Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Navigational Issues and Preliminary Risk Assessment

Doc Ref: **7.20.10**

Chambers Wharf

APFP Regulations 2009: Regulation **5(2)(q)**

Hard copy available in

Box **57** Folder **B**
January 2013

Thames Tideway Tunnel

Creating a cleaner, healthier River Thames

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Thames Tideway Tunnel

Navigational Issues and Preliminary Risk Assessment: Chambers Wharf

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Main Report

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1 Executive summary

1.1 Purpose

1.1.1 This report documents the activities and assessments undertaken to identify the navigational issues, risks and mitigation measures for the proposed permanent and temporary structures at the site known as Chambers Wharf as part of the Thames Tideway Tunnel project.

1.1.2 It was developed through liaison and consultation with Port of London Authority (PLA) and the other key stakeholders. It is intended to support the application for development consent and identify the navigational issues at the site and how these are to be managed. The process was used to inform the design of the permanent and temporary works and a number of measures to address navigational hazards have been embedded into the design.

1.1.3 The preliminary risk assessment follows the project itemised methodology proposed by the PLA rather than the methodology detailed within the PLA Safety Management System. The risk assessment reflects the level of development of the design in the application for development consent, that is, an outline design. The Contractor would be required to prepare detailed risk assessments and method statements and submit these to the PLA for approval before commencing any works in the river at this site.

1.1.4 The assessment was divided into four distinct project phases to assess hazards and develop risk reduction measures commensurate with the risk posed by different operations associated with the project. These phases were specific to this assessment and comprise:

Phase A: construction of cofferdam

Phase B: construction of main tunnel shaft/culvert/connections

Phase C: removal of cofferdam

Phase D: reinstate river wall.

1.2 Issues to be addressed

1.2.1 The proposed Chambers Wharf site lies between the Reeds Wharf house boat community and Cherry Garden Pier on the south bank of the River Thames in the Tower Bridge area (PLA Chart 318).

1.2.2 The issues to be addressed for this site are:

a. wash/draw-off from high speed passing vessels

b. proximity to the authorised channel

c. proximity to Cherry Garden Pier and City Cruises operations

d. proximity to house boats at Reeds Wharf and at Hermitage Wharf

e. proximity to PLA Mill Stairs mooring, the Fuel Buoy and the Essex Buoy

f. project barge breakout (a barge breaking free from its mooring at Chambers Wharf has the potential to cause damage to either the house boats at Reeds Wharf or to vessels moored at Cherry Garden Pier).

1.3 Wash

1.3.1 Thames Clippers are passing the site at speed and could cause barge break outs of moored project vessels if not sufficiently secured.

1.4 Proximity to the authorised channel

1.4.1 The Limits of land to be acquired or used (LLAU) at Chambers Wharf would be a minimum of 8m from the authorised channel (including all work boats or barges moored at the site). The cofferdam would be a minimum of 30m from the authorised channel. At these distances from the authorised channel, no impact on passing vessels would be anticipated.

1.5 Proximity to Cherry Garden Pier, Reeds Wharf, Hermitage Wharf and barge breakout

1.5.1 Cherry Gardens Pier and Reeds Wharf are occupied during working hours and 24 hrs respectively. A Thames Tideway Tunnel barge breaking free from its moorings could cause damage to vessels or harm staff or occupants and it is recommended that special attention is paid to the design of the moorings.

1.6 Proximity to the PLA Mill Stairs buoy

1.6.1 The location of this buoy would be likely to cause operational issues for barges accessing the Chambers Wharf site and an alternative buoy location would be required.

2 Site overview

2.1 Purpose of this report

2.1.1 The purpose of this report is to provide information on the navigational issues, risk assessment and mitigation measures associated with the proposed Chambers Wharf site. The report informs the *Transport Assessment and Environmental Statement* and the PLA approval process.

2.2 Introduction

2.2.1 The Thames Tideway Tunnel project (the 'project') comprises tunnels to store and transfer discharges from combined sewer overflows (CSOs) from West to East London for treatment at Beckton Sewage Treatment Works. The primary objective of the project is to control CSO discharges in order to meet the requirements of the EU Urban Waste Water Treatment Directive (91/271/EEC) (UWWTD) and the related UK Urban Waste Water Treatment Regulations.

2.2.2 The project comprises the following elements:

a. a main tunnel from Acton Storm Tanks to Abbey Mills Pumping Station requiring five main tunnel sites (one of the sites would also intercept flows from one CSO)

b. control of 18 CSOs by diverting intercepted flows into the main tunnel requiring 16 CSO sites; two long connection tunnels (Frogmore connection tunnel and Greenwich connect tunnel) and 11 short connection tunnels

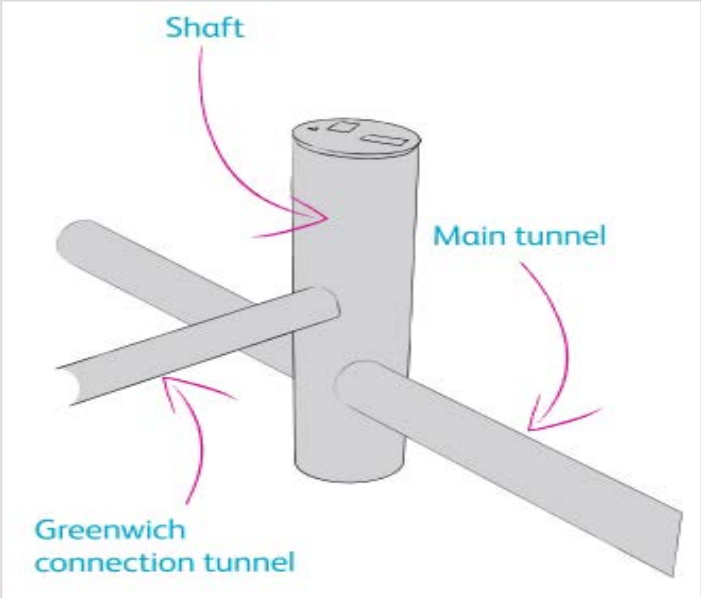
c. control of two CSOs by locally modifying the sewerage system requiring two system modification sites

d. works to drain down the system at Beckton Sewage Treatment Works.

