CANARY WHARF
GROUP PLC

NQ.LBC.06

North Quay
Outline Sequence of Works Report for Banana Wall Listed Building Consent

Arup
July 2020

Contents

1. Introduction

1.1 Canary Wharf (North Quay) Ltd ("the Applicant") are submitting applications for Outline Planning Permission ("OPP") and Listed Building Consent ("LBC") to enable the redevelopment of the North Quay site, Aspen Way, London ("the Site").

1.2 Two separate applications are being submitted as follows:

- Application NQ.1: Outline Planning Application (all matters reserved) ("OPA") - Application for the mixed-use redevelopment of the Site comprising demolition of existing buildings and structures and the erection of buildings comprising business floorspace, hotel/serviced apartments, residential, co-living, student housing, retail, community and leisure and sui generis uses with associated infrastructure, parking and servicing space, public realm, highways and access works; and

- Application NQ.2: Listed Building Consent Application ("LBCA") - to stabilise listed quay wall and any associated/necessary remedial works as well as demolition of the false quay in connection with Application NQ.1.

Together the development proposed under Applications NQ.1 and NQ.2 are referred to as the "Proposed Development".

1.3 At the time of making the OPA, the Applicant is unable to determine exactly how much of the Proposed Development is likely to come forward in which land use. For this reason, the description of development provides the Applicant with flexibility as to the uses that could be undertaken on the Site.

1.4 The Architect is Allies and Morrison LLP and the Structural Engineer is Waterman Group. Ove Arup and Partners Limited (Arup) has been appointed to provide geotechnical engineering services.

1.5 This Report has been prepared to support Application NQ.2 for Listed Building Consent.

1.6 The southern side of the Application NQ.1 site is retained by a Grade I listed 'banana' dock wall, which forms part of the Thames flood defence system. This Report outlines possible measures that could be taken to safeguard the banana wall during and after the construction works at the Application NQ.1 site.

2. Background

The banana wall

2.1 The masonry buttressed banana wall was constructed as part of the original dock construction in 1799-1802. The banana wall still forms part of the enclosure for North Dock and sits under the part of the Application NQ.1 site. It is a nine metre high concave structure, shaped to accommodate ship's hulls, and is reported to be lined with puddle clay and backfilled with River Terrace Deposits. The whole dock, including the banana wall structure, was Grade I listed in 1983. A copy of the citation is included in Appendix 1. A concrete false quay deck spans across the banana wall into the north dock supported on piles. This false quay is discussed further in paragraph 2.8.

Functions of the banana wall

2.2 The banana wall at North Quay performs a dual function. The wall serves to retain the ground levels outside the dock, and also acts as a flood defence to prevent loss of dock water into the upper aquifer in the River Terrace Deposits.

2.3 The dock water level in the dock measured between 2012 and 2014 was at approximately +4.19mOD. This could potentially rise to the statutory flood defence level of +5.23mOD. The upper aquifer level behind the banana wall was recently measured at approximately +1.0mOD. The banana wall is therefore effective at retaining the dock water both in normal conditions and as part of London's flood defences.

2.4 The watertight integrity of the banana wall must be maintained at all times as the wall forms part of the Environment Agency's (EA) flood defence of the River Thames. Failure of the banana wall could lead to a large increase in water levels in the groundwater on the Site and inundation of low lying areas of land.

2.5 If puddle clay lining exists on the back face of the banana wall, it must be maintained intact during excavation and foundation work in order to prevent leakage of water through the banana wall in compliance with the EA regulations for Thames Flood defences.

Historical records of the banana wall

2.6 A detailed section through the banana wall is shown in Figure 1 (Port of London Authority, Drawing No. 6700298). The original drawing is believed to date back from about 1920 and the measurements of the curvature of the wall has been confirmed from a dive survey. The wall is of brick construction throughout, set in hydraulic lime mortar with a coping of Dundee grit-stone, Skempton (1979). The brickwork is between 1.8m and 2.0m thick with a height of approximately 9m. Skempton (1979) shows that the top of the banana wall is at +5.3mOD.

