 degree excavator fitted with a wide bladed bucket (ditching bucket or similar) with no teeth. This will reduce levels in spits to a depth at the discretion of the monitoring archaeologist (C263) up to a maximum of 300mm over its reach so that any archaeological remains revealed may be exposed further by hand and appropriately sampled and recorded. It will then move backwards and start excavating again so that neither the excavating machine nor any dump truck or other spoil removal vehicle travels over the ground which has just been exposed. There is no need for any archaeological watching brief to continue once the River Terrace Deposits have been reached and any remains within them appropriately sampled and recorded. These works are illustrated on

the Construction Sequence Drawing included in Annex 3 (C154–HYD-C-DDB-CR144_PT003-20200, C154–HYD-C-DDB-CR144_PT003-20210, C154–HYD-C-DDB-CR144_PT003-20211, C154–HYD-C-DDB-CR144_PT003-20212, C154–HYD-C-DDB-CR144_PT003-20220) and it is while excavation is taking place through the alluvium illustrated in blue on those drawings that the watching brief is required: it should continue until the river terrace deposits are reached and any archaeological features on or with the river terrace deposits have been exposed and recorded. The proposed C340 Portal and DLR Realignment Construction Programme (C154-HYD-N2-TPG-CR144_PT003-00279 V6.0) reflects this methodology and the following activities accommodate the targeted watching brief:

Secant Pile Walls:

- SE3490: Bulk excavation in “open sky” (for 5m total depth) ;
- SE3550: Excavation under Archaeological watching brief;

Sheet Pile Section – 182m Ch 85973 - 86120:

- SH2070: Bulk excavation in “open sky”;
- SH2090: Excavate to formation level.

5.2.7 It should be noted that the results of the trial trenching may allow the above methodology to be revised, perhaps focussing on particular depths in the alluvium, for example. Any such revision should be undertaken in consultation with the Project Archaeologist.

5.2.8 If the trial trenches do not reveal any archaeological remains then no further archaeological intervention will be required once the sequence of deposits in the trial trenches has been recorded and appropriate geo-archaeological and palaeo-environmental samples have been taken. Equally, if particularly significant archaeological remains are located then an archaeological excavation may have to be undertaken to record the remains. The design of the appropriate mitigation will be undertaken following the trail trenching in consultation with the Project Archaeologist and GLAAS.

5.3 Service diversions

5.3.1 No general watching briefs will be carried out during the excavation of shallow service diversion trenches and micro-tunnelling between thrust and reception pits.

5.4 Site Accommodation and Facilities

5.4.1 The Main Contractor (C340) shall provide the following site accommodation facilities for the use of archaeological operatives, inclusive of any hardstanding and services required:

- design of the method of excavation of the trial trenches and appropriate support structures (see 5.25 above)
- welfare accommodation;
- toilets, with drying and washing facilities;
- first aid; and
- temporary office and secure storage facilities.

6 Programme for the Investigations

6.1 Introduction

6.1.1 Site possession for Victoria Dock Portal started in the fourth quarter of 2009.

6.2 Enabling works

6.2.1 The enabling works at Victoria Dock portal are split up into two areas, the Victoria Dock DLR Realignment and Victoria Dock Portal. Enabling works for Victoria Dock DLR Realignment will occur between 17th March 2011 and 4th August 2011 and the enabling works for Victoria Dock Portal will occur between 17th March 2011 and 14th October 2011.

6.2.2 Watching briefs on service diversions, construction compound/worksite establishment, etc will also take place during the enabling works, including the targeted watching briefs on the shafts for major service diversions.

6.2.3 A watching brief will not be required for the enabling works associated with Victoria Dock DLR Realignment as they are all within the made ground. However, a watching brief will be required during the construction of the thrust and reception pits associated with the sewer diversion micro-tunnelling.

6.2.4 A watching brief will be required during some of the works associated with the Enabling Works (currently C233) for Victoria Dock Portal. The works include:

- M4CUHS2015: Lay connect 1325mm Sewer between 10th June and 14th October
- M4CUHS2075: Lay and connect 600mm Gas Main IP between 21st July and 31st September 2011;

6.3 Main construction

6.3.1 The main construction works are split into two areas, the Victoria Dock DLR Realignment and Victoria Dock Portal. The main works for the Victoria Dock DLR Realignment are programmed between 1st October 2012 and the 4th February 2014. The Victoria Dock Portal works are programmed between the 17th September 2012 and 21st August 2015.

6.3.2 A watching brief will not be required during the works associated with the Main Track Re-Alignment Works (currently C340) for Victoria Dock DLR Realignment as all of the works will be within made ground.

6.3.3 A field evaluation will be undertaken once the secant pile walls have made the area of the portal watertight from groundwater ingress. This will be programmed by C340 in liaison with C263 and the Project Archaeologist. A targeted watching brief may be required during some of the works associated with the main civil works for Victoria Dock Portal (C340) as these works will be within the alluvium. These works include (Ref C340 Portal and DLR Realignment Construction Programme C154-HYD-N2-TPG-CR144_PT003-00279 V6.0):

Secant Pile Walls:

- SE3490: Bulk excavation in “open sky” (for 5m total depth) 15/8/13 – 5/9/13;
- SE3550: Excavation under Archaeological watching brief 6/9/13 – 3/10/13;

Sheet Pile Section – 182m (Ch 85973 – 86120):

- SH2070: Bulk excavation in “open sky” 5/7/13 – 2/8/13;

- SH2090: Excavate to formation level 19/8/13 – 1/10/13.

6.4 Review of Risk of Possible Finds

6.4.1 The Construction Programme and Constructability report for C340 developed by FDC C154 for RIBA F Gate 3 allows for a reduced rate of excavation for a targeted watching brief. The construction programme allows for 60% of the excavation to be dug at a normal engineering excavation rate of 600m3/day Whilst the rate of excavation for the remaining 40% will be reduced to 300m3/day. This reduced rate will allow for a targeted watching brief to be undertaken. The reduced rate should also allow for undertaking brief recordings while other areas within the targeted watching brief zone continue to be excavated at 300m3/day. This approach does not allow for recording of more substantial finds. FDC C154 has developed a scenario for possible or potential finds (not a worst case) in discussion with the CRL archaeologist and C263 Archaeological contractor (email exchange 17 March 2011). This scenario is considered to add between 10 and 15 days to the C340 Construction Programme prepared by C154 for RIBA F Gate 3. This period of time is an estimate and may be increased if significant finds are made.

6.4.2 The C340 Construction Programme prepared by C154 for RIBA F Gate 3 has not been revised to allow for any archaeological find nor has it been revised to allow for excavation of the 3 Nos. trial trenches . As agreed with the CRL C154 Project Engineer, the C340 Contractor will programme the trial trenches into the construction programme. The potential increase in construction time associated with any archaeological find has been added as a risk to the Project Risk Register. The risk to the C340 programme highlights the potential knock-on impact and delay to the removal of the TBMs under contract C305. The C340 contractor will be expected to demonstrate in his Tender submission how he intends to manage this risk.

Scenario for discovery of potential finds – Contract C340

- Assumed Overall area of excavation 8,750m^2
- Area of archaeological potential within this 8,750m^2 is 1,800m^2
- An assumption has been made that three areas of interest will be uncovered.
- These would consist of two lengths of timber trackway each approx 1mx30m^2 aligned roughly with the long axis of the portal and an area of gravel island with cut features 525m^2. Assume gravel island (predicted by the geo-archaeological model (at LZ3 on Figure 5 in the WSI) will turn out to have a phase of settlement cut into the gravel (not waterlogged prehistoric huts or multi-phase settlement).
- It has further been assumed that two areas of interest will be worked on concurrently by C263 and that each area would take <10 working days to fully record before the contractor can return to excavating at 600m^3/day.
- It is assumed that 10 archaeologists in each area could address all finds in an overall 10-15 working day period in each area.

7 Specification for the Investigations

7.1 Generic Standards

7.1.1 The archaeological mitigation works and scope of any archaeological scientific methods shall be designed and undertaken in accordance with the Generic WSI and relevant best practise guidance (and any subsequent revisions) i.e.:

- Crossrail Standards and Specifications;
- Institute for Archaeologists – Standard and Guidance for archaeological excavation, 2008 (revised);
- Institute for Archaeologists – Standard and Guidance for an archaeological watching brief, 2008 (revised);
- Museum of London collections and archive policies and guidance;
- English Heritage – Geo-archaeology, 2007;
- English Heritage - Archaeological Science at PPG16 interventions: Best Practice Guidance for Curators and Commissioning Archaeologists, 2003;
- GLAAS Archaeological Guidance Papers 1999;
- Corporation of London archaeology guidance – Planning Advice Note 3, 2004;
- Museum of London Archaeology Service site recording manual (MOLAS 1994); and
- English Heritage – Understanding Historic Buildings – A guide to good recording practice, 2006.

7.2 Potentially nationally important remains

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

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

7.2.3 Upon discovery of potentially nationally important remains, the Project Archaeologist is to insert the procedure (or reference to the procedure) to be followed in the SS-WSI, identifying any specific individual roles or circumstances that are relevant to the works. Details shall include how relevant parties are to be informed of such discoveries, the criteria to be utilised by the Archaeology Contractor in the assessment of the significance of such discoveries and the timescales to be adhered to.

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

7.3 Human Remains

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

7.3.2 Where human remains are identified, all subsequent works must be undertaken in accordance with relevant legislative and environmental health requirements as set out in the Environmental Requirements (archaeology) section of the relevant package Works Information.

7.3.3 Upon discovery of human remains, the Project Archaeologist is to insert the procedure (or reference to the procedure) to be followed in the SS-WSI, identifying any specific individual roles or circumstances that are relevant to the works. Details shall include how relevant parties are to be informed of such discoveries, the criteria to be utilised in the assessment of the significance of such discoveries, the application process for licences and the timescales to be adhered to.

7.3.4 The Archaeology Contractor shall confirm how the requirements set out in the SS-WSI will be implemented as part of their procedure for excavating and recording human remains in the Archaeology Contractor's Method Statement. This should incorporate best practice guidance, e.g. Council for the Care of Churches (1999) and English Heritage (2002 and 2002a).

7.3.5 At sites known in advance to have a high risk of encountering human remains, provision shall be made by the Archaeology Contractor for site inspection by a recognised specialist.

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

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

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

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

7.3.10 As a result of the discovery of unexpected, potentially nationally important archaeological remains, the SS-WSI will be updated by the Project Archaeologist to incorporate any additional specific primary fieldwork event aims.

7.4 Treasure Act

7.4.1 The Treasure Act 1996 defines 'Treasure' as:

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

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

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

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

7.4.4 Project Archaeologist to insert the procedure (or reference to the procedure) to be followed in the SS-WSI, identifying any specific individual roles or circumstances that are relevant to the works. Details shall include how relevant parties are to be informed of such discoveries, the criteria to be utilised in the assessment of the significance of such discoveries and the timescales to be adhered to.

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

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

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

7.5 Health and safety

7.5.1 The Archaeology Contractor shall undertake the works in accordance with the Employer's Health and Safety requirements, the Main Contractor's Health and Safety Plan and the Designer's Risk Assessment. Where specific health and safety constraints or requirements for the Archaeology Contractor's method of work are required, these shall be set out in this section and detailed in the Archaeology Contractor's Method Statement (in the Health and Safety Plan).

7.5.2 No ground intervention or other survey shall be made without approval of the Archaeology Contractor's Health and Safety Plan, Method Statement and Risk Assessment by the CDM co-ordinator.

7.5.3 Hand excavation or other remote sensing method may be required prior to any mechanical excavation in the first instance to locate any known or suspected below ground hazards. The Archaeology Contractor's Method Statement and Risk Assessment shall take account of any design information (including the Designer's and Main Contractor's Risk Assessment) pertaining to above ground hazards such as buildings and other structures or

public rights of way and below ground hazards such as services, utilities and infrastructure and shall contain a site specific Risk Assessment for unknown below ground hazards such as contaminants including unexploded ordnance. All appropriate mitigation measures shall be in place prior to commencement of any ground intervention or other survey.

7.6 Location and ground elevation of interventions and survey grids

7.6.1 The spatial extent of the investigation(s) shall be set out in accordance with the setting out co-ordinates supplied by the Project Archaeologist. All spatial setting out and recording shall be in accordance with The London Survey Grid Standard (formerly Crossrail Survey Grid). See Crossrail standard CR-STD-010.

7.6.2 Interventions shall be located to a horizontal accuracy of +/-500mm in relation to the detail illustrated in the contract drawing(s). The corner points of each excavation or the centre point of each soil core location shall be set out with a Total Station Theodolite or other suitable automated equipment referenced from approved Permanent Ground Marker (PGM) data supplied to the Archaeology Contractor by the Project Archaeologist. The positions of the trenches and survey points shall be verified by the Archaeology Contractor taking additional check measurements to additional known-location points of detail.

7.6.3 Surface heights shall be recorded and related to Crossrail Permanent Ground Markers (PGMs) or approved Ordnance Survey Bench Marks (OSBM). The full descriptions and locations of PGMs and OSBMs known to the Employer will be supplied to the Archaeology Contractor by the Project Archaeologist. Levelling accuracy between OSBMs/PGMs and site Temporary Bench Marks (TBMs) shall be within 10 mm$\sqrt{k}$: where 'k' is the total distance levelled in kilometres. Each TBM shall be levelled as part of a closed loop starting and finishing on approved OSBMs or Crossrail PGMs. Where more than one TBM is required per site the Archaeology Contractor shall establish the TBMs as part of the same closed loop.

7.6.4 The Archaeology Contractor shall include details of their surveying methodology within their Method Statement (see Section 8), including the setting out of the grid and how they intend to provide the project grid co-ordinates to the Project Archaeologist with the Survey Report.

7.6.5 The Archaeology Contractor shall ensure that all trench or excavation limits, and significant archaeology detail are surveyed 'as dug' in relation to the project grid before leaving the site. Ground level height data shall be recorded for each intervention. Survey methodology and a detailed survey record shall be provided to the Project Archaeologist within the Survey Report.

7.7 Specification for watching brief

7.7.1 Watching brief, as defined in the Generic WSI, is a programme of archaeological monitoring (i.e. observation, investigation and recording) which is carried out by a suitably qualified archaeologist during site investigations (e.g. geotechnical test pits, boreholes and utilities trial trenches) and construction works. The purpose of a watching brief is to identify the potential of any archaeological remains that are uncovered in the course of the works and record them appropriately (as far as is reasonably practicable). The watching brief shall result in the preparation of an ordered archive which will be incorporated into the post-excavation works and into publication of the project results.

7.7.2 The Archaeology Contractor shall undertake the watching brief for all areas of ground disturbance within the Main Victoria Dock Portal worksite which may potentially contain archaeological remains as set out in the SS-WSI. This shall include any activities (including those associated with site set-up and demolition) undertaken by the Main Contractor that involve the removal of modern material, made ground and topsoil, subsoils, and superficial geological deposits such as alluvium and colluvium.

7.7.3 Areas that have been previously subject to archaeological excavation and which are known not to contain significant deposits (for example tunnels, cuttings, and areas of known large-scale modern disturbance) shall be excluded from the scope of the watching brief, unless stated otherwise in the SS-WSI. Areas that have been subject to previous assessment and evaluation (e.g. geophysical survey, surface artefact collection, geotechnical survey, trial trenching etc.) shall be included within the watching brief, as appropriate.

7.7.4 Two classes of watching brief are set out in the Generic WSI:

- A General Watching Brief (GWB) shall comprise observation and recording of the Main Contractor's works without constraint on their working methods.
- A Targeted Watching Brief (TWB) shall comprise observation and recording of the Main Contractor's works with specific operations carried out under the supervision of the Archaeology Contractor. Under targeted watching brief, the Archaeology Contractor may impose constraints on, or require changes to, the Main Contractors' or his sub-contractor's method of working to enable the archaeological investigation to take place alongside construction works.

7.7.5 A Targeted watching brief shall be used for areas of known occasional, dispersed features which are either not considered to be of sufficient significance to warrant archaeological investigation in advance of construction, or where access prior to construction has not been possible and where, as a result, there is a possibility of unexpected discoveries

7.7.6 Except in cases where unexpected, potentially nationally important, archaeological remains are discovered, the targeted watching brief shall be designed and implemented so as to avoid adverse impact on the construction programme, wherever practicable.

7.7.7 The Main Contractor shall make allowance in their activity programme for the completion of any targeted or general watching briefs as set out in the SS-WSIs.

7.7.8 The specification for watching briefs (general and targeted) are set out below:

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

7.8.1 At Victoria Dock Portal, so as to ensure that any archaeological remains can be observed and recorded, excavation through the alluvium and any deposits below will be undertaken by C340 with a large 360 degree excavator fitted with a wide bladed bucket (ditching bucket or similar) with no teeth. This will reduce levels from the bottom of the made ground where it meets the alluvium and then down to the surface of the river terrace deposits in spits of a depth at the discretion of the monitoring archaeologist (C261) up to a maximum of 300mm over its reach, so that any archaeological remains revealed may be exposed further by hand and then appropriately sampled and recorded. It will then move backwards and start excavating again so that neither the excavating machine nor any dump trucks or other spoil removal vehicle travel over the ground which has just been exposed. There is no need for any archaeological watching brief to continue once the River Terrace Deposits have been reached and any remains within them appropriately sampled and recorded.