2.2.3 The main tunnel would connect to the Lee Tunnel at Abbey Mills Pumping Station. All the flows from the Thames Tideway Tunnel and the Lee Tunnel would be transferred to Beckton Sewage Treatment Works via the Lee Tunnel.

2.2.4 The Chambers Wharf main tunnel site would be required to receive the main tunnel from Kirtling Street, drive the main tunnel to Abbey Mills Pumping Station and receive the Greenwich connection tunnel from Greenwich pumping Station. The proposed structures at this site are illustrated in Figure 2.1.

Figure 2.1 Main tunnel infrastructure (below ground)



2.2.5 It is proposed that the Chambers Wharf site would operate as a main tunnel drive and reception site and a connection tunnel reception site. The cofferdam and site working area would accommodate the following:

a. main tunnel shaft of 25m internal diameter, approximately 57m deep
b. cranes
c. excavated material handling area
d. internal site roads
e. maintenance workshops
f. storage facilities for segments, grout etc.
g. site support and welfare.

2.3 Limits of land to be acquired or used

2.3.1 The proposed limits of land to be acquired or used (LLAU) for this site is centred on Chambers Wharf. The total maximum extension into the river from the existing Chambers Wharf river frontage is approximately 60m along most of its length (of which approximately 40m for cofferdam build only). The LLAU does not encroach into the authorised channel, remaining at least five metres from it.

2.3.2 The LLAU encompasses the maximum working area required during construction. A cofferdam would be constructed within this area during the construction phases. The permanent works structure for this site would be on land. The cofferdam is expected to be over 30m away from the authorised channel.

2.3.3 The LLAU would be used intermittently, depending on the progress, method and phasing of construction.

2.3.4 Appendix A lists the various design, construction and site layout drawings.

2.4 Project phases

2.4.1 This assessment was divided into four distinct project construction phases to assess hazards and develop risk reduction measures commensurate with the risk posed by different operations associated with the project. These phases were identified for use during the navigation risk assessment and comprise:

Phase A: construction of cofferdam

Phase B: main tunnel shaft and tunnel construction

Phase C: removal of cofferdam

Phase D: reinstate river wall

2.5 Construction methodology

2.5.1 All works would be undertaken in accordance with the project's *Code of Construction Practice (CoCP)*.

2.5.2 The code sets out a series of objectives and measures to protect the environment and limit disturbance from construction activities as far as reasonably practicable. The topics covered by the *COCP* include but are not limited to: working hours, traffic management, noise and vibration, air quality, waste management, recycling, ecology, archaeology and settlement.

2.5.3 The methodologies, layouts and plant requirements outlined in this document are for illustrative purposes only and may be varied by subsequent design and build construction contractors

2.6 Phase A: Temporary works construction

2.6.1 The cofferdam would be constructed by installing a sheet piled wall. It is currently envisaged that the cofferdam would be designed as a twin walled cofferdam to accommodate the various loading conditions including external tidal loading and internal plant/construction loading.

2.6.2 It is intended to use the river to access and service the cofferdam construction activities, and a jack-up or spud leg barge would be mobilised at the site. A jack-up barge is a hydraulically operated self-elevating platform, which provides a stable platform from which marine piling works can be undertaken. The barge would be equipped with a crawler crane for off-loading and pitching the sheets for the sheet piled wall, a silent piling hammer, a small welfare cabin, a rescue boat and generated power

2.6.3 The majority of the existing piled deck would be removed following cofferdam construction.

2.7 Phase B: Main tunnel shaft and tunnel construction

2.7.1 The main tunnel shaft would be constructed by diaphragm wall construction techniques and have a cast in-situ secondary lining.

2.7.2 An attendant excavator would load the excavation material from the slurry separation plant into a dumper, which would deposit excavated material into the excavated material muck bin. A long reach excavator would load the excavated material into a barge moored alongside the cofferdam wall.

2.7.3 On completion of the tunnelling works, secondary lining concrete to the main and connection tunnel would be undertaken from this site. A concrete batching plant would be mobilised to site. Aggregates would be transported to site by river and offloaded by grab or long reach excavator.

2.8 Phase C: Cofferdam removal

2.8.1 On completion of the main tunnel shaft and tunnel works, the permanent river wall would be constructed. The cofferdam fill would be removed to allow the reconstruction of the river wall (on its current alignment).

2.8.2 Only when the permanent river wall is in place would the cofferdam on the riverside be removed in order to maintain flood protection. The cofferdam piled wall would be dismantled by jack-up barge. Any remaining cofferdam fill material would be removed by barge.

2.9 Phase D: Reinstatement

2.9.1 Once all temporary works structures have been removed and construction work is complete the foreshore would be reinstated.

3 Study aim and area

3.1 Introduction

3.1.1 The aim of this assessment is to identify and assess navigational hazards project-specific to construction activities at the Chambers Wharf site and to assess how the proposed phases of the project would likely impact on existing river users.

3.1.2 This assessment considers all river users and the hazards that project activities could pose to navigation on the River Thames.

3.1.3 In compiling this assessment, the project undertook extensive consultation with the PLA and current river users, along with observations of current river operations.

3.1.4 In order to consider the navigation impact on the wider river community, the scope of this assessment comprised an area from approximately Tower Bridge to Wapping Pier. This study area captures the majority of vessel types likely to transit the section of the river and pass the worksite.

3.1.5 The proposed development site is in close proximity to Cherry Garden pier and other moorings, and the effects of the project's activities on these were considered within this assessment.

3.1.6 The project proposes to use barges during Phases A, B and C to bring in and take away the material used to fill the cofferdam and to supply construction materials.

3.2 General navigation

3.2.1 The Chambers Wharf site is located within the Upper Pool reach of the River Thames and is included in PLA Chart No 318.

3.2.2 This stretch of the River Thames is extensively used by commuter, passenger craft as well as tugs, barges and other working vessels that transport freight.

3.2.3 Safety is the responsibility of all river users; however, overall responsibility for facilitating the safety of navigation on the River Thames rests with the PLA.