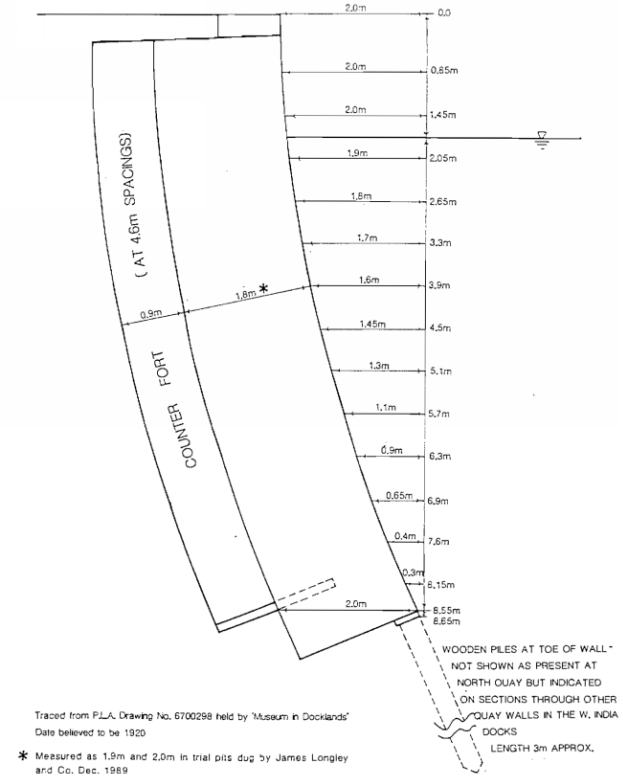


Figure 1 Section through the banana wall

2.7 A counterfort (buttress) is on the retained side connected to the brickwork at a horizontal spacing of approximately 4.5m along the wall in plan. The wall is founded on River Terrace Deposits. Historical information shows that wooden timber piles extend vertically from the toe of the wall for the West India Dock and are approximately 3m in length. However, a survey carried out in 1994 thought that the base of the wall was not to be piled because of the gravel bed was considered sufficiently stable (Survey of London, 1994). In addition, the West India Dock Committee Books (dated 26 February 1802), state that there were to be no piles under the wall of the import dock, but apparently, they were to be built on fir planks. No excavation has been undertaken to confirm the presence or absence of timber piles beneath this section of the banana wall located in the Site. Therefore, for setting out the proposed structures, the presence of wooden timber piles has been assumed.

2.8 The false quay was constructed in 1910 which extends into the dock from the banana wall and runs the length of North Quay. Figure 2 below shows the false quay configuration relative to the banana wall. The false quay is about 19m wide and the deck consists of main concrete beams at approximately 6.5m with secondary beams at approximately 1.6m centres. It is supported on three rows of 1.5m concrete filled steel cylinders each enclosing 0.35m square pre-cast piles and linked by pre-cast braces. The length of the piles are unknown. In 1953 the false quay was strengthened with additional 0.4m square piles (two per bay) and with pre-cast concrete beams. No details of these works are available. From the available information, there is no indication that the banana wall is reliant on the false quay for horizontal or vertical restraint.

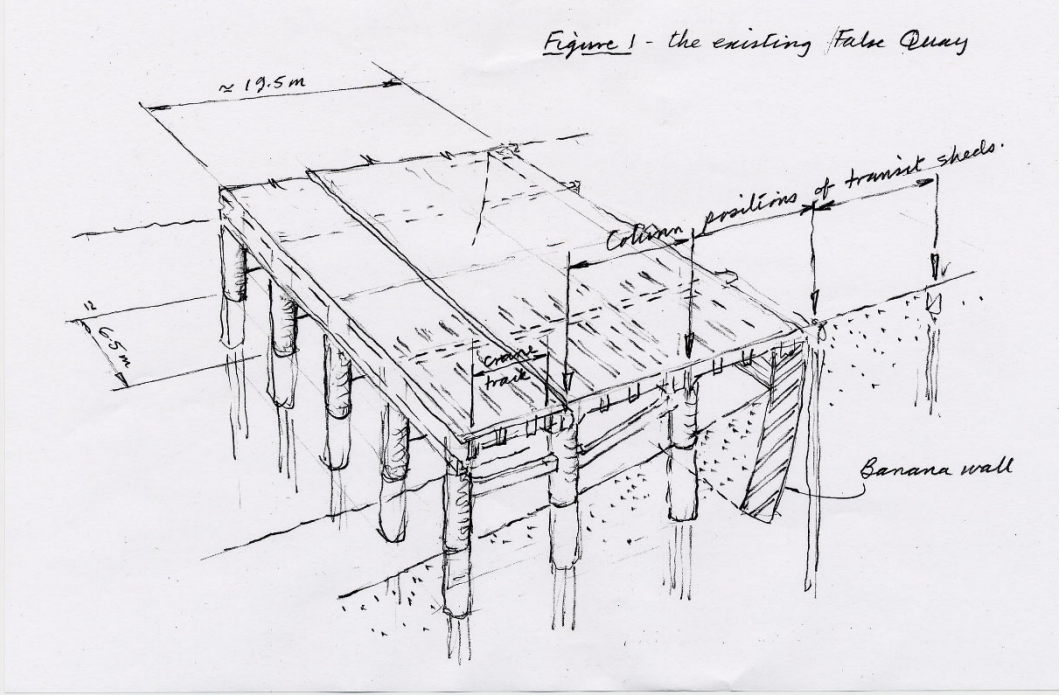


Figure 2 The existing false quay

Previous condition surveys of banana wall

2.9 During July and August 1988 Shoreline Engineering Limited undertook a condition survey of the 300m length of banana wall between Billingsgate Fish Market and the Docklands Light Railway viaduct. The survey was undertaken above and below dock water level with a four-man dive team. A condition survey report was produced with detailed survey logs, drawings (plans, elevations and sections) and photos.