7.8.2 The manner in which the works shall be undertaken are set out in the RIBA F Scheme Construction Report, the drawings from which are attached at Annex 3.

7.8.3 The Main Contractor (currently C340) shall provide the following site accommodation facilities for the use of archaeological operatives, inclusive of any hardstanding and services required:

- welfare accommodation for up three archaeologists (one office-based and two site-based) with provision for a further sixteen archaeologists should more complex remains in two separate locations be identified;
- toilets, with drying and washing facilities;
- first aid; and
- temporary office for two archaeologists and secure storage facilities for the use of up to 18 Archaeologists.

7.9 Further details of watching brief works

7.9.1 The Works to be carried out by the Archaeology Contractor shall consist of two parts:

a) Watching brief ('observation') following, and without interruption to, the progress of the Main Contractor by a core team of archaeologists.

b) Investigation of archaeology and remains of quaternary geological importance undertaken either:

- by the core team, following the progress of the Main Contractor; or
- by additional archaeologists (the 'support team'), to be deployed to investigate unanticipated archaeological remains, where appropriate.

7.9.2 The Archaeology Contractor's core team shall consist of the Archaeology Contractor's key person (the field director) and other appropriately experienced archaeologists commensurate with the scale and nature of the Main Contractor's works.

7.9.3 The core team shall undertake the observation and any required investigation such as they may reasonably be able to undertake.

7.9.4 The Archaeology Contractor's support team shall consist of additional experienced archaeologists. The size of the support team shall be commensurate with the scale and programme of the Main Contractor's works. The Archaeology Contractor shall be required to supply teams of 5 and 10 persons within 24 and 48 hours notice respectively.

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

7.9.6 The Archaeology Contractor shall record the following observations on a daily basis. The record shall consist of, as a minimum:

- The Event Code and chainage/ location of the area observed;
- The date(s) of the observation;
- Personnel employed on site;
- A description of the construction works observed;
- The works (sub) contractor and personnel undertaking and supervising the construction activity;
- Depths and extents of excavation works observed;
- Measure of confidence that any archaeological remains would have been observed and reasons;
- The areas and horizons (both those containing archaeological or remains of quaternary geological importance and those which do not) unaffected by construction activity (with special reference to archaeological sites identified for preservation in situ);
- The reasons why any particular area of the works was not observed, and noting those areas not subject to disturbance from construction;
- Location and description of any archaeological remains; and
- Location and description of any modern remains.

7.10 Investigation undertaken during watching brief

7.10.1 An appropriate sample shall be excavated from cut features and other archaeological remains of importance. Sampling of cut features shall include feature inter-sections to establish relative chronologies. The extent of sampling shall be determined by the Archaeology Contractor in liaison with the Project Archaeologist (and as discussed with the relevant local authority and English Heritage, and a quaternary specialist, if necessary) but may, for instance, include the sample excavation of a selected number of deposits (both layers and negative, cut features), recording of structural remains, drawn sections and profiles, and/or be aimed at recovering sufficient information to determine function, form, and date. In the event of timber remains being discovered, appropriate recording and sampling must be agreed with the Project Archaeologist in consultation with English

Heritage (GLAAS and the Regional Scientific Advisor if available). Any specific variations from this specification shall be indicated in The Archaeology Contractor's Method Statement.

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

7.10.3 Temporary works and any required hand investigation to address below-ground hazards shall be carried out by the Main Contractor under supervision by the Archaeology Contractor in accordance with their approved Method Statement and Risk Assessment. All subsequent trial excavations shall be excavated by the Main Contractor under supervision by the Archaeology Contractor using a mechanical excavator with toothless ditching bucket, except where the nature of the made ground or surface of the pits is such that an alternative bucket or means of breaking out prior to excavation is required (and the Project Archaeologist has agreed an alternative method).

7.10.4 All machine work and demolition of below-ground obstructions (e.g. removal of Station foundations and surface rail foundations) shall be carried out by the Main Contractor under supervision by the Archaeology Contractor. The Main Contractor shall cease work when archaeological evidence is revealed and allow the Archaeology Contractor to undertake investigation, as appropriate. An excavator shall not be used to cut arbitrary trial trenches down to natural deposits without regard to the archaeological stratification.

7.10.5 All undifferentiated topsoil, or overburden of recent origin, shall be removed down to the first archaeological layer. If a mechanical excavator is to be used to remove modern overburden, such as floor slabs or recent levelling layers, this shall be undertaken in spits of c.300mm depth (dependant on specific site conditions), moving along the length of the trench or area. A depth of 500mm shall not be exceeded. The Archaeology Contractor's supervising archaeologist shall use their professional judgement to determine the appropriate depth of each spit and will advise the Main Contractor accordingly. Any variations to the excavation methodology shall be at the discretion of the supervising archaeologist and recorded in writing for inclusion in the final report to the Project Archaeologist.

7.11 Specification for archaeological investigation

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

7.11.2 Modern foundations are likely to be present and will be removed. Where it is clear that modern foundations have truncated certain archaeological levels they should be removed and lower archaeological levels assessed. The Archaeology Contractor shall take all reasonable care to ensure that any damage is limited as far as practicable. If significant damage is likely to occur (eg breaking concrete immediately above organic remains) the work shall be suspended and the Project Archaeologist informed so that a technical solution can be agreed with the Project Manager.

7.11.3 Temporary works and any required hand investigation to address below-ground hazards shall be carried out by the Main Contractor under supervision by the Archaeology Contractor in accordance with their approved Method Statement and Risk Assessment.

7.11.4 All machine work and demolition of below-ground obstructions (e.g. removal of Station foundations and surface rail foundations) shall be carried out by the Main Contractor under supervision by the Archaeology Contractor. The Main Contractor shall cease work when archaeological evidence is revealed and allow the Archaeology Contractor to undertake investigation, as appropriate. An excavator shall not be used to cut arbitrary trial trenches down to natural deposits without regard to the archaeological stratification.

7.11.5 Each spit shall be examined carefully to assist the recovery of any archaeologically significant artefacts and thus to determine when to cease machining.

7.11.6 The archaeological level shall be cleaned in plan by the Main Contractor using a wide blade, ditching bucket or similar, with no teeth. If the machine has to re-enter the trench, care will need to be taken to ensure that it does not damage underlying remains.

7.11.7 The Archaeology Contractor shall undertake hand excavation and cleaning of any archaeologically significant horizons, to fulfil the aims of the work. Within alluvial sequences the Archaeology Contractor shall pay particular attention to establishing the vertical extent of layers of archaeological potential and shall be aware that horizons of cultural activity may be interdigitated with horizons of sterile alluvium. Details of appropriate working within the alluvium are given in Section 5 above.

7.11.8 The Archaeology Contractor's excavation, sampling and recording policy shall be included in the Archaeology Contractor's Method Statement. This is to include, as a minimum:

- The recording of individual contexts on appropriate pro-formas;
- Excavation plans at 1:50 scale; planning and section drawing of appropriate single contexts and features (usually at 1:20 scale for plans and 1:10 scale for inhumations and sections);
- Photographs; and other appropriate drawn and written records; and
- Permanent Ground Markers (PGM's), any temporary benchmarks and approved OS benchmarks shall be indicated on the relevant plans.

7.11.9 The Archaeology Contractor's survey and recording policy shall meet the following requirements:

- All levels shall be recorded to London Grid standards and reduced to OS datum;
- The electronic survey record shall be retained with the project archive.

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

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

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

7.12 Recording systems

7.12.1 The archaeological fieldwork shall be recorded by the Archaeological Contractor to the standards of current best practice. The recording systems adopted during the investigations must be fully compatible with those published by the Museum of London Archaeology Service (MoLAS 1994 3rd ED) and Museum of London (MoL 1998).

7.12.2 The recording is to include, as a minimum:

- At least one representative section at (1:10 or 1:20 scale) of each trial excavation from ground level to the base of the excavation;
- The written record of individual context descriptions on appropriate pro-forma;
- Plans at appropriate scales (1:10 or 1:20);
- Single context planning if appropriate; and
- Photographs and other appropriate drawn and written records.
- Other sections, including the half-sections of individual layers or features shall be drawn as appropriate to 1:10 or 1:20.

7.12.3 Site plans shall identify both London Grid and OS co-ordinates. A 'site location plan', indicating site north shall be prepared at 1:1250. Individual 'trench plans' or 'excavation area plans' at 1:200 (or 1:100) shall be prepared which show the location of archaeology investigated in relation to the investigation area.

7.12.4 Section drawings shall be located on the relevant plan and both London Grid and OS co-ordinates recorded. The locations of the OSBM or PGM bench markers used and any site TBM shall also be indicated.

7.12.5 A record of the full extent in plan of all archaeological deposits as revealed in the investigation shall be made; these plans shall be on polyester based drawing film, and be at

a scale of 1:10 or 1:20 unless otherwise agreed with the Project Archaeologist. 'Single context planning' shall be used on deeply stratified sites. Drawing information shall be digitised for eventual CAD applications. The GLSMR will accept Autocad DXF or .DWG format of extent of site and location of major features with the completed Sites and Monuments Report Form.

7.12.6 A 'Harris matrix' stratification diagram shall be employed to record stratigraphic relationships (Harris 1993). This record shall be compiled and fully checked by the Archaeological Contractor during the course of the fieldwork. Spot dating shall be incorporated onto this diagram during the course of fieldwork.

7.12.7 Recording of structural evidence revealed below ground level will vary according to the level of special interest of the structure and its relationship to below-ground archaeology. Structures of little or no significance shall be noted on a site plan. Detailed element detail drawings of important features revealed in investigations may be required in accordance with the aims and objectives of the investigation.

7.12.8 The photographic record shall consist of monochrome prints/negatives and colour transparencies. A 35mm format SLR camera (film or digital) is acceptable for all site photography. The Archaeology Contractor shall maintain a minimum of two 35mm SLR cameras on site at all times during working hours. The photographic record shall include photographs and transparencies of archaeological features, appropriate groups of features, and structures. Each photograph and transparency shall clearly show details of the above, and may require the use of artificial lighting to achieve suitable definition. Each photograph and transparency shall include an appropriate graduated scale, a north arrow, and a header board detailing (as a minimum) the project event code and context/feature number. In addition, the Archaeology Contractor shall take appropriate record photographs to illustrate work in progress.

7.12.9 The transparencies shall be mounted in suitable frames for long-term curation in preparation for deposition with the archive. Digital photography and video recording may be appropriate in some circumstances and the Archaeology Contractor shall set out proposals for such recording in the Archaeology Contractor's Method Statement for approval by the Project Archaeologist. Where appropriate a photogrammetric record or laser scan record may be made of complex structures, features and horizons, liable to be damaged in the course of the investigation. Appropriate technical specification and scales shall be agreed with the Project Archaeologist if such structures are discovered.

7.13 Archaeological science

7.13.1 A strategy for sampling archaeological and palaeo-environmental deposits and structures (which can include soils, timbers, pollen, diatoms, animal bone, human bone etc.) will be developed by the Archaeological Contractor in consultation with Project Archaeologist English Heritage Regional Science Advisor and the Archaeology Consultant. On-site work and off-site analysis of the processed samples and remains will be undertaken by the Archaeology Contractor's environmental archaeologist as specified in the Archaeology Contractor's Method Statement.

7.13.2 The finds retrieval policies of the appropriate recipient museum will be adopted. In accordance with the collection and retention strategy set out in SS-WSI, all finds (artefacts and ecofacts) visible during excavation shall be collected and processed by the Archaeology Contractor. In some cases, sampling may be the most appropriate strategy.

Finds shall be appropriately packaged and stored under optimum conditions, as detailed in the RESCUE/UKIC publication First Aid for Finds (Watkinson and Neal 1998).

7.13.3 Where there is evidence for industrial activity, macroscopic technological residues (or a sample of them) shall be collected by hand. Separate samples (c. 10ml) shall be collected for micro-slags (hammer-scale and spherical droplets). Reference should be made to the Centre for Archaeology Guideline on Archaeo-metallurgy (English Heritage 2001). Assessment of any technological residues shall be undertaken.

7.13.4 Where appropriate, samples shall be taken for scientific dating (for example radiocarbon dating, OSL, thermo-luminescance at the evaluation stage). This may apply where dating by artefacts is insecure or absent, and where dating is necessary for development of the SS-WSI for subsequent mitigation strategies. Procedures and specifications shall follow English Heritage guidance (English Heritage 2008b).

7.13.5 Buried soils and sediment sequences shall be inspected and recorded on site by the Archaeology Contractor's geo-archaeologist, since field inspection may provide sufficient data for understanding site formation processes. Procedures and techniques presented in the English Heritage documents Environmental Archaeology (English Heritage 2002) and Geo-archaeology (English Heritage 2007) shall be followed. Samples for laboratory assessment shall be collected where appropriate, following agreement with the Project Archaeologist.

7.13.6 Deposits shall be sampled for retrieval and assessment of the preservation conditions and potential for analysis of biological remains following English Heritage guidance (English Heritage 2002). The sampling strategy shall include a reasoned justification for selection of deposits for sampling, and shall be developed by the Archaeology Contractor's environmental archaeologist or recognised bio-archaeologist in liaison with the Project Archaeologist. Flotation samples and samples taken for coarse-mesh sieving from dry deposits shall be processed at the time of the fieldwork wherever possible, to permit variation of sampling strategies if necessary. Sampling strategies for wooden structures shall follow the methodologies presented in Brunning (1996).

7.13.7 Artefacts, biological samples and soils shall be assessed for evidence of site and deposit formation processes and taphonomy and especially for evidence of recent changes that may have been caused by alterations in the site environment.

7.13.8 Assessment of finds assemblages shall include x-radiography of all iron objects (after initial screening to exclude obviously recent debris) and, where appropriate, non-ferrous artefacts (including all coins). Where necessary, active stabilisation /consolidation shall be carried out to ensure long-term survival of the material, but with due consideration to possible future investigations.

7.13.9 Once assessed, all material shall be packed and stored in optimum conditions, as described in First Aid for Finds (Watkinson and Neal 1998). Waterlogged organic materials shall be processed in accordance with: Guidelines for the care of waterlogged archaeological leather (English Heritage/Archaeology Leather Group 1995) and Waterlogged wood: the recording, sampling, conservation and curation of structural wood (Brunning 1996). Samples for absolute dating shall be submitted promptly to the supply laboratory proposed by the Archaeology Contractor or other supplier as instructed by the Project Archaeologist. Delivery times shall be agreed to ensure that the results are available to aid development of specifications for subsequent mitigation strategies in the SS-WSI. Where it is proposed to date human remains, the time limits for reburial imposed

by Schedule 15 of the Crossrail Act (for remains removed from burial grounds) or set out in the relevant burial licence under the Burial Act 1857 (in all other cases) shall be adhered to.

7.13.10 Processing of all soil samples collected for biological assessment, or sub-samples of them, shall be completed as soon as reasonably practicable. The preservation state, density and significance of material retrieved shall be assessed by the Archaeology Contractor's recognised specialist. Special consideration shall be given to any evidence for recent changes in preservation conditions that may have been caused by alterations in the site environment. Unprocessed sub-samples shall be stored in appropriate conditions in accordance with the Archaeology Contractor's Method Statement.

7.13.11 Samples collected for geo-archaeological assessment shall be processed promptly by the Archaeology Contractor's specialist, particularly where storage of unprocessed samples is thought likely to result in deterioration. Appropriate assessment shall be undertaken as agreed with the Project Archaeologist. Where preservation in situ is a viable option, consideration shall be given to minimising the possible effects of compression and loading on the physical integrity of the site and any hydrological or chemical impacts of the proposed construction works (English Heritage 2002).

7.13.12 Animal bone assemblages, or sub-samples of them, shall be assessed by the Archaeology Contractor's specialist with reference to English Heritage guidance (English Heritage 2002).

7.13.13 The results from any specific investigations in Archaeological Science shall be included in the Site Archive and presented in the evaluation report or final fieldwork report. Reports shall include sufficient detail to permit assessment of potential for analysis. They shall include tabulations of data in relation to site phasing and contexts, and include non-technical summaries. The objective presentation of data shall be clearly separated from interpretation i.e. recommendations for further investigations, (both on samples already collected, and at future excavations), shall be clearly separated from the results and interpretation.

7.14 Generic specification for Environmental Sampling

7.14.1 Appropriate features and deposits shall be sampled to retrieve palaeo-environmental and economic indicators. The Archaeology Contractor shall make provision for the sampling of a wide range of contexts for potential assessment and analysis for plant and animal micro/macro fossils and soils/sediments in order to fulfil the aims set out in the SS-WSI.