3.2.4 As part of its activities in maintaining navigational safety, the PLA produces Notices to Mariners (NTMs), which provide essential, up-to-date information and advice to those navigating within the Port of London. NTMs can range from information on special events, notifications of works (eg, the Network Rail works on Blackfriars Bridge), and notification of new and updated navigation rules and regulations. A full list of extant NTMs is available on the PLA website, http://www.pla.co.uk/notice2mariners/index.cfm/site/navigation.

3.2.5 The River Thames becomes tidal downriver of Teddington Lock, with a tidal range of between five and seven metres at different locations.

3.2.6 On the flood tide, the tidal current flows up-river (ie, predominantly east to west) whereas on the ebb tide, the tidal current flows downriver (ie, predominantly west to east).

3.3 The authorised channel

3.3.1 The authorised channel is marked on both Admiralty and PLA charts as a pair of pecked lines that define where the majority of commercial vessels generally navigate. However, vessels cannot always be expected to navigate 'within' the authorised channel.

3.3.2 The authorised channel in the Chambers Wharf area is approximately 120m wide.

3.3.3 The document General Directions for Navigation in the Port of London 2011 states the following:

> *"36. REQUIREMENT TO USE THE AUTHORISED CHANNEL*
>
> *(1) This Direction applies only to vessels navigating between the Margaretness Limit and Putney Bridge.*
>
> *"(2) Except in an emergency or for the purposes of overtaking, or with the permission of the Harbourmaster, or when manoeuvring to or from piers, wharves, anchorages or other berths, all Reporting Vessels and vessels of 13.7 metres or more in Length Overall shall normally navigate only in the authorised channel as identified on PLA charts.*
>
> *"(3) Where there is sufficient room, vessels less than 13.7 metres in Length Overall should normally navigate outside the authorised channel unless constrained by their draught or otherwise restricted in ability to manoeuvre, or in an emergency".*

3.4 Tide set

3.4.1 During consultation for this and other sites associated with the project, the project determined that the 'tide set' in this area of the River Thames should be taken into consideration when assessing navigational hazards.

3.4.2 The term 'tide set 'is used to describe the movement of water into the bight or outside edge of a bend of a river. In a tidal river like the River Thames, which is embanked in the central area, it also leads to an increase in velocity.

3.4.3 Every vessel is affected by tide set in varying degrees. Smaller, faster-moving craft are affected less than larger, slow-moving vessels such as tugs and tows, which have to make course and steering adjustments to counteract the impact of tide set.

3.4.4 The embankments of the River Thames deflect the water flow towards the outside of the next bend. This effect manifests itself particularly in the section of the river that contains the various bridges.

3.4.5 The tide set in and around Chambers Wharf is assessed as 'Slight to the North' on both the flood and ebb tides.

3.5 Existing river users

3.5.1 The proposed work structure at the site is located upstream of Cherry Gardens Pier and downstream of the Reeds Wharf houseboat moorings. It is downstream of Tower Bridge, in an area with moderate levels of traffic passing through Tower Bridge and on towards Canary Wharf.

3.5.2 Passing traffic is mainly commuter traffic, tugs and tows and the occasional cruise ship gaining access to the moorings at HMS Belfast. Leisure traffic also passes the site to access the moorings at St Katherine's Haven, to sightsee further up river and in some cases to access the non-tidal Thames and the canal system.

3.5.3 In 2012 three cruise ships used the Tower Bridge Upper (TBU) mooring at HMS Belfast. These were Silver Cloud from 10 to 12 June 2012, a Super Yacht from 25 July to 13 August 2012 and Hanseatic from 18 to 19 September 2012. Ships are limited to a length of 158m and the ruling depth is 5.8m.

3.5.4 Cruise ships usually swing at Hanover Hole (downriver from Chambers Wharf) and are towed backwards past Chambers Wharf and through Tower Bridge to moor at HMS Belfast.

Figure 3.1 Cruise ship passage

3.5.5 The PLA's advisory speed limit of 12 knots applies past the works (from Cherry Gardens Pier to Wandsworth Bridge). Consequently, Thames Clippers and other high speed craft would have reduced speed when passing the site.

3.5.6 The nearest commuter pier in frequent use is St Katherine's, some 700m upriver. Cherry Gardens Pier is used for mooring City Cruises vessels , but not as a passenger pier.

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4 Summary of navigational issues

4.1 Wash

4.1.1 Thames Clippers operate a high speed service passes the site at up to 30 knots which may cause project vessels to break free from its mooring.

4.1.2 The temporary moorings for construction barges would be designed to protect the moored barges from wash/draw-off from passing high speed vessels

4.2 Interaction with existing river traffic

4.2.1 It is expected that a maximum of three dump, or two motorised barges per day would access this site. Barges leaving the site would have good visibility to Tower Bridge (approximately 800m distance) of any downriver vessel traffic. Barges arriving at the site would have similar visibility when turning to berth at the site.

4.3 Proximity to the authorised channel

4.3.1 The Limit of land to be Acquired or Used (LLAU) at Chambers Wharf is a minimum of 8m from the authorised channel. The LLAU includes all work boats or barges moored at the site. The cofferdam would be a minimum of 30m from the authorised channel. At these distances from the authorised channel, there is not expected to be any impact on passing vessels.

4.4 Proximity to Cherry Garden Pier, Reeds Wharf and at Hermitage Wharf

4.4.1 Cherry Garden Pier provides office space and moorings for City Cruises, one of the major passenger vessel operators on the Thames. Reeds Wharf, located approximately 100m upstream of the site, provides moorings for approximately 35 house boats. A project barge breaking free from its moorings could cause damage to vessels moored at these facilities and harm residents or staff residing/working at these locations.

4.5 Proximity to PLA Mill Stairs fuel buoy

4.5.1 The location of this fuel buoy is likely to cause operational issues for barges accessing the project site and an alternative buoy location would be required.

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5 Risk assessment

5.1 Risk assessment: Methodology

5.1.1 For each of the identified hazards, the associated risk was assessed and classified. The following definitions were applied for the purposes of this report:

a. Hazard: eg, an object, activity or phenomenon that can cause an adverse effect.