2.10 The survey reported that 1.5m of brickwork was exposed above water level. Below water level the face of the wall was accessible to a maximum depth of 2.8m after which probing a further 2m into dock silt was undertaken.

2.11 The report concluded that “the general condition of the brickwork face was intact and stable without any major defects”, however some damage was found this being from general erosion around water level (wave action, frost, chemical attack), pipework having historically being installed through the wall and wash out around these pipes.

2.12 In 2002, Abwood Marine Ltd undertook a condition survey of the section of the banana wall beneath the Upper Bank Street Bridge (formerly Great Wharf Road Bridge) located to the south eastern corner of the North Quay site. The surface of the banana wall was also found to be generally intact and appeared stable with defects similar to those observed in the 1988 survey.

The remedial square piles associated with the 1953 strengthening work for the false quay were recorded in this survey.

2.13 It is not thought that anchors were used to hold back the banana walls and no anchors supporting the wall have been found in any trial pits, either on this site or anywhere else at Canary Wharf.

3. Ground and groundwater conditions

3.1 Based on the geological maps published, the geological sequence at the Site is expected to consist of superficial deposits at the surface with Made Ground, Alluvium and River Terrace Deposits. The solid geology is expected to consist of Harwich Formation and London Clay in localised areas. Lambeth Group, Thanet Sand and Chalk are expected to be at depth beneath the River Terrace Deposits. Several ground investigations have historically been undertaken on and near to the Site and confirm the published geology. Figure 3 is a north-south geological cross section through the middle of the North Quay site.

3.2 There are three groundwater regimes at the Site, the upper aquifer, the lower aquifer and the dock water. The upper aquifer maybe considered as the strata above the clay within the Lambeth Group, namely the River Terrace Deposits. The clay within the Lambeth Group forms an aquitard which in turn defines the top of the lower aquifer. The lower aquifer is generally taken as that found in the Thanet Sand and Chalk. The dock water and the upper aquifer are separated by the banana wall, dock silt and the clay lining of the dock. The recent measurement of the dock water level and upper aquifer are shown on Figure 3.