7.14.2 The Archaeology Contractor shall use ten litre plastic buckets (with lids and handles), or strong polythene bags (double bagged) secured at the neck, for the recovery of bulk 'disturbed' environmental samples. An adhesive label recording the project event code, context number and sample information shall be securely fixed to a vertical face of the bucket only or attached to the neck of the bag. Labels shall be completed with an indelible ink pen. A duplicate non-adhesive label shall be inserted within the bucket or between the polythene bags.

7.14.3 The selection, preparation for and methods of taking samples together with their size, presentation and processing shall be in accordance with current best practice (e.g. IFA Standard and Guidance for Artefact and Environmental Study, Collection, Research and Conservation 2008d; English Heritage –Geo-archaeology, 2007; English Heritage - Archaeological Science at PPG16 interventions: Best Practice Guidance for Curators and Commissioning Archaeologists, 2003).

7.14.4 The Archaeology Contractor shall be responsible for the protection of all samples and finds and for their transport (including loading and unloading) to the Archaeology Contractor's facilities or other location as agreed with the Project Archaeologist. Samples shall be protected at all times from temperatures below 5 and above 25 degrees Celsius and from wetting and drying out due to weather exposure.

7.14.5 Bulk samples shall normally be in the range of 10-60 litres. The size selected will depend on the likely density of macrofossils in the soil. The lower end of the range (10-20 litres) will be suitable for the recovery of macrofossils from waterlogged deposits. For non-waterlogged deposits the sample volume is likely to be in the middle to higher range (20-40 or 40-60 litres) dependant upon site activity, conditions and preservation. The residue of soil left in the bottom of any inhumations after the removal of human remains shall be retrieved for bulk processing. Vessel or pit fills containing human remains shall be processed as bulk samples to ensure the maximum retrieval of cremated bone. Cremation vessels and deposits of placed human bone within cut features may require excavation in spits. The fill residues from the excavation of these features shall be bulk sampled to ensure maximum retrieval of cremated bone, associated small finds and floral and faunal remains. All work shall be undertaken in compliance with the generic Crossrail standards for Human Remains (see Section 7A) which may require the reburial of human remains within a specific timeframe.

7.14.6 For 'bulk disturbed' samples the limits of the sample zone shall be recorded and identified on plan.

7.14.7 The Archaeology Contractor shall use appropriately sized monolith or kubiena boxes for the recovery of 'undisturbed' monolith samples for geo-archaeological study (pollen, other microfossil and micro-morphological studies etc). Care shall be taken to ensure that wherever possible only newly exposed sections are sampled to avoid contamination, desiccation and decalcification. This sampling shall be undertaken under supervision of the Archaeology Contractor's environmental specialist. Boxes shall be wrapped neatly and tightly in bin-liners or plastic sacks and secured with rubber bands. A label shall be attached to the outside (in duplicate) with site name and code, feature/context number and depths of sample.

7.14.8 The Archaeology Contractor shall record the depth of the 'undisturbed' monolith at the top and the bottom of the sample. There shall be a 50mm overlap between each monolith. This information shall be plotted onto a section drawing at an appropriate scale, with all levels reduced to heights relative to Ordnance Datum. Where the sample crosses archaeological context boundaries these shall be noted on the sample recording pro-forma.

7.14.9 Where it is not possible to insert monolith boxes, the Archaeology Contractor shall take a vertical series of small 'spot' samples. Samples shall be at 20mm vertical intervals with no more than 10mm depth being sampled. In the case of deposits with a low organic content it may be necessary to take as much as 5g or even 20g per sample. If so, sampling shall be extended laterally at a given depth in 10mm deep spits.

7.14.10 Where appropriate, the Archaeology Contractor shall take contiguous column samples for the retrieval of macrofossils. The individual sub-samples will be of 1-10kg, depending on the nature of the deposit and the category of material to be retrieved. Where several specialists are involved it may be necessary to take separate sub-samples for a range of palaeo-environmental evidence, for example, insects, molluscs and seeds, to ensure that adequate sub-samples are available for specialist assessment.

7.14.11 The emerging Specification will contain the following standards and guidance which will be further defined by Crossrail at the detailed design stage:

- generic standards;
- spatial survey setting out and recording requirements;
- use of plant and materials;
- hand excavation and recording, drawn, written, photographic records;
- finds and environmental assemblage recovery strategies and requirements, including absolute dating techniques; and
- required attendances shall include excavation, lighting, safe access to the trial trenches from the office accommodation, and access to and from the trenches.

8 Description of required deliverables

8.1.1 This section sets out what is required from the Archaeological Contractor per event. The specific event types listed at Victoria Dock Portal are:

- Targeted watching brief of utilities and ground excavation within the main Victoria Dock Portal Works. These require weekly progress reporting followed by a fieldwork report (section 8.7).
- Trial trenching as described above following the construction of the secant pile walls. These require weekly progress reporting followed by a fieldwork report (section 8.7).

8.1.2 All other requirements such as archiving, summary report for HER and post-excavation should be followed as set out below.

8.2 Archaeological Contractors Method Statement

8.2.1 The Archaeology Contractor shall provide a detailed Method Statement for the works for the Project Archaeologist's approval. The Method Statement shall be prepared in association with the Main Contractor, taking account of their Environmental Plan and other relevant site information provided by them and requirements for the works set out in the Works Information (e.g. relating to health and safety, security, engineering design requirements and attendances). The Method Statement shall include, as appropriate:

a) A resource plan and programme and CVs;

b) The Archaeology Contractor's IT capability and proposed IT plan (including specific survey methods for on-site recording of stratigraphic profiles and sub-surface topographic modelling;

c) The Archaeology Contractor's approach to Archaeological Science;

d) The methods for survey and setting out works;

e) The methods to address the specific event types required (trial trench, area excavation etc);

f) The safe method of working whilst excavating trenches or pits including any temporary works required;

g) The method for disposing of water from trenches and test pits in waterlogged ground;

h) Site management plan to include details of the method for preparing safe access route to the working areas, the proposed site accommodation, services and welfare;

i) The retention and disposal policies for samples and artefacts recovered during the work;

j) The method for excavating and recording inhumations and cremations in compliance with the generic Crossrail standards for Human Remains (see Section 7.3);

k) The method for preparation of the required reports, archive and all associated deliverables;

l) The procedures for assessment of potential for analysis (post excavation assessment);analysis and publication proposals;

m) The method for preparation of the digital dataset, digital drawings, and digital report deliverables;

n) The Archaeology Contractor's methods and approach for undertaking the site based works and off site processes to completion.

o) The Health and Safety Plan and Site-Specific Risk Assessment (including unexploded ordnance);

p) The Quality Assurance Plan;

q) The procedures for on- and off- site security and emergency response plan (including environmental incidents);

r) The method for complying with project generic and site specific environmental and consent requirements; and

s) The Archaeology Contractor's requirements and specification for services and facilities and attendances required to be supplied by the Main Contractor or the Employer.

8.3 Site Archives

8.3.1 The site archive shall be organised to be compatible with other archaeological archives in London, or where outside the greater London area, any specific requirements of the receiving museum. This requirement for archival compatibility includes computerised databases.

8.3.2 For London archives, individual descriptions of all archaeological strata and features excavated or exposed shall be entered onto prepared pro-forma recording sheets which include the same fields of entry on the recording sheets of Museum of London Archaeology. Sample recording sheets, sample registers, finds recording sheets, registered finds catalogues and photographic record cards shall also follow the Museum of London Archaeology equivalents.

8.3.3 Archives shall be prepared to conform with current best practise (e.g. Brown and Duncan 2007; Institute of Field Archaeologists 2008f). The archive shall cover all finds, samples and records (drawn, written, photographic and electronic) collected and produced during the works. The archive shall be indexed and internally consistent. The Archaeology Contractor shall complete the site archive and submit to the Project Archaeologist within 8 weeks of completion of a fieldwork event.

8.3.4 The site archive shall be deposited by at a museum to be confirmed by the Project Archaeologist.

8.4 Digital Data

8.4.1 The Archaeology Contractor shall produce a digital data archive of all primary field data produced during the works in accordance with ADS guidelines (Richards and Robinson 2001).

8.4.2 The Archaeology Contractor shall prepare and provide field and laboratory data, evaluation or excavation trench and phasing plans showing archaeological features recorded, and report text in digital form, as well as in paper form. Consideration should be given to recording electronic plans during fieldwork.

8.4.3 The digital archive for each fieldwork event shall be copied to CD-R or DVD (recordable laser disc) and submitted to the Project Archaeologist for archiving in the Employer's document management system.

8.4.4 Final reports, site plans and other illustrations shall be prepared in accordance with the Employer's Information Management standards and procedures.

8.4.5 All data files submitted shall be scanned by a virus detection programme updated to the most current version. The disk label shall clearly indicate:

- Confirmation that this check has been carried out (including details of the virus checking programme name and version used) and that the submission is virus free.
- Fieldwork event name and code.
- Supplier company name, date and QA details (as a minimum, the name, position and signature of the approver).

8.4.6 Prior to commencing the works, the Archaeology Contractor shall submit an example hard copy and data output of each of the data formats required (i.e. data, graphic, CAD and text) produced by their current software, for approval by the Project Archaeologist. The Archaeology Contractor shall inform the Project Archaeologist of any changes or upgrades made to approved software prior to processing any works data. The sample disk shall include data from a previous real job or jobs.

8.4.7 A sequential numbering of data issues shall be rigorously adhered to so that no data versions are submitted out of sequence. The organisation of the data prior to submission shall be the responsibility of the Archaeology Contractor. The Archaeology Contractor shall ensure that data originating from different sources within the Archaeology Contractor's organisation is compatible with the project requirements. The Archaeology Contractor shall nominate one person to the Project Archaeologist who is the main point of contact for matters relating to the digital data submissions.

8.4.8 Where errors or inconsistencies are noted in the data, by either the Project Archaeologist or Archaeological Contractor they shall be corrected by the Archaeology Contractor and a corrected data file issued to the Project Archaeologist. When a change or addition is made to the data within an issue, a complete data group shall be re-issued, not just the changed fields. This may not require complete replacement of the whole data set which includes other previous issues.

8.4.9 Where any changes are made to a data record between digital data submissions, the Archaeology Contractor shall record the date of the change and the name of the person carrying out the change. The Archaeology Contractor shall ensure that each data amendment is carried out correctly.

8.4.10 The Archaeology Contractor shall make two identical copies of the digital archive. The first copy shall be retained by the Archaeology Contractor until the expiry of the Contract maintenance period. The second copy shall be issued to the Project Archaeologist. A digital archive for each Crossrail site (incorporating individual event archives) shall be submitted to a regional or national data archive as agreed with the service provider by the Employer.

8.5 Interim Statement

8.5.1 Within 7 days of completion of a fieldwork event the Archaeology Contractor shall submit an Interim Statement to the Project Archaeologist.

8.5.2 The Interim Statement shall be brief, and the information contained commensurate with the timescale for production. The report shall not duplicate effort to be utilised at a later date and shall draw on the data gathered during the initial assessment undertaken during fieldwork.

8.5.3 A site plan indicating all as-dug investigations shall be provided. Key stratigraphic profiles and topographic templates of the major stratigraphic units shall be provided.

8.5.4 The Interim Statement including illustrations shall be submitted as a single PDF file to the Project Archaeologist. CAD drawing files shall also be submitted.

8.5.5 The Interim Statement text shall be submitted in hard copy and as an MS Word *.doc document in accordance with the Employer's information management standards and procedures.

8.5.6 The Interim Statement shall include an approved report title sheet and QA page (to be supplied by the Employer).

8.5.7 The following shall appear in the footer or header of each Interim Statement:

8.5.8 Copies of the Interim Statement shall be provided by the Project Archaeologist to Rob Whytehead (English Heritage), Regional Archaeological Advisor, and Jane Sidell (GLAAS), Archaeological Advisor to the London Borough of Newham, for comment.

8.6 Survey Report

8.6.1 The Archaeology Contractor shall provide a written and graphic survey report for the works upon completion of fieldwork. Evidence shall be provided for check measurements and results of levelling for establishment of TBMs. The survey report shall be submitted by the Archaeology Contractor to the Project Archaeologist within 2 weeks of the completion of fieldwork.

8.6.2 The Archaeology Contractor shall prepare and submit 'as excavated' site area outlines and levels in accordance with Crossrail standard CRS-SDT-05. Each drawing shall identify the relevant event code and sub-site division, if applicable.

8.7 Fieldwork Report

8.7.1 The watching brief reports shall be prepared by the Archaeology Contractor within 6 weeks of the completion of the fieldwork (unless this is varied by the Project Archaeologist). The evaluation report will be prepared either as soon as is practicable if significant find requiring mitigation are uncovered, or within 6 weeks of completion of fieldwork if no archaeological finds are uncovered. The Fieldwork Report shall follow the standard structure set out in City of London Planning Advice Note 3 and IFA standards i.e.:

Contents list

Non technical summary

1. Introduction
2. Planning background
3. Previous work(s) relevant to archaeology of site (DBA, DDBA, surveys etc)
4. Geology and topography of site
5. Research objectives and aims
6. Methodology of site-based and off-site work
7. Results and observations including quantitative report, stratigraphic report(including any constraints on site).
8. Assessment of results against original expectations (using criteria for assessing national importance i.e. period, relative completeness, condition, rarity, and group value) and review of evaluation strategy
9. Statement of potential of archaeology
10. Conclusions and recommendations for appropriate mitigation strategy
11. Publication and dissemination proposals (in addition to fieldwork report)
12. Archive deposition
13. Bibliography
14. Acknowledgements
15. Sites & Monuments Record form
16. A3 plans

8.7.2 The Fieldwork Reports shall provide an illustrated factual statement and statement of importance with associated assessment of potential for further fieldwork and/or analysis of the archive. The Fieldwork Reports shall utilise information collected during archaeological fieldwork and from any other appropriate sources agreed with the Project Archaeologist.

8.7.3 The Fieldwork Reports shall include sections detailing the background to the project, any previous relevant research and investigation, location and topography/geology, a description of the methodology employed and the techniques adopted. Where relevant, these sections shall include location plans with scale and grid co-ordinates.

8.7.4 Each component of the works (e.g. stratigraphic/structural, artefactual and environmental/economic) shall be supported by a statement setting out:

- A quantification of the resource (tabulated and cross referenced as appropriate);
- Provisional dating and evidence for residuality and intrusiveness;
- The range of material, including sampling and/or taphonomic biases; and,
- The condition of the material, including preservation bias.

8.7.5 The stratigraphic statement shall include: a description of the geomorphology and sedimentation record of the survey area; a description of the fieldwork results (brief context descriptions supported by plans and sections as necessary, with levels related to Ordnance Datum); a trench summary table indicating depths of all major stratigraphic units, and their boundaries. Photographs shall be included where appropriate.

8.7.6 The Archaeology Contractor shall produce a subsurface model(s) and profiles to illustrate the extent, character and depth of the major stratigraphic topology identified. The model shall be correlated with previous works within the survey area in order to inform the mitigation design. The processing software and presentation format of the data shall be included in the Archaeology Contractor's Method Statement for approval by the Project Archaeologist.

8.7.7 The assessment of results and statement of potential shall include the Archaeology Contractor's conclusions based on the recorded data, e.g. the monument/site class represented, site/feature function and relevant parallels. The statement shall also comment on the potential of the data to address the projects' research themes. As appropriate, comment shall be made on the site as a whole and the individual components (e.g. artefactual, palaeo-environmental, economic). The statement shall utilise the criteria laid down by the Secretary of State for Culture, Media and Sport Criteria for Scheduling, to establish importance.

8.7.8 In reporting the results of the works, the accuracy of the original expectations and the appropriateness of the methods adopted shall be assessed by the Archaeology Contractor in order to illustrate what level of confidence can be placed on the information. The Project Archaeologist will use that information as the basis for developing any further mitigation strategy and/or further analysis and publication.

8.7.9 The report shall be illustrated with a site location plan, survey location plans as appropriate (to include archaeological interpretation of results), and individual trench and area plans identifying archaeological features exposed and investigated.

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

8.7.11 Copies of the Fieldwork Report shall be provided by the Project Archaeologist to the GLAAS advisor for the LB of Newham, to Robert Whytehead (English Heritage) and the London Borough of Newham for comment.

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

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8.8 OASIS Summary Sheet

8.8.1 The Archaeology Contractor shall complete an OASIS Summary Sheet for the works (i.e. one per fieldwork event) for submission both to OASIS and the Greater London Historic Environment Record (GLHER). The Summary Sheet shall be included in the Fieldwork Report.

8.9 Summary Report

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

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

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

8.10 Post excavation assessment

8.10.1 If instructed by the Project Archaeologist, the Archaeology Contractor shall undertake a post-excavation assessment of the site archive and submit a report of their findings to the Project Archaeologist for approval. Assessment of potential for analysis shall be undertaken in accordance with English Heritage guidelines.

8.10.2 The Archaeology Contractor shall provide details of their current post excavation assessment procedures with their Method Statement.