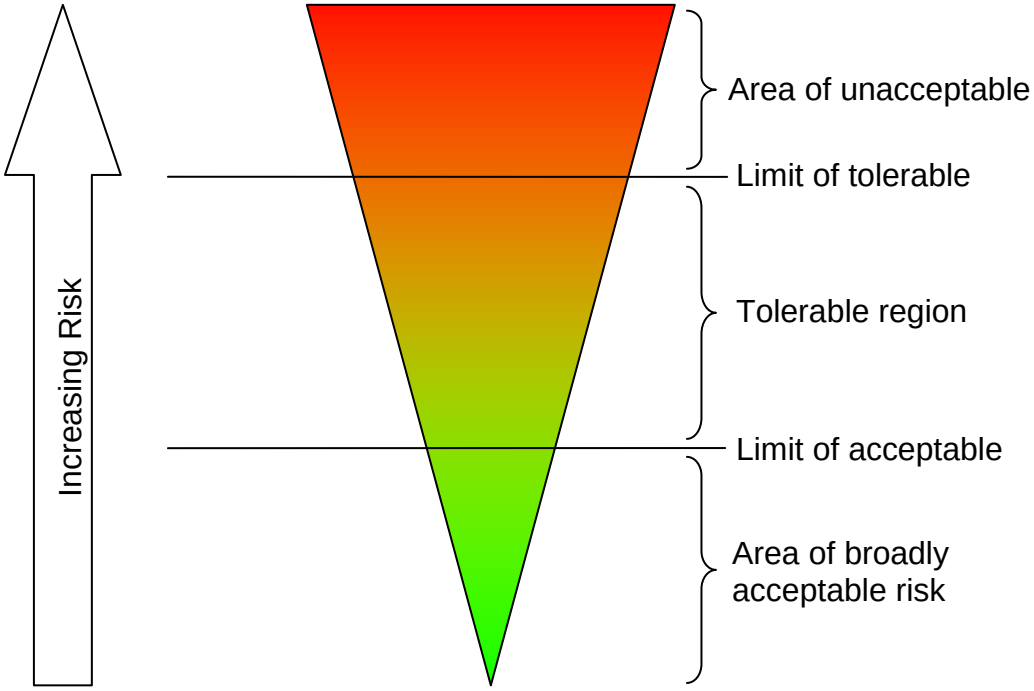
b. Risk: a relative measure of harm or loss, derived from the combination of the severity of a particular consequence together with the probability of the consequence occurring.

c. Consequence: a particular scenario (expressed as harm to people, damage to the environment, an operational impact and/or negative media attention) that results from a hazardous situation.

d. Probability: the 'chance' of a particular hazard consequence occurring, measured as a frequency (per year).

5.1.2 The assessment used the principle of reducing navigational risks to a level that is As Low As Reasonably Practicable (ALARP). ALARP is part of the Health and Safety at Work Act 1974 and involves assessing the acceptability of a risk against the difficulty, time and expense needed to control it. The ALARP concept is illustrated in Figure 5.1.

Figure 5.1 The ALARP Principle



5.1.3 At the lower end of the ALARP triangle, risks are small due to either low probability or insignificant consequences. These risks can generally be accepted provided that common safeguards are implemented. Moving up

the ALARP triangle to the tolerable region, risks increase in magnitude due to either an increase in probability or an increase in severity of consequences. Risks in the tolerable region can be accepted provided that risk controls are implemented that demonstrate that the risk is reduced to a level deemed to be ALARP; where any further risk reduction would be disproportionate in terms of cost, time and resources required to implement it compared to the benefit it would introduce. At the top of the ALARP triangle is a region of unacceptable risk that cannot be accepted without risk controls to reduce the risk to a tolerable and ALARP level.

5.1.4 This risk assessment was undertaken on a qualitative basis, using the engineering and operational judgement of representatives from the project team and representatives from river users and operators. Hazard consequences were considered based on most likely outcomes.

5.2 Risk assessment: Criteria

5.2.1 When commencing the assessment of the risk posed by the project's activities, the project's marine consultant recommended using the risk assessment criteria and methodology within the existing PLA Safety Management System (SMS). The rationale behind this recommendation was to provide the project team and the PLA with a consistent assessment score that could be transferred across into the PLA's existing SMS and enable an appreciation of the increase in risk resulting from the project's temporary and permanent works.

5.2.2 Consultation with the PLA highlighted the desire to use an alternative risk terminology, alternative assessment matrix and risk classification scorecard. These changes have now been incorporated as requested.

5.2.3 This section details the risk criteria used throughout this assessment. The assessment process identifies four distinct areas of risk and the probable consequences associated with each hazard assessed in terms of harm or loss to:

a. people (life)

b. environment

c. operational impact

d. media attention.

5.2.4 Table 5.1 details the 'probability' criteria used to assess how likely each hazard is to occur in terms of average frequency in the PLAs jurisdiction.

Table 5.1 Probability Criteria

	Frequency	Score
Rare	Has not occurred in the in the last ten years	1
Unlikely	Has not occurred in the in the last three years	2
Possible	Has not occurred in the in the last year	3
Likely	Has occurred in the in the last year	4
Almost certain	Occurs several times per year	5

5.2.5 Table 5.2 details the severity criteria applied to the safety- related consequences of each hazard.

Table 5.2 Severity Criteria: People	Level
First aid case / Medical treatment case	1
Restricted work case	2
Lost Time Injury / Moderate permanent partial disability injury	3
Single Fatality / Severe permanent partial disability	4
Multiple fatalities	5

5.2.6 Table 5.3 details the severity criteria applied to the environmental loss related consequences of each hazard.

Table 5.3 Severity Criteria: Environment	Level
Low impact with no lasting effect	1
Temporary effect / Minor effect to small area	2
Short to medium term impact	3
Medium to long term effect / large area affected	4
Long term impact / severe impact on sensitive area	5

5.2.7 Table 5.4 details the severity criteria applied to the property loss/damage related consequences of each hazard.

Table 5.4 Severity Criteria: Operational Impact	Level
Insignificant or no damage to vessel / equipment	1
Minor or superficial damage to vessel / equipment	2
Moderate damage to vessel / equipment requiring immediate repairs	3
Major damage to vessel / equipment and detention	4
Very serious damage to vessel or equipment possible criminal proceedings	5

5.2.8 Table 5.5 details the severity criteria applied to negative media attention/coverage consequences of each hazard.

Table 5.5 Severity Criteria: Media Attention	Level
No Coverage	1
Local coverage	2
Regional coverage	3
National coverage	4
International coverage	5

5.3 Risk matrix

5.3.1 The risk matrix in Table 5.6 was used to provide a risk score, combining severity of a particular consequence with the likelihood (probability) of the consequence occurring.