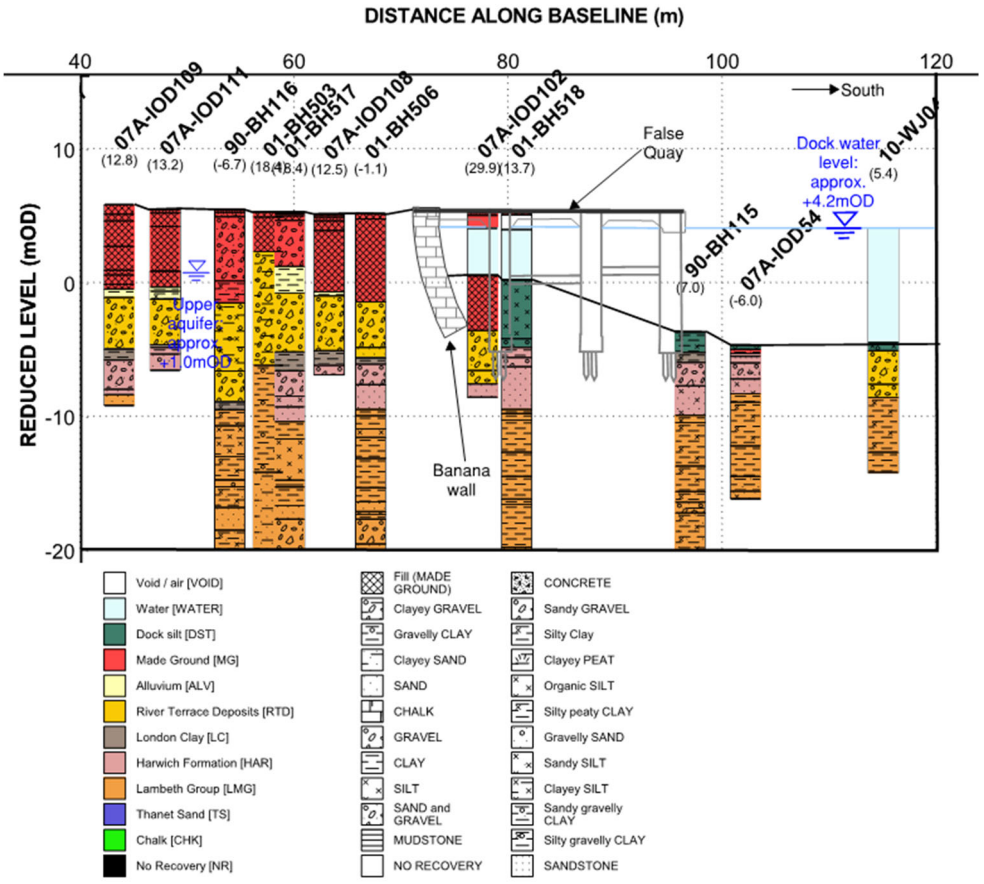


Figure 3 North-South geological section through the North Quay site

4. Proposed North Quay development

4.1 The Proposed Development comprises: demolition of existing buildings and structures and erection of buildings and construction of basements with the following uses: Business floorspace (B1), Hotel/Serviced Apartments (C1), Residential (C3), Co-Living (C4/Sui Generis), Student Housing (Sui Generis), Retail (A1-A5), Community and Leisure (D1 and D2) and other Sui Generis Uses. Associated infrastructure, including a new deck over part of the existing dock; Creation of streets, open spaces, hard and soft landscaping and public realm; Creation of new vehicular accesses and associated works to Aspen Way, Upper Bank Street, Hertsmere Road and underneath Delta Junction; Connections to the Aspen Way Footbridge and Crossrail Place (Canary Wharf Crossrail Station); Car, motorcycle, bicycle parking spaces, servicing; Utilities including energy centres and electricity substation(s); and other minor works incidental to the proposed development.

4.2 The Proposed Development comprises a number of tall buildings over a basement, which will span over the Banana Wall with piles on either side of the wall providing support to the new structures. The new structures will leave a void or compressible material above to avoid permanent loading of the wall. The adjacent existing false quay deck will be removed.

4.3 In order to test and validate the Outline Planning Application, an Indicative Scheme showing the potential location of buildings, uses and open spaces has been produced. This scheme provides a vehicle for examining the possible impacts of the project. It remains schematic but it conforms to the development parameters as defined in the Development Specification, Parameter Plans and Design Guidelines.

4.4 Figure 4 shows the site plan and the proposed buildings of the Indicative Scheme with the alignment of the existing Banana Wall indicated.

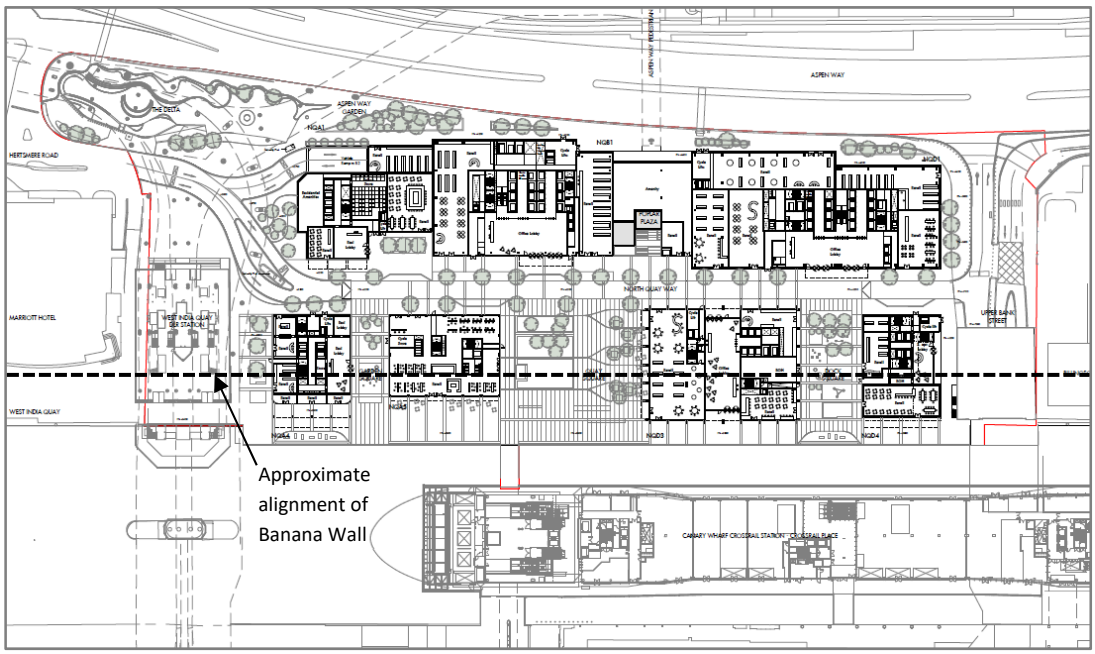
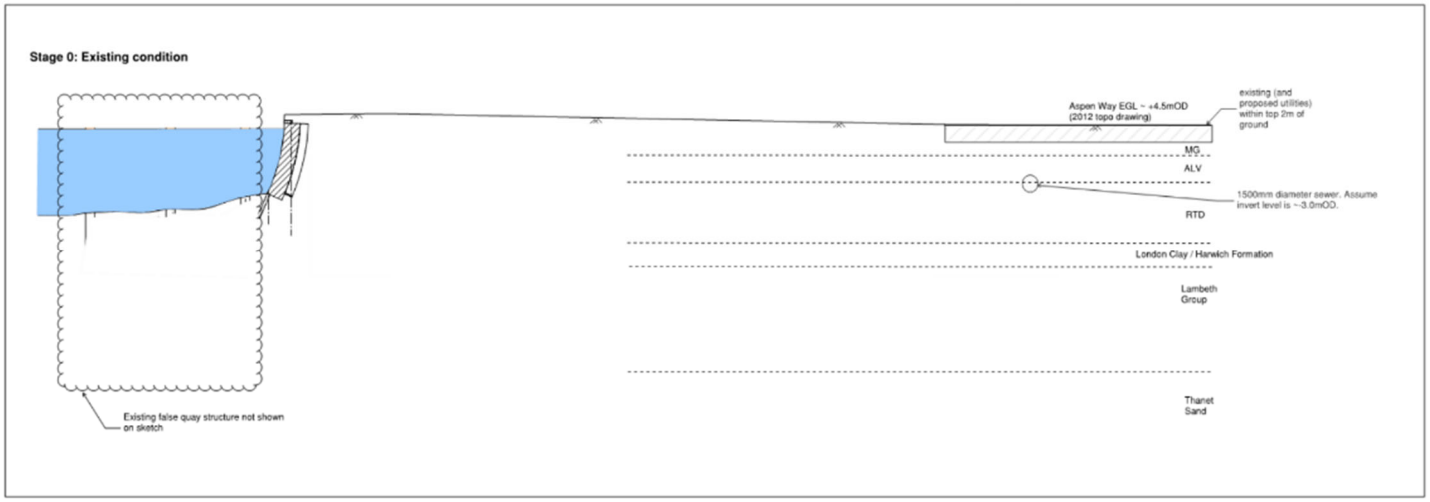