9 Results of Consultation and Required Site Monitoring Process

9.1.1 Greater London Archaeological Advisory Service (GLAAS) has been consulted on the proposed Victoria Dock Portal works and GLAAS' concerns over the suitability of a targeted watching brief for this location have been addressed by the inclusion of three trial trenches that are to be dug within the confines of the secant pile walls and prior to the main bulk excavation of the portal. The implications of uncovering an archaeological find on the portal construction programme have been assessed by C154 (see Sections 3.3 and 6.3.4) and recorded in the C154 Project Risk Register. This register and associated risks will be managed by Crossrail and the Victoria Dock Portal contractor (C340) during the construction works.

9.1.2 Prior to commencing the works the Archaeology Contractor shall agree a programme of weekly written progress reports and periodic progress meetings with the Project Archaeologist an/or Project Manager and shall be represented at such meetings to the satisfaction of the Project Archaeologist. The Archaeology Contractor shall provide information describing progress on-site to date, the processing of samples and artefacts and feedback from any initial assessment.

9.1.3 The LB of Newham, the GLAAS advisor and Robert Whytehead (English Heritage) shall be informed in writing at least one week in advance of commencement of fieldwork by the Project Archaeologist.

9.1.4 Periodic updates on the progress of the Crossrail archaeology programme shall be submitted to the external consultees by the Project Archaeologist. The Archaeology Contractor shall provide information to the Project Archaeologist as requested to inform this reporting.

9.1.5 The Project Archaeologist shall arrange and convene monitoring site visits by the external consultees, as appropriate. There shall be no unauthorised access to the works in any other circumstances. Any visits to the works shall be in accordance with the Main Contractor's health and safety, site access and security requirements.

9.1.6 The Archaeology Contractor may propose that archaeological excavation be carried out as an extension to evaluation works, if the scope of such work is readily incorporated into the SS-WSI. The detailed method for this work shall be agreed between the Archaeology Contractor and the Project Archaeologist at a site meeting and subsequently in writing between the Project Archaeologist and the relevant external consultees.

10 Personnel requirements

10.1.1 The Archaeology Contractor shall provide project personnel of experience as described below. The personnel shall be approved by the Project Archaeologist. Approval may be withdrawn by the Employer at their discretion and in accordance with the contract conditions.

10.1.2 The Archaeology Contractor shall submit CVs of all proposed personnel including any specialists, but excluding site technician grades, to the Project Archaeologist for approval if this has not already been done as part of the pre-qualification process.

10.1.3 The works shall be managed, directed and staffed by appropriately qualified and experienced personnel. The Archaeology Contractor's Key Person shall possess at least ten years relevant experience.

10.1.4 The excavation, sampling and recording of the works shall be directed in the field by a Fieldwork Director who is a Member of the Institute of Field Archaeologists (MIFA) The Fieldwork Director shall be on site throughout the fieldwork stages.

10.1.5 The Archaeology Contractor's project team shall include an environmental archaeologist suitably qualified in archaeological science and geo-archaeological sediment description methods, and on site sample processing and assessment techniques. A wood specialist (preferably with a prehistoric background) will also be required if timber remains are located.

10.1.6 The Archaeology Contractor's project team shall be staffed by technician grades with minimum six months experience in appropriate aspects of excavation and recording.

10.1.7 Specialist staff employed on any aspect of the works, including post-excavation assessment or analysis of any kind including the writing of reports, shall be suitably qualified and shall be supervised by personnel with a minimum of ten years of relevant experience in their field (this may be inclusive of post-graduate studies).

10.1.8 Specialist staff shall be available, normally at 24 hours notice, for the duration of the works to provide advice on any specialist tasks to be undertaken.

11 References and Glossary of Terms

11.1 References

- C340 Portal and DLR Realignment Construction Programme (C154 –HYD-N2-TPG-CR144_PT003-00279);
- Crossrail, Environmental Statement — February 2005 (available to view here http://www.crossrail.co.uk/crossrail-bill-documents);
- Crossrail, 2005 Assessment of Archaeology Impacts, Technical Report, Part 4 of 6, South-East Route Section: Isle of Dogs to Abbey Wood. Crossrail (doc no. 1E0318-E2E00-00001);
- Crossrail, Supplementary Environmental Statement 2 (SES2) — January 2006 (available to view here http://www.crossrail.co.uk/crossrail-bill-documents);
- Crossrail, Assessment of Archaeology Impacts, Technical Report. Additional Provisions — January 2006 (Specialist Technical Report [STR]) (available to view here http://www.crossrail.co.uk/the-railway/getting-approval/parliamentary-bill/crossrail-bill-documents/specialist-technical-reports#tag/576);
- Crossrail, Amendment of Provisions 2 Environmental Statement – May 2006 (available to view here http://www.crossrail.co.uk/crossrail-bill-documents);
- Supplementary Environmental Statement 3 (SES3). November 2006 (available to view here http://www.crossrail.co.uk/crossrail-bill-documents);
- Crossrail, Archaeology Programming Assessment, November 2006;
- Crossrail MDC 4 Detailed Desk Based Assessments (DDBA) for Victoria Dock Portal & Custom House station (doc no.CR-SD-PRW-X-IS-00001);
- Crossrail, MDC4 Archaeology Overview of ground Levels and Land Raising around the Docks in the MDC4 area, January 2008;
- Crossrail, 2008b MDC4 Archaeology, Geo-archaeological Deposit Model: Victoria Dock Portal (appendix to DDBA, doc no.CR-SD-PRW-X-IS-00001);
- Crossrail, 2008c MDC4 Archaeology, Updated Baseline Assessment; Crossrail, in prep Archaeology Generic Written Scheme of Investigation;
- Crossrail, MDC4 Archaeology Overview of ground Levels and Land Raising around the Docks in the MDC4 area, January 2008;
- Crossrail, MDC4 Archaeology — Geo-archaeological Deposit Model: Victoria Dock Portal. January 2008 (appendix to DDBA, doc no.CR-SD-PRW-X-IS-00001);
- Crossrail, MDC4 Archaeology DDBA Victoria Dock Portal Package Specific WSI Deliverable — 2008 (doc no.CR-SD-PRW-X-IS-00001);
- Crossrail, MDC4 Written Scheme of Investigation for the DLR realignment at Victoria Dock Portal and Custom House Station 2009 (doc no. CR-SD-PRW-X-IS-00002);
- Crossrail, Archaeological Monitoring of Ground Investigations: Limmo Peninsula and Victoria Dock Portal (Excel Car Park) 2010.

- Crossrail, Archaeological monitoring and deposit model of ground investigations GI package 30: Victoria Dock Portal, Custom House Station and Connaught Tunnel Worksites 2010 (doc no C122-OVE-T1-RGN-CRG01-50001)
- English Heritage, 2006 Understanding Historic Buildings: A guide to good recording practice;
- Museum of London, 2002 A research framework for London archaeology;
- Sidell, E J, Wilkinson, K N, Scaife, R G, and Cameron, N, 2000 The Holocene evolution of the London Thames: archaeological excavations (1991–8) for the London Underground Limited Jubilee Line Extension Project, MoLAS Monogr Ser 5, London; and
- Victoria County History, Essex Volume 6.

11.2 Glossary of Terms

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

ATD	Above Tunnel Datum. Tunnel Datum is 100m below Ordnance Datum. To convert an OD height to TD add 100m
APZ	Archaeological Priority Zone
BP	Before Present
c.	Circa
CRL	CrossRail Ltd
CH22	Cultural Heritage Asset Number 22
DDBA	Detailed Desk Based Assessment
DLR	Docklands Light Railway
EMP	Environmental Management Plan
EMR	Environmental Minimum Requirements
ES	Environmental Statement
EWMA	Enabling Works Managing Agent
GLAAS	Greater London Archaeology Advisory Service
LB	London Borough
LoD	Limit of Deviation
LZ	Landscape Zone
m	metre
MDC4	Multi-Disciplinary Consultant 4, Halcrow
MoLAS	Museum of London Archaeology Service (now MOLA)
MOLA	Museum of London Archaeology (formerly MoLAS)
NLL	North London Line
NGR	National Grid Reference
OSBM	Ordnance Survey Bench Mark
PDP	Project Delivery Partner
PGM	Permanent Ground Marker
SI	Systems Integration/Site Investigation
SS-WSI	Site Specific–Written Scheme of Investigation
TBM	Tunnel Boring Machine
WSI	Written Scheme of Investigation

Annex 1 – Archaeological Research Agenda

These are set out in the Generic WSI (CR-PN-PRW-EN-PD-00009) and in 4.2 above.

Annex 2 – Site Information

To be obtained from the PDP site manager and Principal Contractor

Annex 2.1 Services and Utilities

Please refer to Archaeological Contractor (currently C263) Works Information Chapter 1 Worksite Information

Annex 2.2 Extinguishments of Rights of Way

Please refer to Archaeological Contractor (C263) Works Information Chapter 1 Worksite Information

Annex 2.1 Surface Water Control

Please refer to Archaeological Contractor (currently C263) Works Information Chapter 1 Worksite Information

Annex 2.1 Protective Fencing

Please refer to Archaeological Contractor (currently C263) Works Information Chapter 1 Worksite Information

Annex 2.1 Credit Boards

Please refer to Archaeological Contractor (currently C263) Works Information Chapter 1 Worksite Information

Annex 2.1 Care in Executing the Site Operations

Please refer to Archaeological Contractor (currently C263) Works Information Chapter 1 Worksite Information

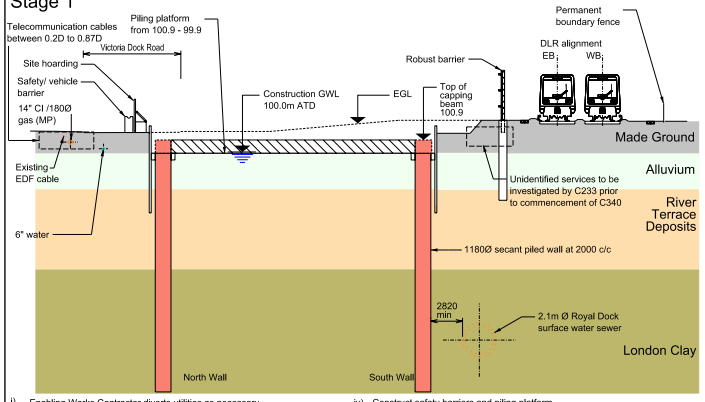
Annex 2.1 Parking of Vehicles

Please refer to Archaeological Contractor (currently C263) Works Information Chapter 1 Worksite Information

Annex 3 – Plans and Other Illustrations

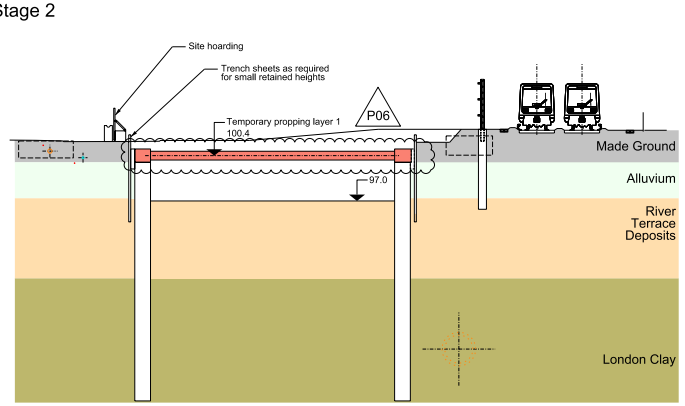
Annex 3.1 Figures 1-5 from C122-OVE-T1-RGN-CRG01-50001.

Stage 1



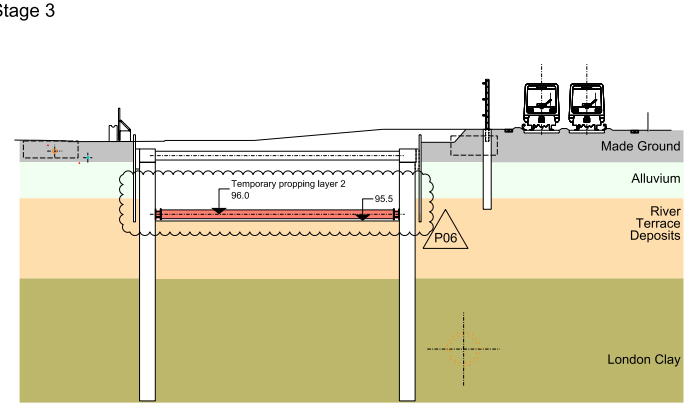
i) Enabling Works Contractor diverts utilities as necessary
Note: Original 1325mm Ø FW sewer will constitute a sub-surface obstruction at this location
ii) Divert existing DLR onto new alignment and construct robust barrier between portal site and DLR
iii) Set up monitoring of utilities, highways, DLR and other third party assets (see Note 8)
iv) Construct safety barriers and piling platform
v) Bench ground to south and create access route no higher than 101.5m ATD.
vi) Establish traffic management
vii) Construct guide walls
viii) Construct secant pile wall (conventional reinforcement in north and south walls, GFRP reinforcement in west wall). Pockets to be formed in reinforcing cages with Pilecor ready to receive slab reinforcement

Stage 2



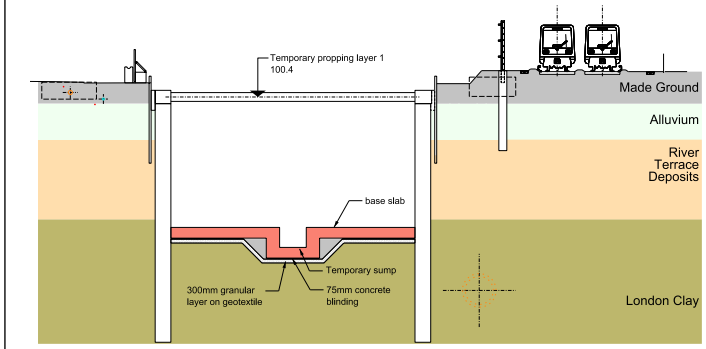
i) Excavate to secant pile design cut off level
ii) Break piles down
iii) Construct capping beam
iv) Excavate to 97.0m ATD with passive dewatering within excavation
v) Install temporary propping at 100.4m ATD (or 101.55 ATD on nibs)

Stage 3



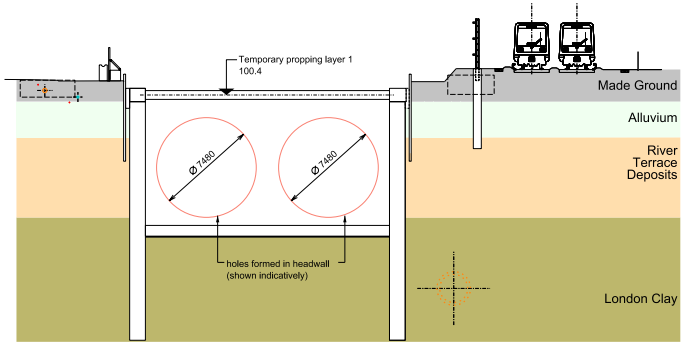
i) Excavate to 95.5 ATD, with passive dewatering within excavation
ii) Install temporary propping at 96.0 ATD.
P06

Stage 4



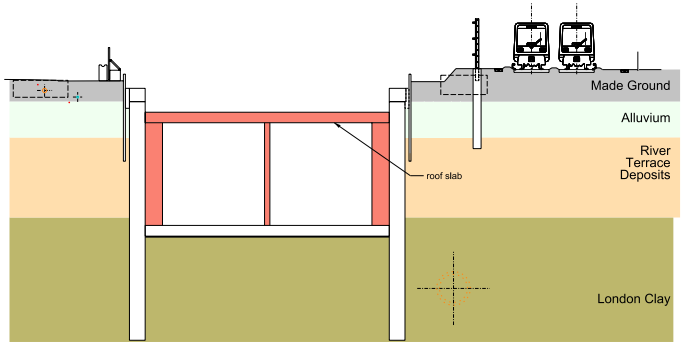
i) Excavate to formation level with passive dewatering within excavation
ii) Construct temporary sump
iii) Place geotextile, granular layer and blinding
iv) Expose pile reinforcement in pockets formed with pilecor
v) Fix base slab reinforcement
vi) Cast base slab
vii)Remove temporary propping layer 2

Stage 5



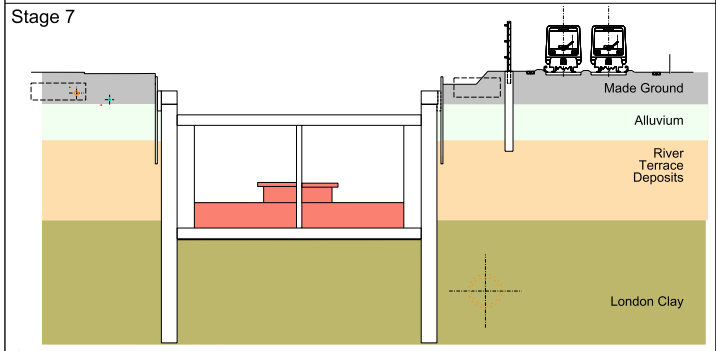
i) Construct reinforced concrete headwall against secant piled west wall. Headwall to include steel rings provided as free issue by C305
ii) Transfer responsibility for TBM Reception Chamber to C305
iii) C305 receive TBMs and construct temporary waterproof seal between tunnel and portal
iv) Responsibility for TBM Reception Chamber reverts to C340
v) Construct permanent waterproof seal to tunnel, fill temporary sump with concrete and infill hole in base slab
vi) Ensure weepholes in base slab B28 are clear and running free.
vii)Infill temporary weephole in sump, then fill temporary sump with concrete
P06

Stage 6



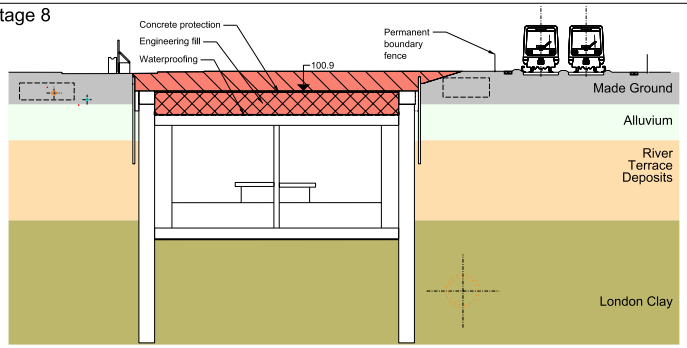
i) Construct lining walls
ii) Construct median wall
iii) Construct roof slab
iv) Remove temporary propping layer 1.