Table 5.6 Risk Assessment Matrix

Likelihood	Rare	**1**	**2**	**3**	**4**	**5**
	Unlikely	**2**	**4**	**6**	**8**	**10**
	Possible	**3**	**6**	**9**	**12**	**15**
	Likely	**4**	**8**	**12**	**16**	**20**
	Almost certain	**5**	**10**	**15**	**20**	**25**
	Severity	Level 1	Level 2	Level 3	Level 4	Level 5

5.3.2 The risk score in Table 5.7 indicates the magnitude and acceptability of the risk in accordance with the ALARP principle. The PLA method applies this to both individual and average risk.

Table 5.7 Risk Classification

Score	Classification	Definition
1 to 2	**Slight**	No action is required.
3 to 4	**Minor**	No additional controls are required, monitoring is required to ensure no changes in circumstances.
5 to 9	**Moderate**	Efforts should be made to reduce risk to ALARP level. Job can be performed under direct supervision of Senior Officer.
10 to 14	**High**	Efforts should be made to reduce risk to ALARP level. Job can only be performed after authorisation from Harbour Master and after further additional controls required under the circumstances.
15 to 25	**Extreme**	Intolerable risk. Job is not authorised.

5.4 Hazard identification

5.4.1 A hazard can be defined as 'the potential for an adverse consequence', and may be associated with a situation that could cause harm to people, damage to the environment, an operational impact or negative media attention.

5.4.2 In order to facilitate a comprehensive overview of potential maritime hazards, various river users and operators were consulted throughout the risk assessment process, including:

a. Thames Clippers;

b. Cory Environmental Limited;

c. City Cruises;

d. Livett's Launches;

e. Bennett's Barges;

f. London Duck Tours;

g. Metropolitan Police Marine Policing Unit;

h. Royal National Lifeboat Institute (RNLI).

5.4.3 The project also made several site visits to HR Wallingford's physical model during the risk assessment process. This provided Captain David Phillips (at the time, PLA Harbour Master (Upper)), freight (Cory Environmental) and commercial (Thames Clippers) operators with the opportunity to understand the impact of the proposed developments on the river flow patterns and to visualise the scale of the temporary and permanent work at various locations. However, the site at Chambers Wharf was not included in this physical model.

5.5 Mitigation strategy

5.5.1 Throughout the assessment process, it was evident that potential hazards presented by the project would require mitigation measures throughout the project lifecycle.

5.5.2 The following section will identify and detail the navigational issues and proposed mitigation measures.

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6 Navigational issues and mitigation measures

6.1.1 It is acknowledged that mitigation measures may themselves introduce further hazards that also require mitigation. Where appropriate, these have been considered.

6.1.2 Mitigation measures were developed with an emphasis on measures that are within the project's control (e.g. design of in-river structures).

6.1.3 The navigational issues are presented in section 4 of this report. The proposed mitigation measures are listed below.

6.2 Wash

6.2.1 Thames Clippers operate a high speed service passes the site at up to 30 knots.

Actions required

6.2.2 A number of actions, specific to the issue, have been commenced or completed in order to assist the project to provide a robust and evidence-based assessment to the PLA. These actions include:

a. consider the case of potential barge break out caused by vessels passing the site at speed during the design stage of the project.

Mitigation of issues: Design

6.2.3 The following measures are embedded in the designs and this assessment therefore only assesses the residual risk assuming the effective implementation of these measures:

a. The temporary moorings for construction barges would be designed to protect the moored barges from wash/draw-off from passing high speed vessels

b. The design of the temporary and permanent structures includes the provision of ladders, safety grab chains and other lifesaving equipment around the work sites to aid emergency egress from the river, in accordance with the PLA's guidance document 'Review of Lifesaving Provisions Along the River Thames'.

6.2.4 The following sections set out the proposed mitigation measures to address the residual risks.

Mitigation of issues: Physical

6.2.5 None identified

Mitigation of issues: River operations

6.2.6 None identified

6.3 Interaction with existing river traffic

6.3.1 The sight lines from the site are clear and there are no piers in the immediate vicinity, therefore no specific mitigation measures are proposed.

6.4 Proximity to authorised channel

6.4.1 The proposed cofferdam is more that 25m from the authorised channel and there are no proximity issues, therefore no mitigation measures are proposed.

6.5 Proximity to Cherry Garden Pier, Reeds Wharf and Hermitage Wharf

6.5.1 A barge breaking free from moorings could cause damage to Cherry Garden Pier, vessels moored at the pier and harm to people on the pier. Further, a barge breaking free from moorings could harm houseboats and their occupants at Reeds Wharf and Hermitage Wharf. It is therefore recommended to provide moorings attached to both the bed and the structure (for example; ground anchors with wires, in addition to 2 bow, 2 stern and 2 springs).

6.6 Proximity to PLA Mill Stairs fuel buoy

6.6.1 The location of the PLA mooring 71 and buoy are very close to the LLAU and would cause operational issues for barges accessing the project site. It is therefore recommended to seek an alternative location.

7 General navigational hazards

7.1.1 In addition to the 'navigation issues' considered within this report, navigational hazards associated with day-to-day river operations were also identified. These hazards relate to the interaction of the project-related marine traffic with existing river users.

7.1.2 'Worst Credible' consequences and the probability of the consequences were considered in the assessment. As a result, in some cases the Worst Credible score was lower than the 'Most Likely' score. This is explained by the probability that a 'moderate injury', for example, is higher than the probability of a 'single fatality'.

7.1.3 Full hazard details contained in Annex A through to Annex I as follows:

7.1.4 Phase D does not have a hazard log due to the permanent works occupying less river space then is currently the case.