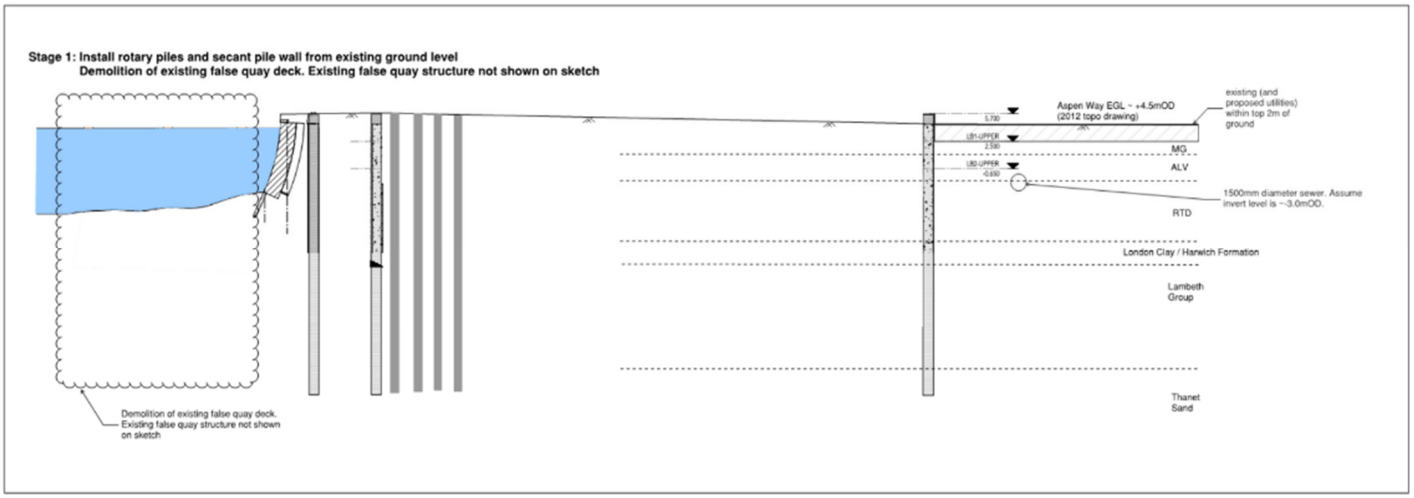
Figure 4 Proposed North Quay development (extract from A&M Drawing 19141-00-07-100 P0)