Stage 7



i) Place mass concrete within TBM Reception Pit
ii) Construct walkway

Stage 8



i) Waterproof roof slab, place protective board and cast 100mm concrete screed with A193 mesh reinforcement
ii) Place engineering fill, then cast protective concrete screed 100mm thick with A193 mesh reinforcement and indicator mesh
iii) Place suitable backfill and compact over structure
iv) Reinstate Victoria Dock Road
v) Construct permanent boundary fence to DLR

Safety, Health and Environmental Information

Notes below are additional to hazards/risks normally associated with this type of work:

Construction

Ci. The UXO risk is rated LOW. Refer to the Pre-Construction Information.
Cii. Refer to drawings for services locations. Verify locations before excavations.
Ciii. It has not been possible to carry out radar surveys in the rail corridors (DLR or old NLL). The contractor should therefore take additional care when excavating.
Civ. Vibration to be minimised when working near services. NG to approved methodology of all work within 15m of 600mm gas main.
Cv. Vibration to be minimised when working near DLR.
Cvi. Piling: Safety guard must be in place when auger is rotating.
Cvii. Tall plant near DLR, road and buildings. Dropped or slewed loads, toppling plant impacting railway. Safe system of work including adequate piling mat, lifting plans and safe vehicle movements.

Construction (contd.)

Cviii. Settlement monitoring to be carried out on DLR and adjacent structures as specified
Cix. DLR trains have no driver and do not operate on line of sight. PC must be aware of how to stop trains in an emergency.

Operations

Oi. None

Maintenance

Mi. None

Dismantling/Demolition (Future)

Di. None

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

Rev.	Date	Description	By	Chkd	App	Auth
P01	17/02/2010	Issued for GATE 1	PD	MB	ST	
P02	12/08/2010	Issued for IDR 2	PG	MB	-	
P03	14/09/2010	Issued for GATE 2	NG	MB	ST	
P04	07/01/2011	Issued for IDR 3	RL	MB	AB	
P05	14/02/2011	Issued for GATE 3	MR	MB	ST	
P06	02/03/2011	Re-Issued for GATE 3	BN	MB	ST	

Notes

1. Ground strata and ground water levels (GWL) are indicative and are based on GDN_2.0 dated June 2008
2. All levels are in metres above tunnel datum.
3. Construction loading 20 kN/m².
4. Position of safety barrier, plant and working restrictions to be agreed with DLR.
5. Chainages based on Crossrail Reference Chainage.
6. All works to be undertaken by C340 unless otherwise stated.
7. Background monitoring required, refer to Instrumentation and Monitoring Plan

KEY

Constructed in this stage

Scale 1:200

4m 0 4m 8m 12m 16m 20m

Crossrail Limited
25 Canada Square
Canary Wharf
London
E14 5LQ

www.crossrail.co.uk

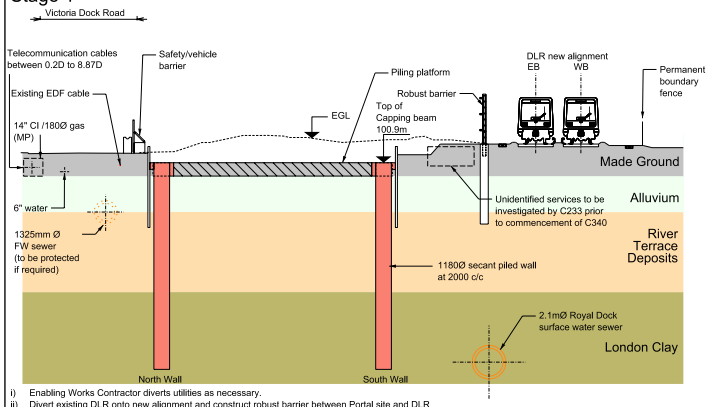
Contract : Victoria Dock Portal Design
Originator : Hyder
Location : Victoria Dock Portal
Title : Construction Sequence TBM Reception Chamber and FTS Recess Ch 85800 to Ch 85837 CC340 P06
By : B.NICHOLS
Chk : M.BOYD
App : S.T.DAVIES
Auth :
Scale : 1:200@ A1
Drawing and CAD file No : C154-HYD-C-DDB-CR144_PT003-20200
Rev : P06
Suitability : S4

RESTRICTED

Fit for authorisation

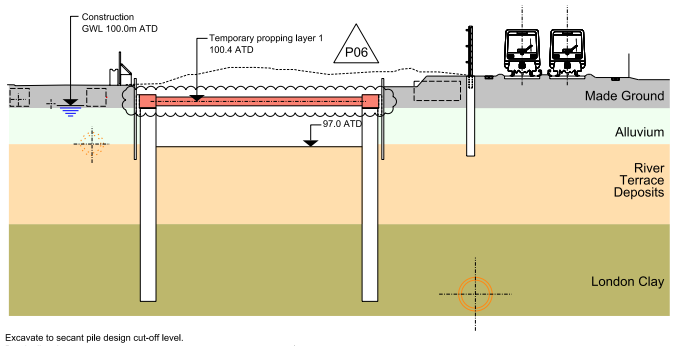
Copy Approved for Design - Created: 03-MAR-2011

Stage 1



i) Enabling Works Contractor diverts utilities as necessary.
ii) Divert existing DLR onto new alignment and construct robust barrier between Portal site and DLR
iii) Set up monitoring of utilities, highways, DLR and other third party assets (See Note 7).
iv) Construct safety barrier and piling platform
v) Bench ground to south and create access route no higher than 101.5m ATD.
vi) Construct guide walls
vii) Construct secant pile walls. Pockets to be formed in reinforcing cages with Pilecor ready to receive slab reinforcement

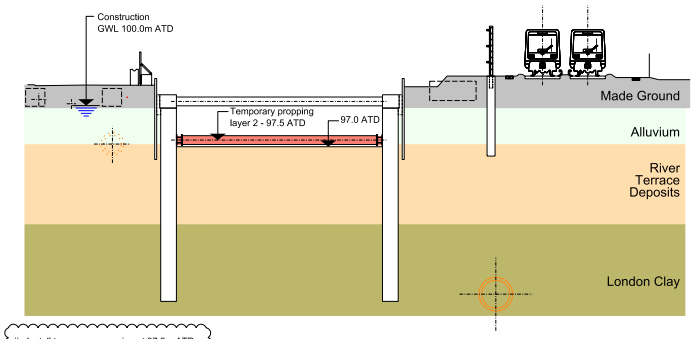
Stage 2



i) Excavate to secant pile design cut-off level.
ii) Break piles down
iii) Construct capping beam and nibs (where required)
iv) Excavate to 97.0 ATD with passive dewatering within excavation
v) Install temporary propping at 100.4m (or 101.55m ATD on nibs)

P06

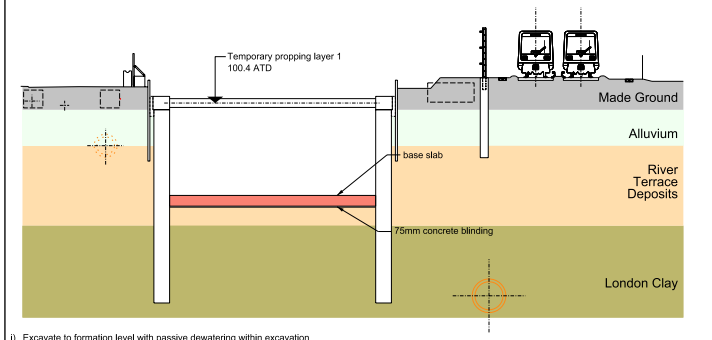
Stage 3



i) Install temporary propping at 97.5m ATD.

P06

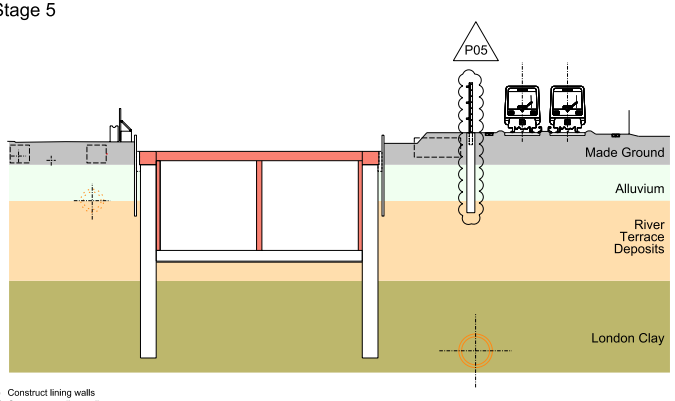
Stage 4



i) Excavate to formation level with passive dewatering within excavation
ii) Blind excavation
iii) Expose pile reinforcement in pockets formed with Pilecor
iv) Fix base slab reinforcement
v) Cast base slab (including weepholes in base slab B28)
vi) Remove temporary propping layer 2.

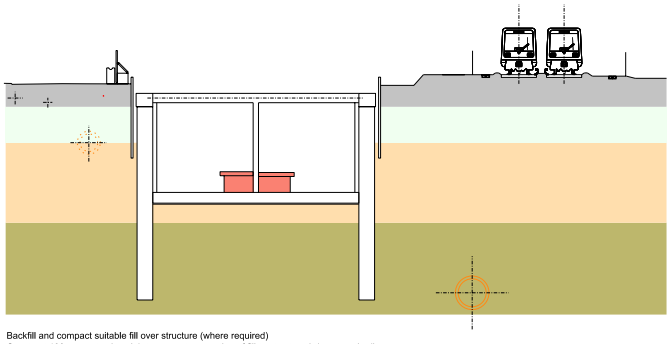
P06

Stage 5



i) Construct lining walls
ii) Construct median wall
iii) Construct roof slab
iv) Remove temporary propping layer 1
v) Demolish nibs (where required)

Stage 6

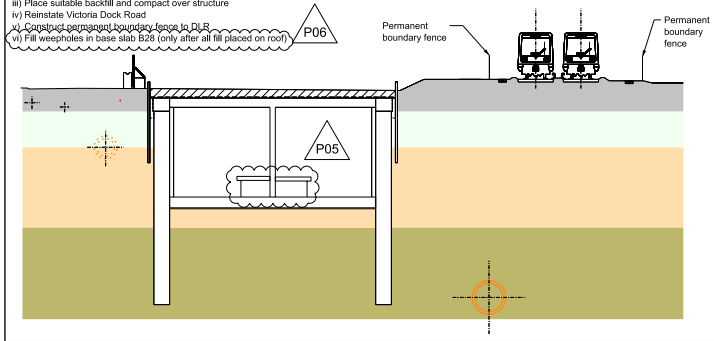


i) Backfill and compact suitable fill over structure (where required)
ii) Construct 100mm protection slab to prevent excavation of fill to structure (where required)
iii) Backfill and compact suitable fill over roof slab (where required)
iv) Construct walkway
v) Remove safety barrier and install permanent fencing

Stage 7

i) Waterproof capping beams and roof slab and place protective board
ii) Cast 100mm concrete screed with A193 mesh reinforcement
iii) Place suitable backfill and compact over structure
iv) Reinstate Victoria Dock Road
v) Construct permanent boundary fence to DLR
vi) Fill weepholes in base slab B28 (only after all fill placed on roof)

P06



Safety, Health and Environmental Information

Notes below are additional to hazards/risks normally associated with this type of work:

Construction

Ci. The UXO risk is rated LOW. Refer to the Pre-Construction Information.
Cii. Refer to drawings for services locations. Verify locations before excavations.
Ciii. It has not been possible to carry out radar surveys in the rail corridors (DLR or old NLL). The contractor should therefore take additional care when excavating.
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Cv. Vibration to be minimised when working near DLR.
Cvi. Piling: Safety guard must be in place when auger is rotating.
Cvii. Tall plant near DLR, road and buildings. Dropped or slewed loads, toppling plant impacting railway. Safe system of work including adequate piling mat, lifting plans and safe vehicle movements.

Construction (contd.)

Cviii. Settlement monitoring to be carried out on DLR and adjacent structures as specified
Cix. DLR trains have no driver and do not operate on line of sight. PC must be aware of how to stop trains in an emergency.

Operations

Oi. None

Maintenance

Mi. None

Dismantling/Demolition (Future)

Di. None

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

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P01	17/02/2010	Issued for GATE 1	PD	MB	ST	
P02	12/08/2010	Issued for IDR 2	PG	MB	-	
P03	14/09/2010	Issued for GATE 2	NG	MB	ST	
P04	07/01/2011	Issued for IDR 3	RL	MB	AB	
P05	11/02/2011	Issued for GATE 3	RL	MB	ST	
P06	02/03/2011	Re-Issued for GATE 3	BN	MB	ST	

Notes

1. Ground strata and ground water levels (GWL) are indicative and are based on GDN_2.0 dated June 2008
2. All levels are in metres above tunnel datum.
3. Construction loading as 20 kN/m².
4. Position of safety barrier, plant and working restrictions to be agreed with DLR.
5. Chainages based on Crossrail Reference Chainage.
6. All works to be undertaken by C340 unless otherwise stated.
7. Background monitoring required. Refer to Instrumentation and Monitoring Plan.

KEY

Constructed in this stage

Scale 1:200

4m 0 4m 8m 12m 16m 20m

Crossrail Limited
25 Canada Square
Canary Wharf
London
E14 5LQ

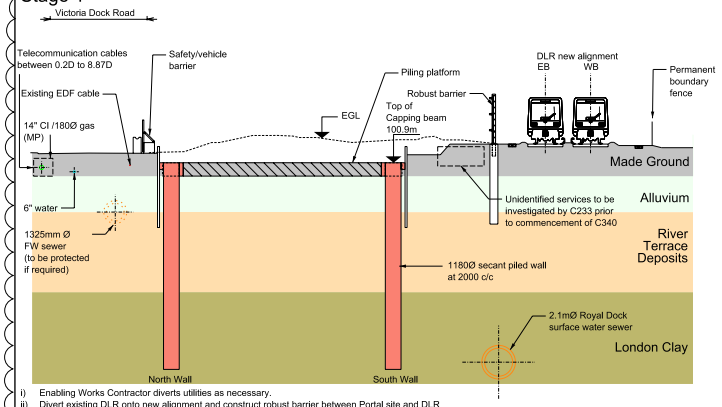
www.crossrail.co.uk

Contract : Victoria Dock Portal Design
Originator : Hyder
Location : Victoria Dock Portal
Title : Construction Sequence Cut and Cover Section Ch 85837 to Ch 85883 CC340
By : B.NICHOLS
Chk : M.BOYD
App : S.T.DAVIES
Auth :
Scale : 1:200@ A1
Drawing and CAD file No : C154-HYD-C-DDB-CR144_PT003-20210
Rev : P06
Suitability : S4