7.2 Project phases A to C: Most likely

Table 7.1 Most likely risk scores

				Score – Post Mitigation			
Hazard Id	**Hazard title**	**Hazard description**	**Phase**	**People**	**Environment**	**Operational**	**Media**
1	Increase in flow	Changes to the hydrodynamics of the river may affect passing vessels.	A	6	6	6	6
			B	6	6	6	6
			C	6	6	6	6
2	Contact - High Speed Passenger Vessel with worksite	A High Speed Passenger Vessel comes into contact with the project's temporary or permanent worksite at Chambers Wharf.	A	6	4	4	4
			B	9	6	6	6
			C	6	4	4	4
3	Contact - Class V passenger vessel with worksite	A Class V passenger vessel comes into contact with the project's temporary or permanent worksite at Chambers Wharf.	A	6	4	4	4
			B	9	6	6	6
			C	6	4	4	4
4	Contact - private leisure vessel with worksite	Private leisure vessels, including narrow boats, comes into contact with the project's temporary or permanent worksite at Chambers Wharf.	A	6	2	6	4
			B	9	3	9	6
			C	6	2	6	4

Table 7.1 Most likely risk scores

Hazard Id	Hazard title	Hazard description	Phase	Score – Post Mitigation			
				People	Environment	Operational	Media
5	Contact - commercial freight with worksite	Commercial freight comes into contact with project work site at Chambers Wharf.	A	6	4	6	4
			B	6	4	6	4
			C	6	4	6	4
6	Contact - tug and tow with worksite	A tug and tow comes into contact with project work site at Chambers Wharf.	A	6	4	6	4
			B	6	4	6	4
			C	6	4	6	4
7	Grounding - all vessels due to 'Squat Effect'	At periods of low water, vessels may be affected by the 'Squat Effect', causing them to be closer to the river bed than expected.	A	4	4	4	4
			B	4	4	4	4
			C	4	4	4	4
8	Mooring breakout	A vessel involved in project activities breaks free from temporary/layup moorings.	A	6	4	6	4
			B	9	6	9	6
			C	6	4	6	4
9	Collision -High Speed Passenger Vessel (construction/ deconstruction)	A vessel conducting project construction/ deconstruction activities collides with a High Speed Passenger Vessel (eg, Thames Clipper) in the vicinity of Chambers Wharf.	A	6	4	6	6
			B	N/A	N/A	N/A	N/A
			C	6	4	6	6
10	Collision -Class V Passenger Vessel (construction/ deconstruction)	A vessel conducting project construction/ deconstruction activities collides with a Class V passenger vessel in the vicinity of Chambers Wharf.	A	6	4	6	6
			B	N/A	N/A	N/A	N/A
			C	6	4	6	6
11	Collision -Class V Passenger Vessel (construction/ deconstruction)	A vessel conducting project construction/ deconstruction activities collides with a Class V passenger vessel in the vicinity of Chambers Wharf.	A	**9**	**6**	**9**	**9**
			B	N/A	N/A	N/A	N/A
			C	**9**	**6**	**9**	**9**
12	Collision - commercial	A vessel conducting project construction/ deconstruction	A	9	6	6	9
			B	N/A	N/A	N/A	N/A

Table 7.1 Most likely risk scores

Hazard Id	Hazard title	Hazard description	Phase	Score – Post Mitigation: People	Environment	Operational	Media
	freight operator (construction/ deconstruction)	activities collides with a commercial freight operator in the vicinity of Chambers Wharf.	C	9	6	6	9
13	Collision -tug and tow (construction/ deconstruction)	A vessel conducting project construction/ deconstruction activities collides with a tug and tow in the vicinity of Chambers Wharf.	A	9	6	6	9
			B	N/A	N/A	N/A	N/A
			C	9	6	6	9
14	Contact -Cherry Gardens Pier or the Floating Gardens (construction/ deconstruction)	A vessel conducting project construction/deconstruction activities makes contact with Cherry Gardens Pier or the Floating Gardens, including Moored Vessels or associated pier structures.	A	6	4	6	8
			B	N/A	N/A	N/A	N/A
			C	6	4	6	8
15	Collision -High Speed Passenger Vessel (delivery/ material removal)	A vessel conducting project delivery/material removal activities collides with a High Speed Passenger Vessel (eg, Thames Clipper) in the vicinity of Chambers Wharf.	A	N/A	N/A	N/A	N/A
			B	6	4	6	6
			C	N/A	N/A	N/A	N/A
16	Collision -Class V passenger vessel (delivery/ material removal)	A vessel conducting project delivery/ material removal activities collides with a Class V passenger vessel in the vicinity of Chambers Wharf.	A	N/A	N/A	N/A	N/A
			B	6	4	6	6
			C	N/A	N/A	N/A	N/A
17	Collision -private leisure vessel (delivery/ material removal)	A vessel conducting project delivery/material removal activities collides with a private leisure vessel in the vicinity of Chambers Wharf.	A	N/A	N/A	N/A	N/A
			B	**9**	**6**	**9**	**9**
			C	N/A	N/A	N/A	N/A
18	Collision - commercial freight operator	A vessel conducting project delivery/material removal activities collides with a	A	N/A	N/A	N/A	N/A
			B	9	9	6	9

Table 7.1 Most likely risk scores

Hazard Id	Hazard title	Hazard description	Phase	Score – Post Mitigation: People	Environment	Operational	Media
	(delivery/ material removal)	commercial freight operator in the vicinity of Chambers Wharf.	C	N/A	N/A	N/A	N/A
19	Collision -tug and tow (delivery/ material removal)	A vessel conducting project delivery/material removal activities collides with a tug and tow in the vicinity of Chambers Wharf.	A	N/A	N/A	N/A	N/A
			B	9	9	6	9
			C	N/A	N/A	N/A	N/A
20	Contact -Cherry Gardens Pier or the Floating Gardens (delivery/ material removal)	A vessel conducting project delivery/ material removal activities makes contact with Cherry Gardens Pier or the Floating Gardens, including Moored Vessels or associated pier structures.	A	N/A	N/A	N/A	N/A
			B	6	4	6	8
			C	N/A	N/A	N/A	N/A