4.5 Further details of the dock edge arrangement can be found on the following drawings which accompany the application for Listed Building Consent:

19141-00-07-400	EXISTING SITE LOCATION PLAN
19141-00-07-401	EXISTING SITE DEMOLITION PLAN
19141-00-07-402	DOCK EDGE SECTIONS KEY PLAN
19141-00-07-403	EXISTING SECTION AA
19141-00-07-404	PROPOSED SECTION AA
19141-00-07-405	EXISTING SECTION BB
19141-00-07-406	PROPOSED SECTION BB
19141-00-07-407	EXISTING SECTION CC
19141-00-07-408	PROPOSED SECTION CC

4.6 The typical outline construction sequence for the substructure works is shown in Figure 5. This sequence is indicative and will be developed further during detailed design stages.





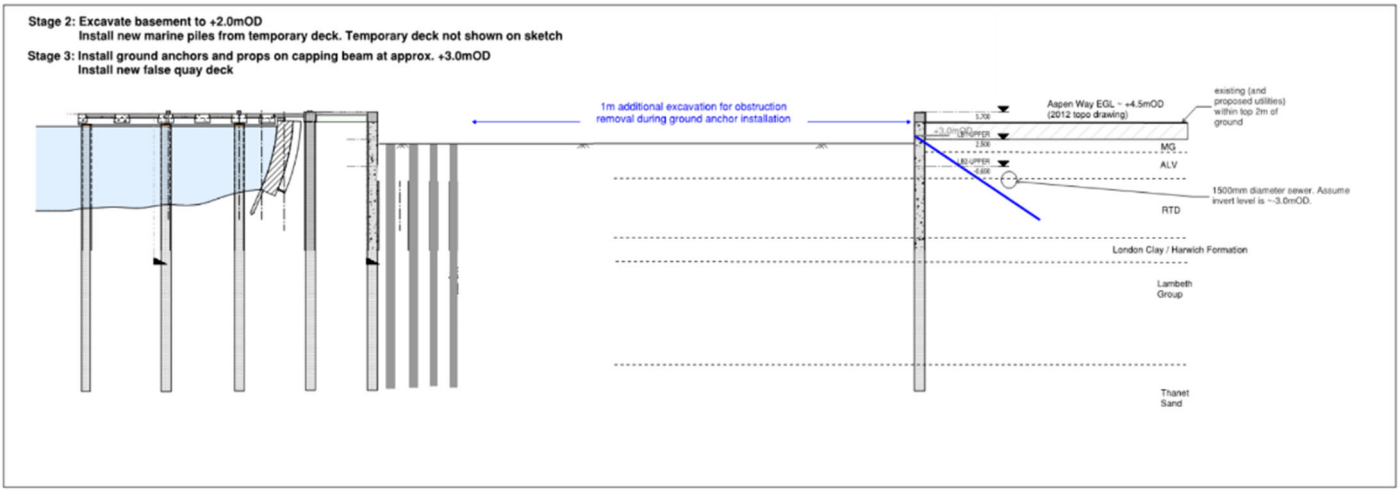
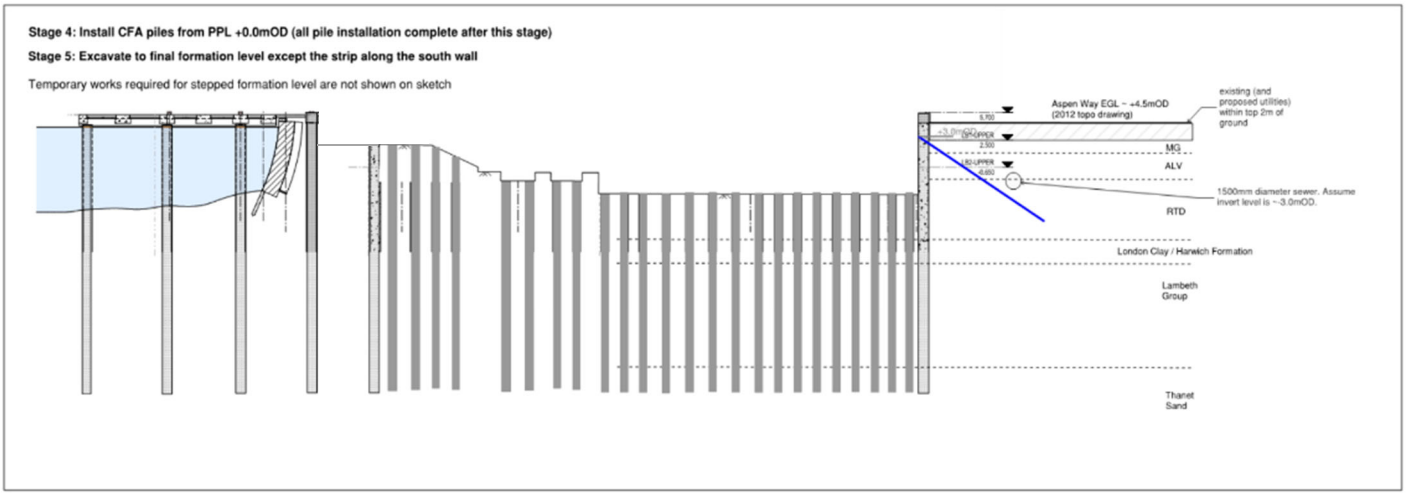
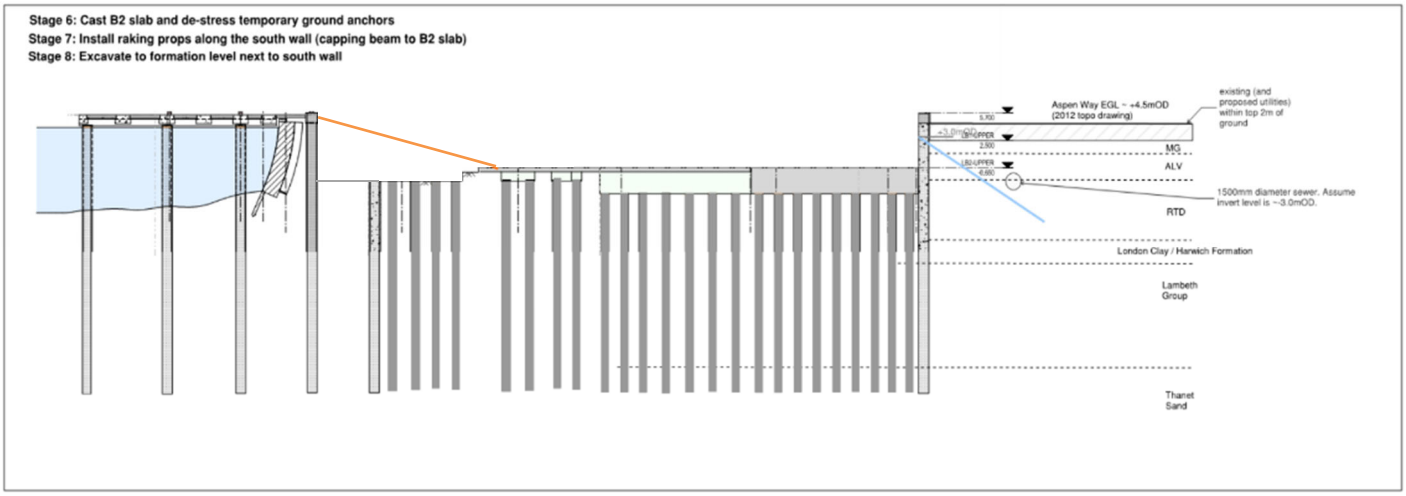