Fit for authorisation

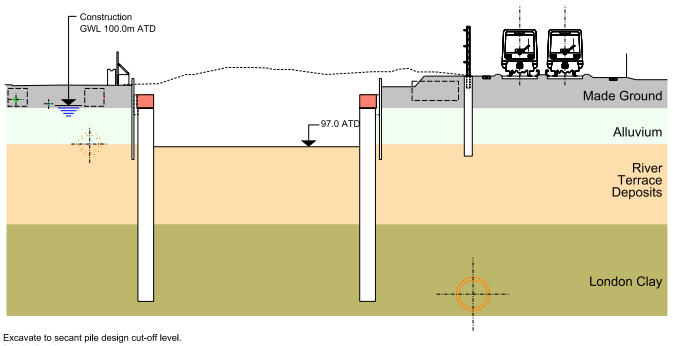
RESTRICTED

Stage 1



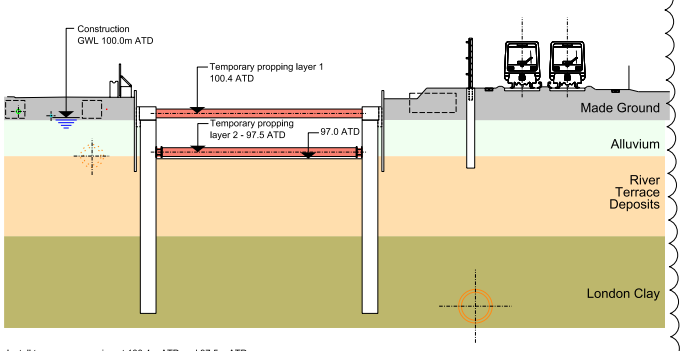
i) Enabling Works Contractor diverts utilities as necessary.
ii) Divert existing DLR onto new alignment and construct robust barrier between Portal site and DLR
iii) Set up monitoring of utilities, highways, DLR and other third party assets (See Note 7).
iv) Construct safety barrier and piling platform
v) Bench ground to south and create access route no higher than 101.5m ATD.
vi) Construct guide walls
vii) Construct secant pile walls. Pockets to be formed in reinforcing cages with Pilecor ready to receive slab reinforcement

Stage 2



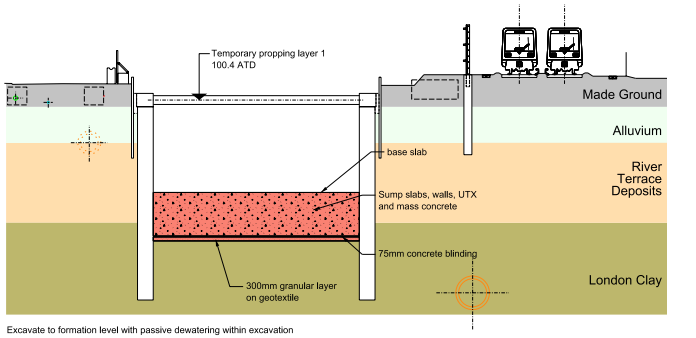
i) Excavate to secant pile design cut-off level.
ii) Break piles down
iii) Construct capping beam
iv) Excavate to 97.0 ATD with passive dewatering within excavation

Stage 3



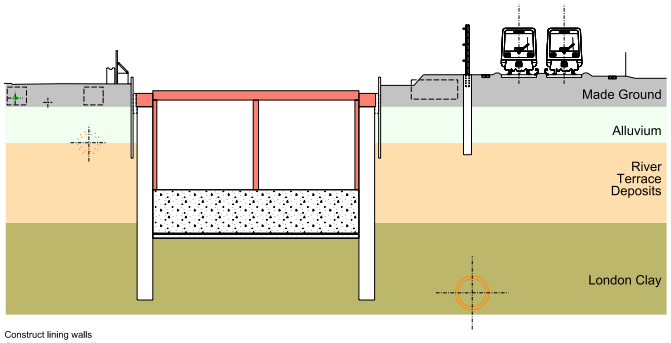
i) Install temporary propping at 100.4m ATD and 97.5m ATD.

Stage 4



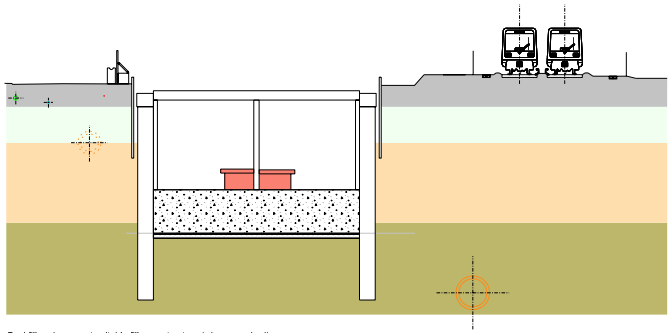
i) Excavate to formation level with passive dewatering within excavation
ii) Place geotextile, granular layer and blinding
iii) Expose pile reinforcement in pockets formed with Pilecor
iv) Construct sump base slab, walls, slab to support track, under track crossings and place mass concrete
v) Remove temporary propping layer 2

Stage 5



i) Construct lining walls
ii) Construct median wall
iii) Construct roof slab (see notes on roof construction below)
iv) Remove temporary propping layer 1
v) Demolish nibs (where required)

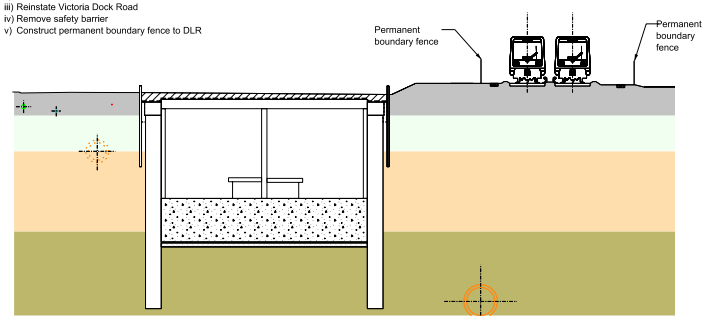
Stage 6



i) Backfill and compact suitable fill over structure (where required)
ii) Construct 100mm protection slab to prevent excavation of fill to structure (where required)
iii) Backfill and compact suitable fill over roof slab (where required)
iv) Construct walkway
v) Remove safety barrier and install permanent fencing

Stage 7

i) Waterproof capping beams and roof slab and place protective board
ii) Cast 100mm concrete screed with A193 mesh reinforcement
iii) Reinstate Victoria Dock Road
iv) Remove safety barrier
v) Construct permanent boundary fence to DLR



Roof Construction:

1. Roof slabs R1 to R3 are to be constructed west to east.
2. The prop immediately east of slabs R1 to R3 is only to be removed once the slab concrete has achieved its 7 day strength.

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

Construction
- Ci. The UXO risk is rated LOW. Refer to the Pre-Construction Information.
- Cii. Refer to drawings for services locations. Verify locations before excavations.
- Ciii. It has not been possible to carry out radar surveys in the rail corridors (DLR or old NLL). The contractor should therefore take additional care when excavating.
- Civ. Vibration to be minimised when working near services. NG to approved methodology of all work within 15m of 600mm gas main.
- Cv. Vibration to be minimised when working near DLR.
- Cvi. Piling: Safety guard must be in place when auger is rotating.
- Cvii. Tall plant near DLR, road and buildings. Dropped or slewed loads, toppling plant impacting railway. Safe system of work including adequate piling mat, lifting plans and safe vehicle movements.

Construction (contd.)
- Cviii. Settlement monitoring to be carried out on DLR and adjacent structures as specified
- Cix. DLR trains have no driver and do not operate on line of sight. PC must be aware of how to stop trains in an emergency.

Operations
- Oi. None

Maintenance
- Mi. None

Dismantling/Demolition (Future)
- Di. None

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

Rev.	Date	Description	By	Chkd	App	Auth
P01	17/02/2010	Issued for GATE 1	PD	MB	ST	
P02	14/02/2011	Issued for GATE 3	MR	MB	ST	

Notes
1. Ground strata and ground water levels (GWL) are indicative and are based on GDN_2.0 dated June 2008
2. All levels are in metres above tunnel datum.
3. Construction loading as 20 kN/m².
4. Position of safety barrier, plant and working restrictions to be agreed with DLR.
5. Chainages based on Crossrail Reference Chainage.
6. All works to be undertaken by C340 unless otherwise stated.
7. Background monitoring required. Refer to Instrumentation and Monitoring Plan.

P02

KEY
Constructed in this stage

P02
Scale 1:200
4m 0 4m 8m 12m 16m 20m

Crossrail
Crossrail Limited
25 Canada Square
Canary Wharf
London
E14 5LQ
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www.crossrail.co.uk

Contract :
Victoria Dock Portal Design
Originator :
Hyder
Location :
Victoria Dock Portal
Title :
Construction Sequence
Cut and Cover Section
Ch 85883 to Ch 85912
CC340
By : M.RAMPLEY
Chk : M.BOYD
App : S.T.DAVIES
Auth :
Scale : 1:200@ A1
Drawing and CAD file No : C154-HYD-C-DDB-CR144_PT003-20211
Rev : P02
Suitability : S4

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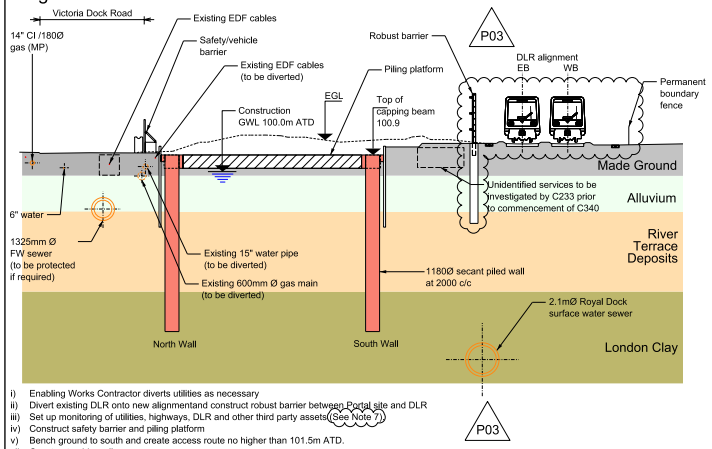
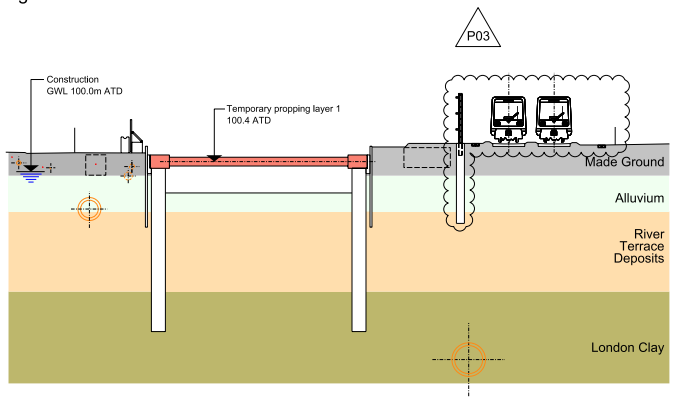
Stage 1



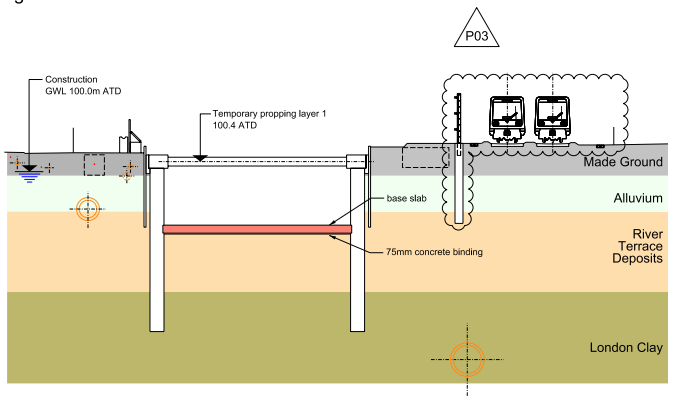
i) Enabling Works Contractor diverts utilities as necessary
ii) Divert existing DLR onto new alignmentand construct robust barrier between Portal site and DLR
iii) Set up monitoring of utilities, highways, DLR and other third party assets (See Note 7)
iv) Construct safety barrier and piling platform
v) Bench ground to south and create access route no higher than 101.5m ATD.
vi) Construct guide walls
vii) Construct secant pile walls. Pockets to be formed in reinforcing cages with Pilecor ready to receive slab reinforcement.

Stage 2



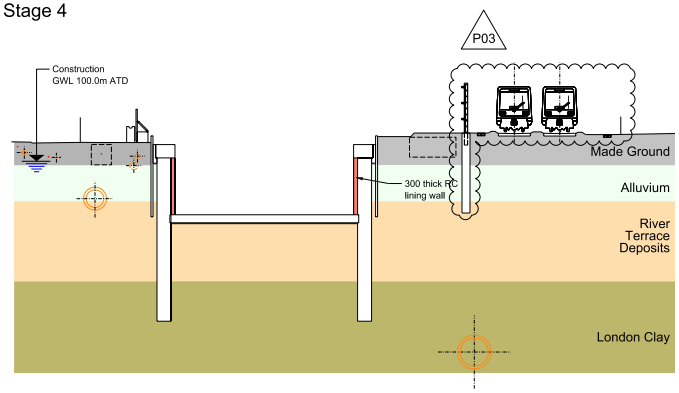
i) Excavate to secant pile design cut-off level.
ii) Break piles down
iii) Construct capping beam and nibs (where required)
iv) Excavate to 97.5 ATD with passive dewatering within excavation
v) Install temporary propping layer 1 at 100.4 ATD (or 101.4 ATD on nibs)

Stage 3



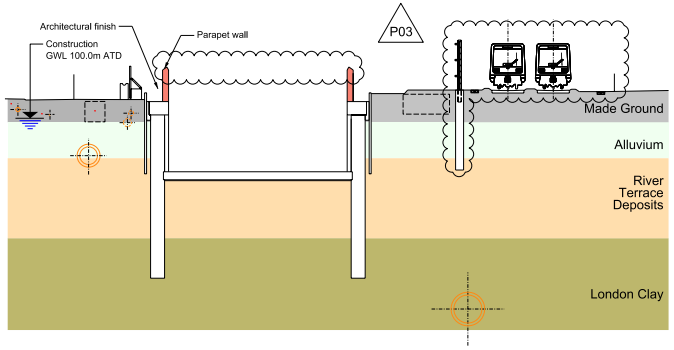
i) Excavate to formation level
ii) Blind excavation
iii) Expose pile reinforcement in pockets formed with Pilecor
iv) Cast base slab

Stage 4



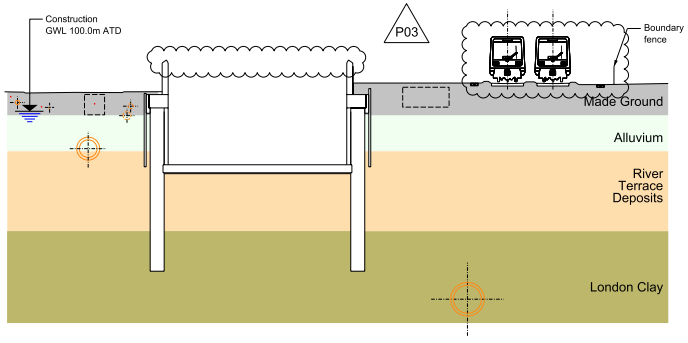
i) Remove temporary propping layer 1.
ii) Construct 300 thick RC lining walls

Stage 5



i) Construct parapet walls

Stage 6



i) Remove safety barrier
ii) Construct permanent boundary fence to DLR

Safety, Health and Environmental Information

Notes below are additional to hazards/risks normally associated with this type of work:

Construction

Ci. The UXO risk is rated LOW. Refer to the Pre-Construction Information.
Cii. Refer to drawings for services locations. Verify locations before excavations.
Ciii. It has not been possible to carry out radar surveys in the rail corridors (DLR or old NLL). The contractor should therefore take additional care when excavating.
Civ. Vibration to be minimised when working near services. NG to approved methodology of all work within 15m of 600mm gas main.
Cv. Vibration to be minimised when working near DLR.
Cvi. Piling: Safety guard must be in place when auger is rotating.
Cvii. Tall plant near DLR, road and buildings. Dropped or slewed loads, toppling plant impacting railway. Safe system of work including adequate pilling mat, lifting plans and safe vehicle movements.

Construction (contd.)

Cviii. Settlement monitoring to be carried out on DLR and adjacent structures as specified
Cix. DLR trains have no driver and do not operate on line of sight. PC must be aware of how to stop trains in an emergency.

Operations

Oi. None

Maintenance

Mi. None

Dismantling/Demolition (Future)

Di. None

P03

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

Rev.	Date	Description	By	Chkd	App	Auth
P01	15/09/2010	Issued for GATE 2	MR	MB	ST	
P02	07/01/2011	Issued for IDR 3	RL	MB	AB	
P03	11/02/2011	Issued for GATE 3	RL	MB	ST	

Notes

1. Ground strata and ground water levels (GWL) are indicative and are based on GDN_2.0 dated June 2008
2. All levels are in metres above tunnel datum.
3. Construction loading 20 kN/m².
4. Position of safety barrier, plant and working restrictions to be agreed with DLR.
5. Chainages based on Crossrail Reference Chainage.
6. All works to be undertaken by C340 unless otherwise stated.
7. Background monitoring required. Refer to Instrumentation and Monitoring Plan.