7.3 Project phases A to C: Worst Credible

Table 7.2 Worst Credible risk scores

Hazard Id	Hazard title	Hazard description	Phase	Score: People	Environment	Operational	Media
1	Increase in flow	Changes to the hydrodynamics of the river may affect passing vessels.	A	8	6	8	6
			B	8	6	8	6
			C	8	6	8	6
2	Contact - High Speed Passenger Vessel with worksite	A High Speed Passenger Vessel comes into contact with project worksite at Chambers Wharf.	A	10	6	8	10
			B	10	6	8	10
			C	10	6	8	10
3	Contact - Class V passenger vessel with worksite	A Class V passenger vessel comes into contact with project worksite at Chambers Wharf.	A	10	6	8	10
			B	10	6	8	10

Table 7.2 Worst Credible risk scores

Hazard Id	Hazard title	Hazard description	Phase	Score			
				People	Environment	Operational	Media
			C	10	6	8	10
4	Contact - private leisure vessel with worksite	Private leisure vessels, including narrow boats, comes into contact with project worksite at Chambers Wharf.	A	10	4	8	8
			B	10	4	8	8
			C	10	4	8	8
5	Contact - commercial freight with worksite	Commercial freight comes into contact with project worksite at Chambers Wharf.	A	8	6	8	8
			B	8	6	8	8
			C	8	6	8	8
6	Contact - tug and tow with worksite	A tug and tow comes into contact with project worksite at Chambers Wharf.	A	8	6	8	8
			B	8	6	8	8
			C	8	6	8	8
7	Grounding - all vessels due to 'Squat Effect'	At periods of low water, vessels may be affected by the 'Squat Effect', causing them to be closer to the river bed than expected.	A	6	4	6	6
			B	6	4	6	6
			C	6	4	6	6
8	Mooring breakout	A vessel involved in project activities breaks free from the temporary/layup moorings.	A	6	4	6	4
			B	6	4	6	4
			C	6	4	6	4
9	Collision -High Speed Passenger Vessel (construction/ deconstruction)	A vessel conducting project construction/ deconstruction activities collides with a High Speed Passenger Vessel (eg, Thames Clipper) in the vicinity of Chambers Wharf.	A	10	4	10	10
			B	N/A	N/A	N/A	N/A
			C	10	4	10	10
10	Collision -Class V passenger vessel (construction/ deconstruction)	A Class V passenger vessel conducting project construction/ deconstruction activities collides with a Class V passenger vessel in the vicinity of Chambers Wharf.	A	10	4	10	10
			B	N/A	N/A	N/A	N/A
			C	10	4	10	10
11	Collision -Class V Passenger Vessel	A vessel conducting project construction/ deconstruction activities collides with a Class V	A	10	4	10	10
			B	N/A	N/A	N/A	N/A

Table 7.2 Worst Credible risk scores

Hazard Id	Hazard title	Hazard description	Phase	Score			
				People	Environment	Operational	Media
	(construction/ deconstruction)	passenger vessel in the vicinity of Chambers Wharf.	C	10	4	10	10
12	Collision - commercial freight operator (construction/ deconstruction)	A vessel conducting project construction/ deconstruction activities collides with a commercial freight operator in the vicinity of Chambers Wharf.	A	8	6	8	8
			B	N/A	N/A	N/A	N/A
			C	8	6	8	8
13	Collision -tug and tow (construction/ deconstruction)	A vessel conducting project construction/ deconstruction activities collides with a tug and tow in the vicinity of Chambers Wharf.	A	8	6	8	8
			B	N/A	N/A	N/A	N/A
			C	8	6	8	8
14	Contact -Cherry Gardens Pier or the Floating Gardens (construction/ deconstruction)	A vessel conducting project construction/ deconstruction activities makes contact with Cherry Gardens Pier or the Floating Gardens, including Moored Vessels or associated pier structures.	A	8	4	8	8
			B	N/A	N/A	N/A	N/A
			C	8	4	8	8
15	Collision -High Speed Passenger Vessel (delivery/ material removal)	A vessel conducting project delivery/ material removal activities collides with a High Speed Passenger Vessel (e.g. Thames Clipper) in the vicinity of Chambers Wharf.	A	N/A	N/A	N/A	N/A
			B	10	6	8	10
			C	N/A	N/A	N/A	N/A
16	Collision -Class V Passenger Vessel (delivery/ material removal)	A vessel conducting project delivery/ material removal activities collides with a Class V passenger vessel in the vicinity of Chambers Wharf.	A	N/A	N/A	N/A	N/A
			B	10	6	8	10
			C	N/A	N/A	N/A	N/A
17	Collision -Private Leisure Vessel (delivery/ material removal)	A vessel conducting project delivery/ material removal activities collides with a private leisure vessel in the vicinity of Chambers Wharf.	A	N/A	N/A	N/A	N/A
			B	10	4	8	8
			C	N/A	N/A	N/A	N/A
18	Collision -	A vessel conducting project	A	N/A	N/A	N/A	N/A

Table 7.2 Worst Credible risk scores

Hazard Id	Hazard title	Hazard description	Phase	Score			
				People	Environment	Operational	Media
	commercial freight operator (delivery/ material removal)	delivery/ material removal activities collides with a commercial freight operator in the vicinity of Chambers Wharf.	B	8	6	8	8
			C	N/A	N/A	N/A	N/A
19	Collision -tug and tow (delivery/ material removal)	A vessel conducting project delivery/ material removal activities collides with a tug and tow in the vicinity of Chambers Wharf.	A	N/A	N/A	N/A	N/A
			B	8	6	8	8
			C	N/A	N/A	N/A	N/A
20	Contact -Cherry Gardens Pier or the Floating Gardens (delivery/ material removal)	A vessel conducting project delivery/ material removal activities makes contact with Cherry Gardens Pier or the Floating Gardens, including Moored Vessels or associated pier structures.	A	N/A	N/A	N/A	N/A
			B	6	4	6	8
			C	N/A	N/A	N/A	N/A

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8 Mitigation measures

8.1 Existing mitigation

8.1.1 Existing safeguards (measures that manage the risk) in the form of control measures and relevant PLA guidance, are set out in Table 8.1 together with any additional controls deemed desirable or necessary to reduce risk to a level that is ALARP. The risk is assessed taking account of the impact of these various safeguards and controls.