Figure 5 Outline construction sequence





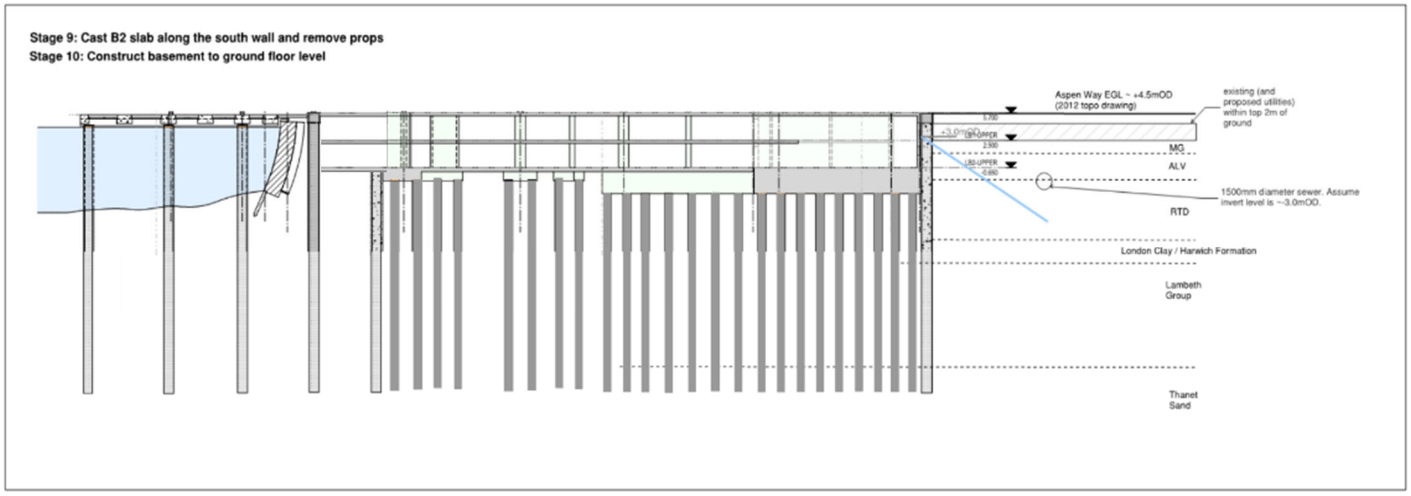


Figure 5 Outline construction sequence (cont'd)