P03

KEY

Constructed in this stage

P03

Scale 1:200

4m 0 4m 8m 12m 16m 20m

Crossrail

Crossrail Limited
25 Canada Square
Canary Wharf
London
E14 5LQ

www.crossrail.co.uk

Contract : Victoria Dock Portal Design
Originator : Hyder
Location : Victoria Dock Portal
Title : Construction Sequence
Open Cut Constructed With Secant Piles
Ch 85912 to Ch 85975
CC340

By : R.LOWE
Chk : M.BOYD
App : S.T.DAVIES
Auth : ---

Scale : 1:200@ A1
Drawing and CAD file No : C154-HYD-C-DDB-CR144_PT003-20212
Rev : P03
Suitability : S4

RESTRICTED

Fit for authorisation

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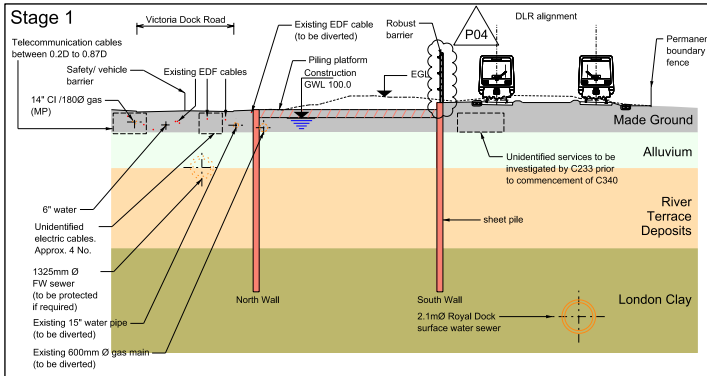
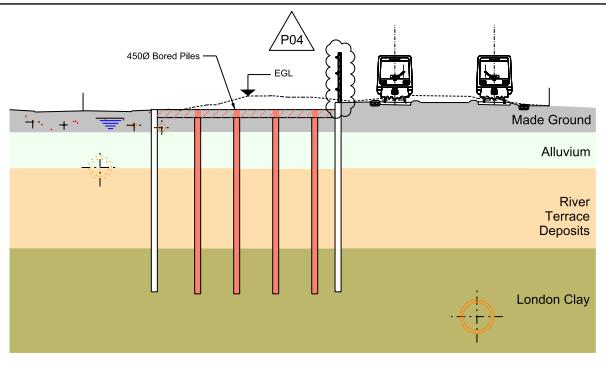
Stage 1



i) Enabling Works Contractor diverts utilities as necessary
ii) Divert DLR onto new alignment and construct robust barrier between Portal site and DLR. DLR troughs on Eastbound at sleeper ends
iii) Set up monitoring of utilities, highways, DLR and other third party assets (See Note 7).
iv) Construct safety barrier and piling platform
v) Establish traffic management
vi) Install temporary works (sheet piles shown for illustration only)

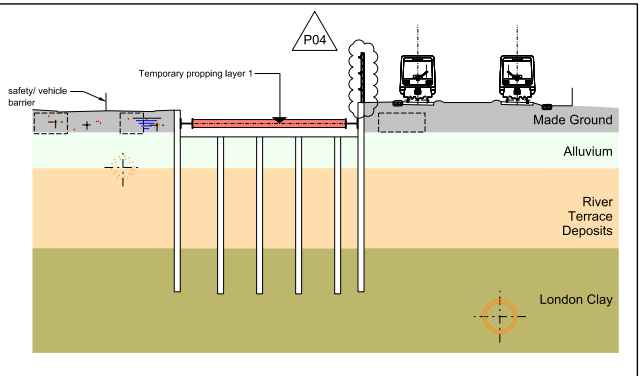
P04

Stage 2



i) Construct 450mmØ CFA piles

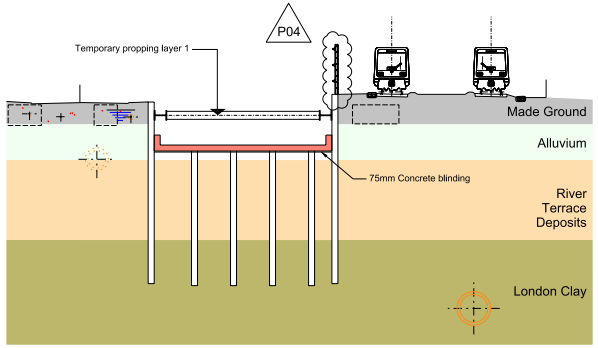
Stage 3



i) Excavate to a maximum of 99.800m ATD with passive dewatering within excavation. Break down piles as excavation proceeds
ii) Install temporary propping layer 1 where required. Deflection of wall should not exceed 0.0025H when propped, 0.0025H when unpropped. Where H= excavation depth

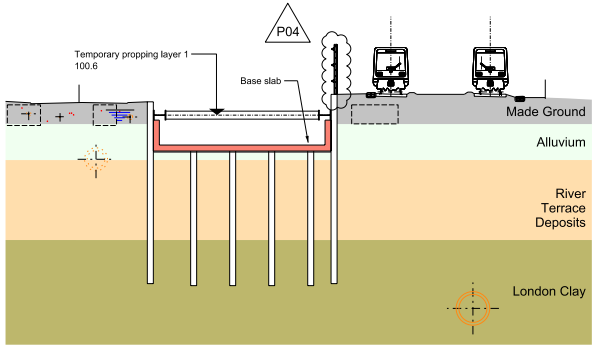
P03

Stage 4



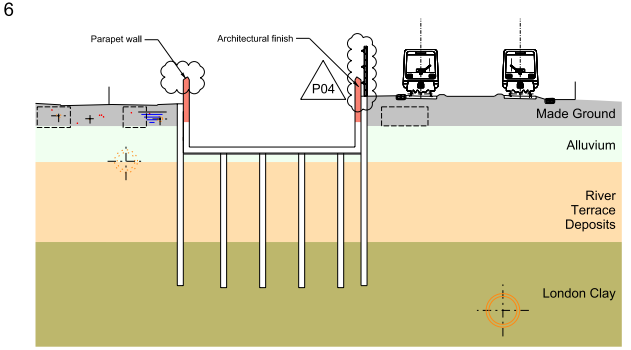
i) Excavate to formation
ii) Break down piles to cut off levels
iii) Blind excavation
iv) Cast base slab

Stage 5



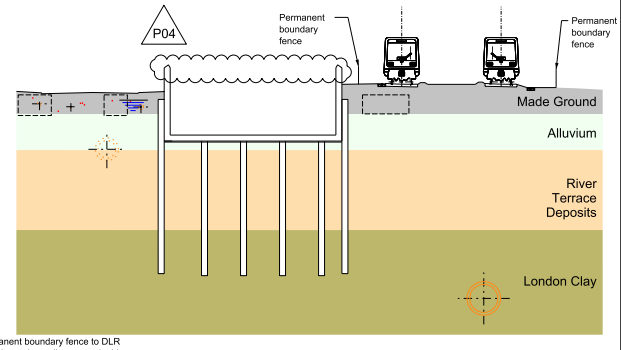
i) Cast walls of U-trough to underside of walling

Stage 6



i) Remove temporary propping layer 1
ii) Cast remainder of U-trough walls and parapet walls

Stage 7



i) Construct permanent boundary fence to DLR
ii) Remove or cut down sheet piles on north side
iii) Cut down sheet piles on south side. South side sheet piles shall not be removed

Safety, Health and Environmental Information

Notes below are additional to hazards/risks normally associated with this type of work:

Construction

Ci. The UXO risk is rated LOW. Refer to the Pre-Construction Information.
Cii. Refer to drawings for services locations. Verify locations before excavations.
Ciii. It has not been possible to carry out radar surveys in the rail corridors (DLR or old NLL). The contractor should therefore take additional care when excavating.
Civ. Vibration to be minimised when working near services. NG to approved methodology of all work within 15m of 600mm gas main.
Cv. Vibration to be minimised when working near DLR.
Cvi. Tall plant near DLR, road and buildings. Dropped or slewed loads, toppling plant impacting railway. Safe system of work including adequate piling mat, lifting plans and safe vehicle movements.

Construction (contd.)

Cvii. Settlement monitoring to be carried out on DLR and adjacent structures as specified
Cviii. DLR trains have no driver and do not operate on line of sight. PC must be aware of how to stop trains in an emergency.

Operations

Oi. None

Maintenance

Mi. None

Dismantling/Demolition (Future)

Di. None

P04

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

Rev.	Date	Description	By	Chkd	App	Auth
P01	17/02/2010	Issued for GATE 1	RL	MB	ST	
P02	14/09/2010	Issued for GATE 2	NG	MB	ST	
P03	07/01/2011	Issued for IDR 3	RL	MB	AB	
P04	11/02/2011	Issued for GATE 3	RL	MB	ST	

Notes

1. Ground strata and ground water levels (GWL) are indicative and are based on GDN_2.0 dated June 2008
2. All levels are in metres above tunnel datum.
3. Construction loading 20 kN/m².
4. Position of safety barrier, plant and working restrictions to be agreed with DLR.
5. Chainages based on Crossrail Reference Chainage.
6. All works to be undertaken by C340 unless otherwise stated.
7. Background monitoring required. Refer to Instrumentation and Monitoring Plan.

P04

KEY

Constructed in this stage

P04

Scale 1:200

4m 0 4m 8m 12m 16m 20m

Crossrail

Crossrail Limited
25 Canada Square
Canary Wharf
London
E14 5LQ

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Contract : Victoria Dock Portal Design
Originator : Hyder
Location : Victoria Dock Portal
Title : Construction Sequence Reinforced Concrete U-Trough Ch 85975 to Ch 86120 CC340

By : R.LOWE
Chk : M.BOYD
App : S.T.DAVIES
Auth :

Scale : 1:200@ A1
Drawing and CAD file No : C154-HYD-C-DDB-CR144_PT003-20220
Rev : P04
Suitability : S4

RESTRICTED

Fit for authorisation

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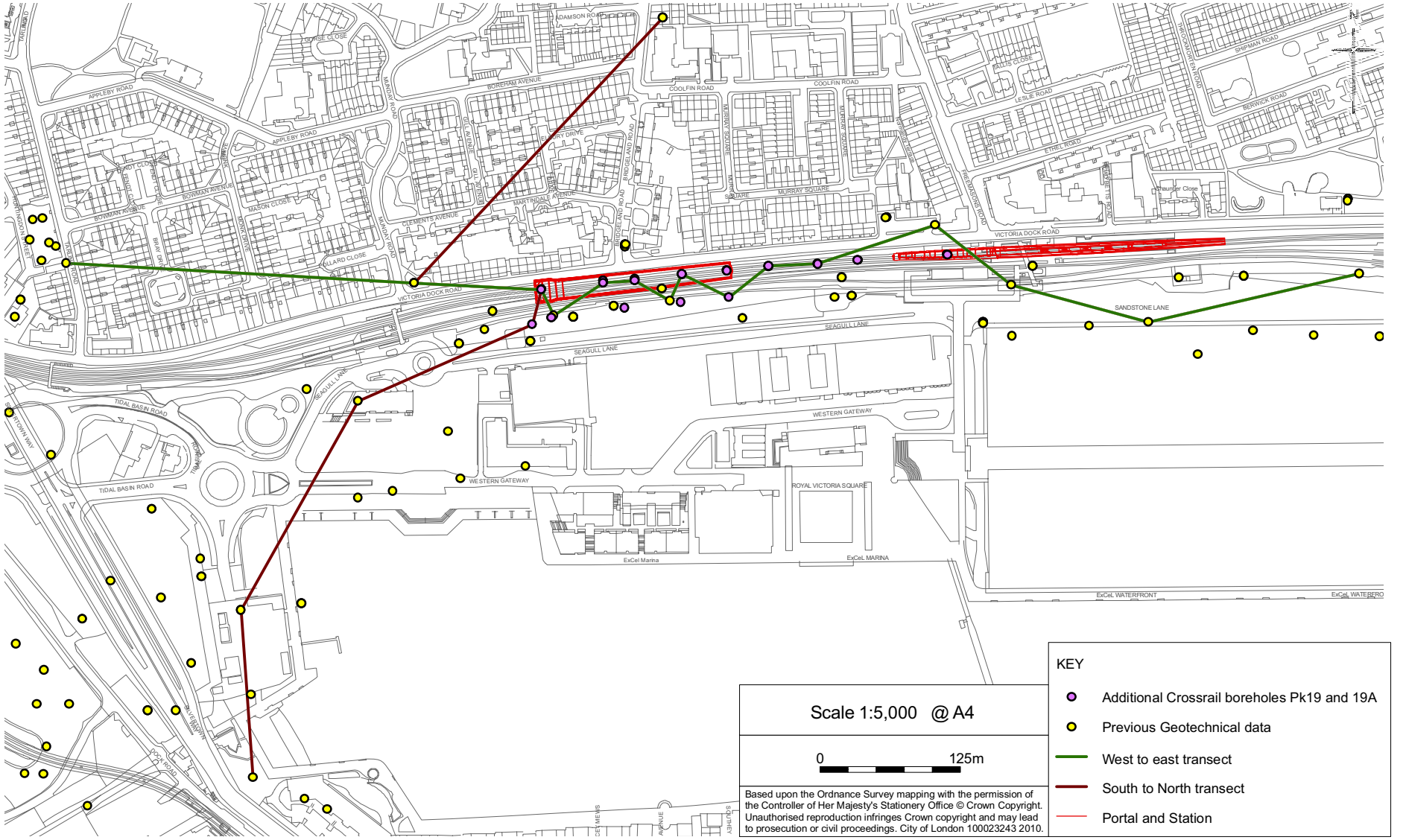

Fig 1 Location of geotechnical data and borehole transects

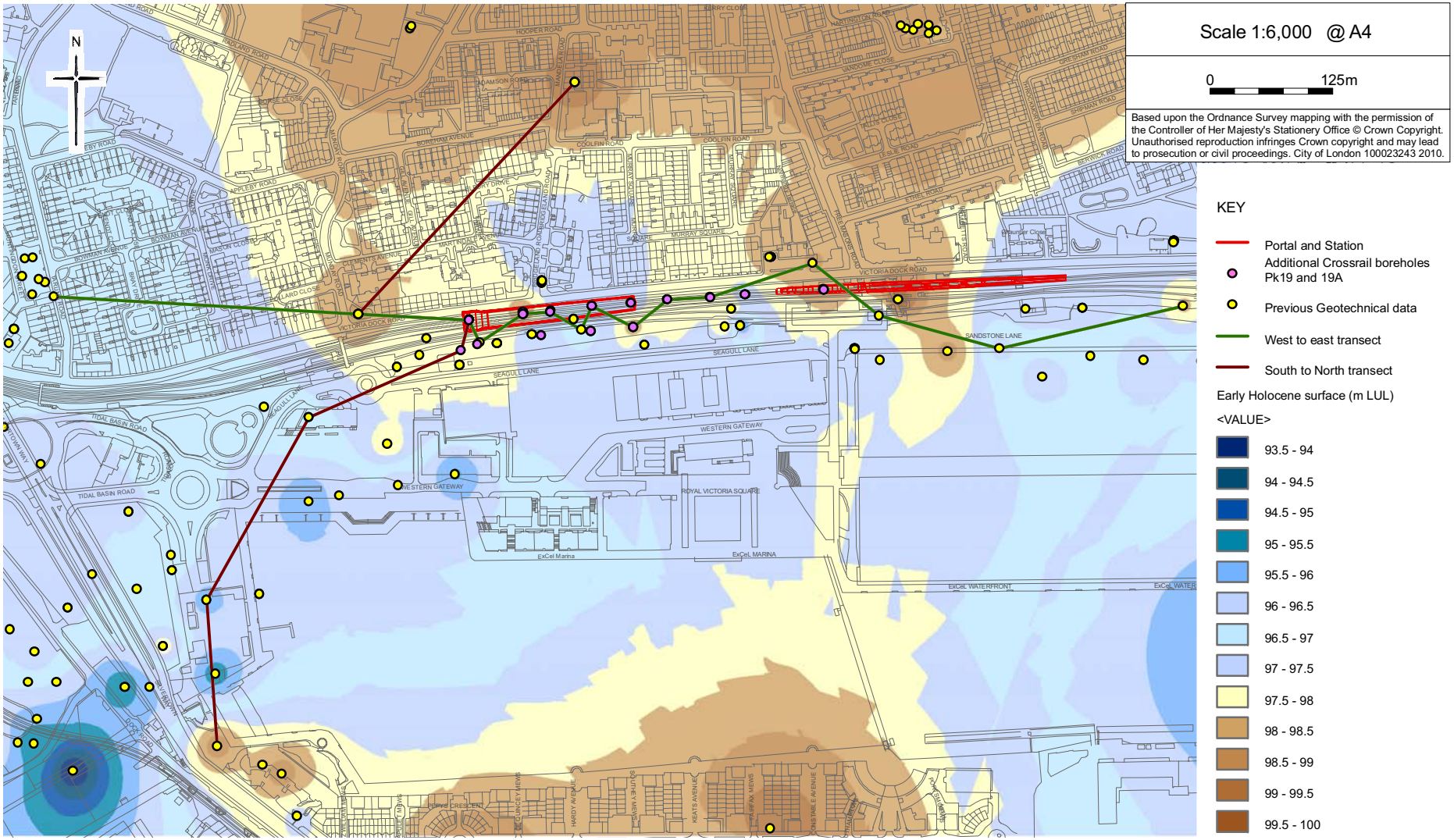

Fig 2 Buried topography of the Early Holocene

Victoria Dock portal West to East transect

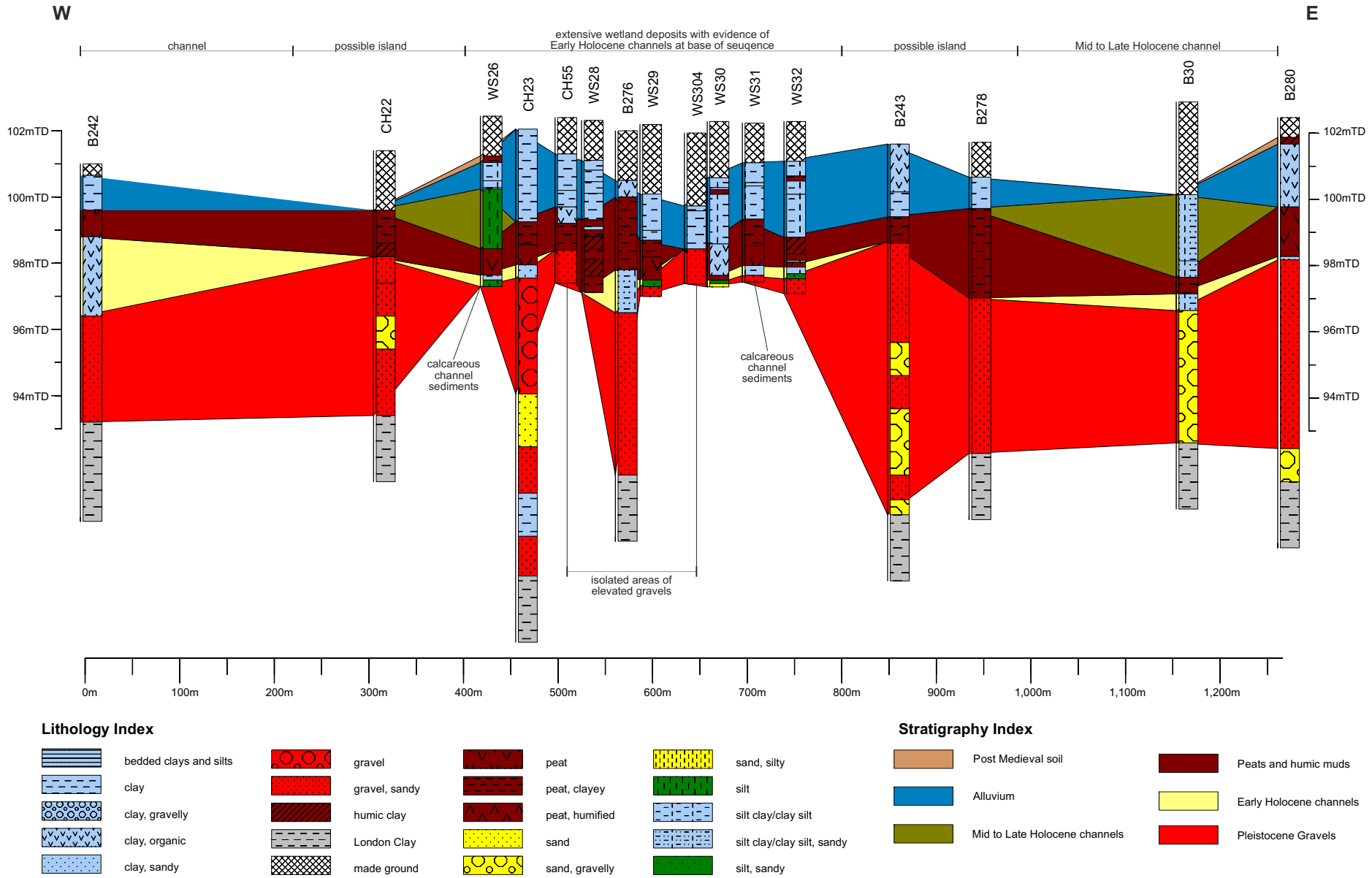

Fig 3 West to east transect across the site

Victoria Dock portal South to North transect

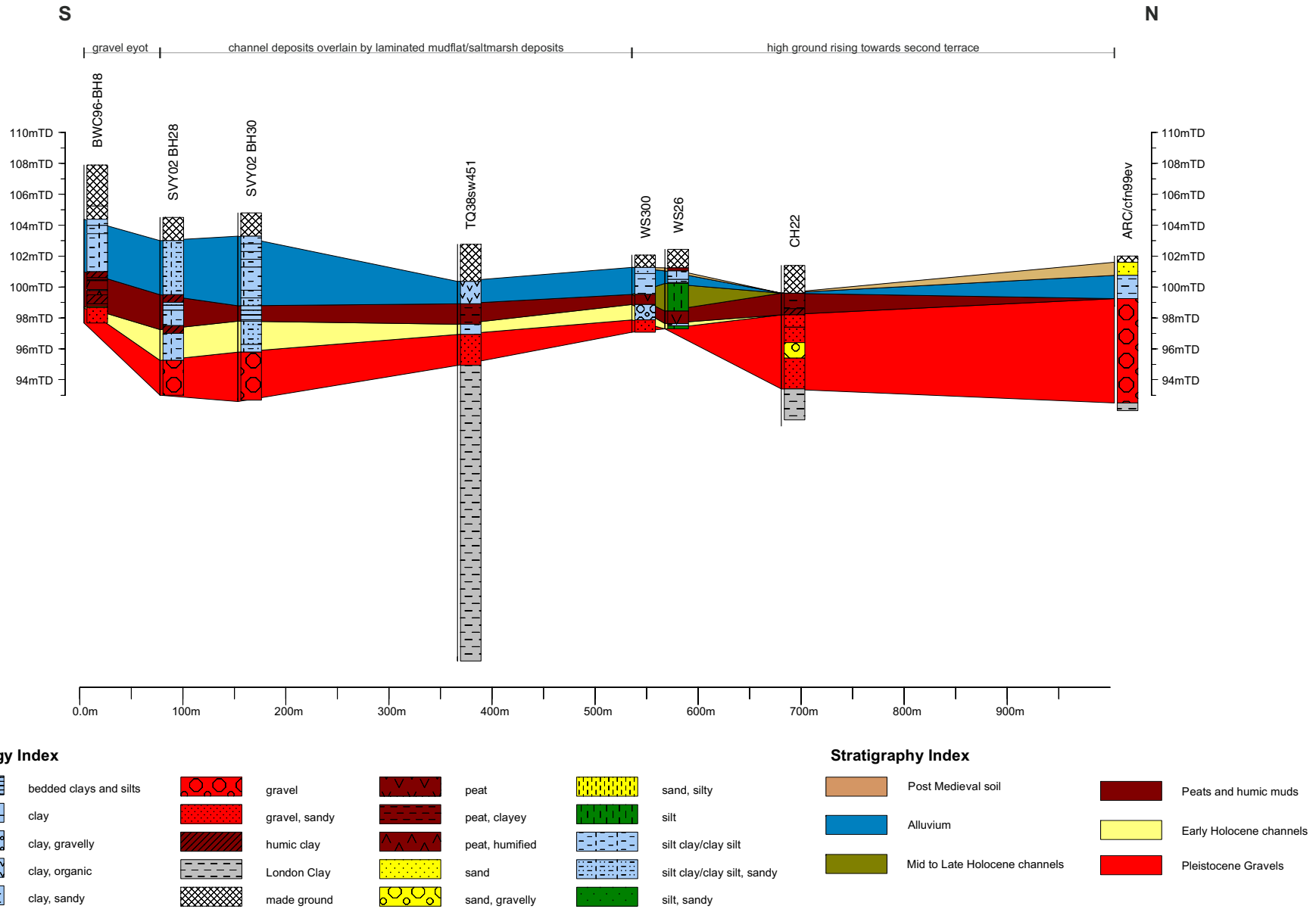

Fig 4 South to north transect across the site

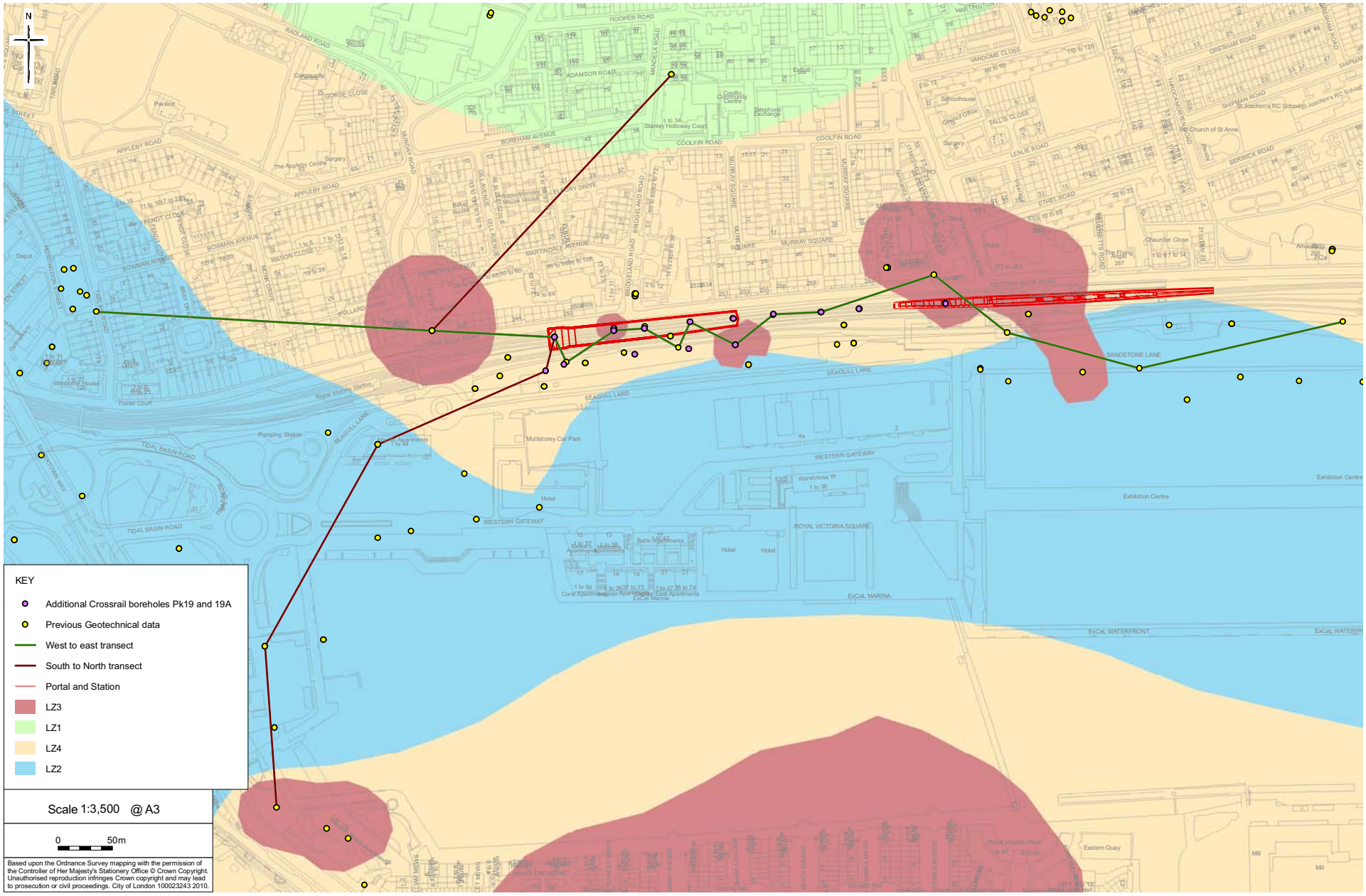

Fig 5 Landscape Zones

Annex 4 – Health and Safety Requirements

Annex 4.1 Designers Risk Assessment and CDM requirements

Please refer to Package Work Order C263 Works Information Chapter 3. Key construction risks relating to working constraints are provided in the RIBA F constructability report.

Annex 4.2 Archaeological Contractors risk assessments and Health and Safety Plans

Please refer to Package Work Order C263 Works Information Chapter

Annex 4.3 Archaeological Contractor's Safety Audits, Safety Inspections, Reporting of Accidents

Please refer to Package Work Order C263 Works nformation Chapter 3

Annex 4.4 Personal Protective Equipment (PPE)

Minimum personal PPE will consist of:

- Hi Visibility Vest (in the appropriate colour for the nature for the Worksite);
- Hard Hat;
- Gloves;
- Safety glasses;
- Laced boots with ankle support, steel insoles and toe caps (rigger boots are not permitted on Crossrail Sites);

Additional PPE which may be required for Victoria Dock Portal:

- Protective disposable contamination suits for work on rail sites or other identified contaminated areas (Annex 4, 4.5)

Annex 4.5 Labelling of Hazardous Substances, Contaminated Land

Please refer to Package Work Order C263 Works Information Chapter 3

Annex 4.6 CRL Health and Safety Management System, CRL Drugs and Alcohol Policy

Please refer to Package Work Order C263 Works Information Chapter 3

Annex 4.7 CRL and work on Network Rail Land

Please refer to Package Work Order C263 Works Information Chapter 3

Health & Safety - Designer's Hazard Record

Project Title	Project Code
Victoria Dock Portal	C154

Assessment Coverage:

Works associated with the Archaeological Site Specific Written Scheme of Investigation

1. Scope of Commission and Assessment of Coverage:

Written Scheme of Investigation for all the archaeological works Victoria Dock Portal

2. Brief Description of the Works:

Targeted watching briefs on excavation works and archaeological trial trenches

3. Key Risk Reduction measures taken during design process:

Use machines working backwards over the ground with an archaeologist standing in front observing the excavated surface

4. Significant Project Specific Hazards Remaining:

Usual on-site hazards (tripping, falling objects, moving plant, collapsing trench sides, infection, toxic substances) to be mitigated through RAs and measures by the Principal Contractor and the Archaeological Contractor

5. Specific Construction Requirements

Welfare facilities.

6. Means by which significant hazards conveyed to contractors and others:

SS-WSI.

Date of Review	

Assessed by:

Name	J Hunter	Signature		Date	4/3/2011

Reviewed by:

Name		Signature		Date	

	Health & Safety - Designer's Hazard Record			Project Code/Doc No: C154	
	Project Title: Victoria Dock Portal	Assessor (Name): Jim Hunter	Assessor (Signature): 	Date: 8/3/2011	Revision: A

Ref	Activity & Hazard	Level of Risk (optional)	Design Input to Eliminate or Reduce Hazards, and Hazards Remaining	Residual Hazard?
1	Live services (injury or death caused by hitting live services)		Excavations to be undertaken after service diversion. Main Contractor's H&S plan to be followed including routine scanning for live services prior to excavation. Archaeological contractor to undertake risk assessment and adhere to results.	Acceptable
2	Working at depth (trench collapse, poisonous gases or other substances)		Any trenches will be shored with sheet piling and frames rather than battered or stepped. Main Contractor's H&S plan to be followed. Archaeological contractor to undertake risk assessment and adhere to results.	Acceptable
3	Usual hazards associated with archaeological watching briefs (tripping, falling objects, moving plant, collapsing trench sides, infection, toxic substances)		Usual RAs from the Main and Archaeological Contractors to be undertaken and followed.	Acceptable
4	Leptospirosis, contaminated material etc. -.		Wear overalls and suitable gloves. Ensure facilities for changing and storage of PPE. Ensure good washing facilities available and are used	Acceptable

Ref	Activity & Hazard	Level of Risk (optional)	Design Input to Eliminate or Reduce Hazards, and Hazards Remaining	Residual Hazard?
5	Asbestos in ground.		Ensure staff are aware of the signs that might indicate asbestos materials in the ground. Any such indication should be notified to the Principal Contractor immediately	Acceptable
6	Site vehicles and other operations. -		All activities to be co-ordinated through the Principal Contractor.	Acceptable
7	Work at height. -		Excavations will be fenced. Access to excavations will be by ladder, secured at the top.	Acceptable

Annex 5 – Environmental Protection Requirements

Please refer to Package Work Order C 263 Works Information Chapter 4.

Annex 6 – programme and order of work for implementation of works and integration with other activities

Please refer to Chapter 6 above

Annex 7 - Enabling and temporary works design requirements, attendances and Implementation

Please refer to Chapter 7 above

Annex 8 - Security requirements

Any security requirement will be communicated to the Archaeology Contractor by the PDP Site Manager and/or the Principal Contractor. Please refer to Package Work Order C 263 Works Information Chapter 3

Annex 9 - Need for screening or other protective works

Please refer to Package Work Order C 263 Works Information Chapter 4

Annex 10 - Procedure for notification of the Discovery of Human Remains

Please refer to Chapter 7 above

Annex 11 - Procedure for notification of the Discovery of material falling under the Treasure Act 1996

Please refer to Chapter 7 above

Annex 12 - Procedure for notification of major unexpected discoveries

Please refer to Chapter 7 above