5. Approach to design and sequence of works

5.1 The approach to the design and sequence of works is being developed to avoid structural intervention of the historic banana wall and to avoid changing the permanent loading condition of the wall. It involves the following:

- The setting out of the proposed secant pile wall and marine piles to be confirmed with survey trenches along the top of the banana wall verify its position and to avoid piling through the banana wall.
- The full removal of the adjacent existing false quay deck and new construction works such as piling and construction of new marine deck adjacent to the banana wall shall (if undertaken) be planned to limit construction loading to the current conditions. Where construction loads adjacent to the wall are temporarily higher than existing conditions, stability calculations shall be undertaken to confirm that the banana wall maintains satisfactory stability.
- The top of the banana wall shall be inspected prior to and during the demolition of the false quay to ensure the condition and integrity of the banana wall are maintained.
- Any puddle clay lining existing on the back face of the banana wall, shall be maintained intact during excavation and foundation work in order to prevent leakage of water through the banana wall. Any pipe penetrations to be capped.
- A secant pile wall shall be installed behind the banana wall to allow excavation of the proposed basement. Ground movement predictions and impact assessment for the excavation of the basement on the banana wall will be undertaken. Monitoring of the banana wall will be carried out to confirm movements are within satisfactory limits.
- The structural / architectural design is being developed to avoid placing permanent surcharge on the banana wall or the ground behind. The setting out of the proposed marine piles allows for the possible presence of the timber pile at the base of the banana wall.

5.2 The excavation of the basement may require stabilisation works to be undertaken to ensure there are no impacts to the Banana Wall. Remedial works to the Banana Wall will also be undertaken if required.

6. References

[1] Abwood Marine Limited (2002) Banana wall, false quay and bed level survey, January 2002.

[2] Shoreline Engineering Limited (1988) Survey of North Quay, Adjacent to Shed 35, Isle of Dogs, July/ August 1988.

[3] Skempton (1979), Engineering in the Port of London, 1789-1808, Transactions of the Newcomen Society, vol.50, 1978, p.87-108.

[4] Survey of London: Volumes 43 and 44, Poplar, Blackwall and Isle of Dogs, ed. Hermione Hobhouse (London, 1994), pp. 268-281. British History Online http://www.british-history.ac.uk/survey-london/vols43-4/ [accessed 16 March 2017].

[5] West India Dock Committee (1802) Minute Books, 26 February 1802.

Appendix 1 - Banana Wall Listing

SCHEDULE

In the entry for :-

1.
4431
TQ 3780 25/ 860A
I

WEST INDIA DOCKS
Isle of Dogs

Import Dock and Export Dock

2.

The address shall be amended to read:-

WEST INDIA DOCKS
Isle of Dogs

Quay walls, copings and buttresses to Import Dock and Export Dock.

1 April 1985

Signed by authority of the Secretary of State

P. N. BRISTOW
Principal in the Department of the Environment.

Note:-The list was previously amended in respect of this entry on 1 July 1983.

1.
4431

TQ 3780 25/860A

WEST INDIA DOCKS
Isle of Dogs

Import Dock and
Export Dock

I
2.

Following the Act of 1799, the West India Docks were opened in 1802, the first and greatest of the enclosed security commercial docks, a pioneering civil engineering design by William Jessop with Ralph Walker, that created the modern Port of London after 1800 and set the precedent for commercial dock design. The Import Dock is the earliest, 1800-02, followed to south by the Export Dock of 1803-06. Totalling 54 acres and 2,600 ft long with an original impounded depth of 23 ft, the quay walls are sophisticated brickwork having a concave profile and counterfort buttresses, on a gravel bed. The ashlar granite copings have largely been renewed or concealed by jetties. The locks to the Blackwall Basin were enlarged later in the C19 but see West Ferry Road for the Limehouse Entrance lock to the former City Canal subsequently in the 1860s enlarged as the present South Dock. Expenditure on works from 1800 to 1806 amounted to the vast sum of £1.1 million. These docks with Nos 1 and 2 warehouses (qv) are now the only surviving examples of the first intensive period of London dock construction: 1800-10.