Table 8.1 Existing safeguards

• Boat Masters License	• Vessel Master Experience
• MCA - MGN 199 (M) Dangers of Interaction	• Permanent/Temporary Notice to Mariners
• Aids to Navigation	• Passage Planning
• Safe Systems of Work	• Tug Operator Procedures
• Contractors Risk Assessment	• BML Local Knowledge Endorsement
• River Bylaws	• General Directions
• VTS Qualification	• VHF Communications
• Bridge Special Signal Lights	• Ship Towage Code of Practice
• VTS Navigational Broadcast	• Emergency Plans and Procedures
• Thames AIS	• Oil Spill Contingency Plan
• PLA Bridge Guide	• Maintenance / Inspection Routines
• Admiralty Charts	• COLREGs
• Tide Gauges	• Qualified Crew
• Tide Tables	• Barge Operators daily check lists
• Accurate Tidal Information	• High Speed Craft Code

8.1.2 The above list is not exhaustive but was used to highlight the measures that are most relevant to project operations.

8.2 Proposed mitigation

8.2.1 The proposed risk reduction/mitigation measures were divided into three categories: design, physical and river operations. This is to provide the PLA with assurance that the measures proposed throughout this assessment have regard to the project's responsibility to reduce risk rather than focussing on local authorities' and existing river users' responsibilities.

8.3 Design

8.3.1 The following measures are embedded in the designs and this assessment therefore only assesses the residual risk assuming the effective implementation of these measures:

a. The project has minimised the footprint of the temporary works and therefore encroachment into the channel as much as deemed feasible.

b. No new permanent structures are proposed to be constructed and the river wall would be reinstated at its original location.

c. The temporary moorings for construction barges would be designed to protect the moored barges from wash/draw-off from passing high speed vessels.

8.3.2 The following sections identify proposed mitigation to address the residual risks.

8.4 Physical

8.4.1 assessment and understanding of operating procedures to ensure minimum disruption/interaction with existing users.

8.5 River operations

8.5.1 Notice to Mariners - highlighting expected additional barge movements in area and times when barge movements are likely to be expected.

Table 8.2 Mitigations within the project's control

Procedural	Informational	Qualifications / Personnel	Guidance / Publications	Site Specific
Safe Systems of Work	Sound Warnings	Berth Master (term to be defined)	Temporary Notice to Mariners	Grab Chains
Contractors Risk Assessment	Light Warnings	Qualifications / Competence of on site personnel	Permanent Notice to Mariners	Fendering
Site Working Practises	Anemometer at site			Impact Protection - Temporary Works
Scheduling of barge movements to assist with existing river events				Impact Protection - Permanent Works
				New Tide Gauges / Markers

9 Conclusion

9.1 Assessment

9.1.1 This *Navigation Issues and Preliminary Risk Assessment* assessed the potential impact of the proposed works at Chambers Wharf on existing users.

9.1.2 The project's approach to this assessment comprised stakeholder engagement, analysis of Automatic Identification System (AIS) data, observation of current river operations including a desktop review of hazards, and development of potential mitigation measures.

9.1.3 The risk assessment criteria, assessment matrix, terminology and risk classification were provided by the PLA. The assessment also follows the Formal Safety Assessment (FSA) methodology:

a. stakeholder consultation

b. identification of hazards

c. hazard analysis.

9.1.4 No new permanent structures would be constructed in the river and the river wall would be reinstated at its original location. Therefore it was determined that the structure would not present a navigational hazard.

9.1.5 During construction of the cofferdam there would be no temporary structures or construction vessels within 8m of the authorised channel.

9.2 Stakeholder engagement

9.2.1 The main issue identified throughout the risk assessment process was a public buoy that is used by Cory Limited Ltd. This would require relocating during the temporary works to a location further downriver.

9.3 Risk analysis

9.3.1 Hazards at various stages of the project were assessed and scored using the risk matrix and scorecard provided by the PLA and in terms of 'Most Likely' and 'Worst Credible' scenarios.

9.3.2 Annexes A to G provide full details of the hazards identified and their overall scores. The analysis is summarised in below tables.

Table 9.1 Hazard overview: Most Likely

Most Likely	Phase A	Phase B	Phase C
Extreme: Intolerable risk. Job is not authorised	0	0	0
High: Efforts should be made to reduce risk to ALARP level. Job can only be performed after authorisation from Harbour Master and after further additional controls required under the circumstances.	0	0	0
Moderate: Efforts should be made to reduce risk to ALARP level. Job can be performed under direct supervision of Senior Officer.	35	44	35
Minor: No additional controls are required, monitoring is required to ensure no changes in circumstances.	20	12	20
Slight: No action is required.	1	0	1

Table 9.2 Hazard overview: Worst Credible

Worst Credible	Phase A	Phase B	Phase C
Extreme: Intolerable risk. Job is not authorised.	0	0	0
High: Efforts should be made to reduce risk to ALARP level. Job can only be performed after authorisation from Harbour Master and after further additional controls required under the circumstances.	14	24	8
Moderate: Efforts should be made to reduce risk to ALARP level. Job can be performed under direct supervision of Senior Officer.	5	45	6
Minor: No additional controls are required, monitoring is required to ensure no changes in circumstances.	0	0	0
Slight: No action is required.	0	0	0

9.3.3 Most of the hazards (within the Most Likely assessment) fell within the ‘moderate risk’ category, requiring efforts to be made to reduce the risk to ALARP level.

9.3.4 For ‘Worst Credible’ scenarios’, a number of hazards fell within the ‘high risk’ category, indicating that the work could only be performed after authorisation from the Harbour Master, requiring efforts to be made to reduce the risk to ALARP level.

9.4 Overall

9.4.1 This report sought to provide an independent, evidence-based assessment of current river operations and the likely impact that project operations would have on existing river users.

The overall responsibility for safety on the River Thames lies with the Port of London Authority, which needs to determine whether the issues and hazards set out in this report present a ‘tolerable’ navigational risk.

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10 Recommendations

10.1 General

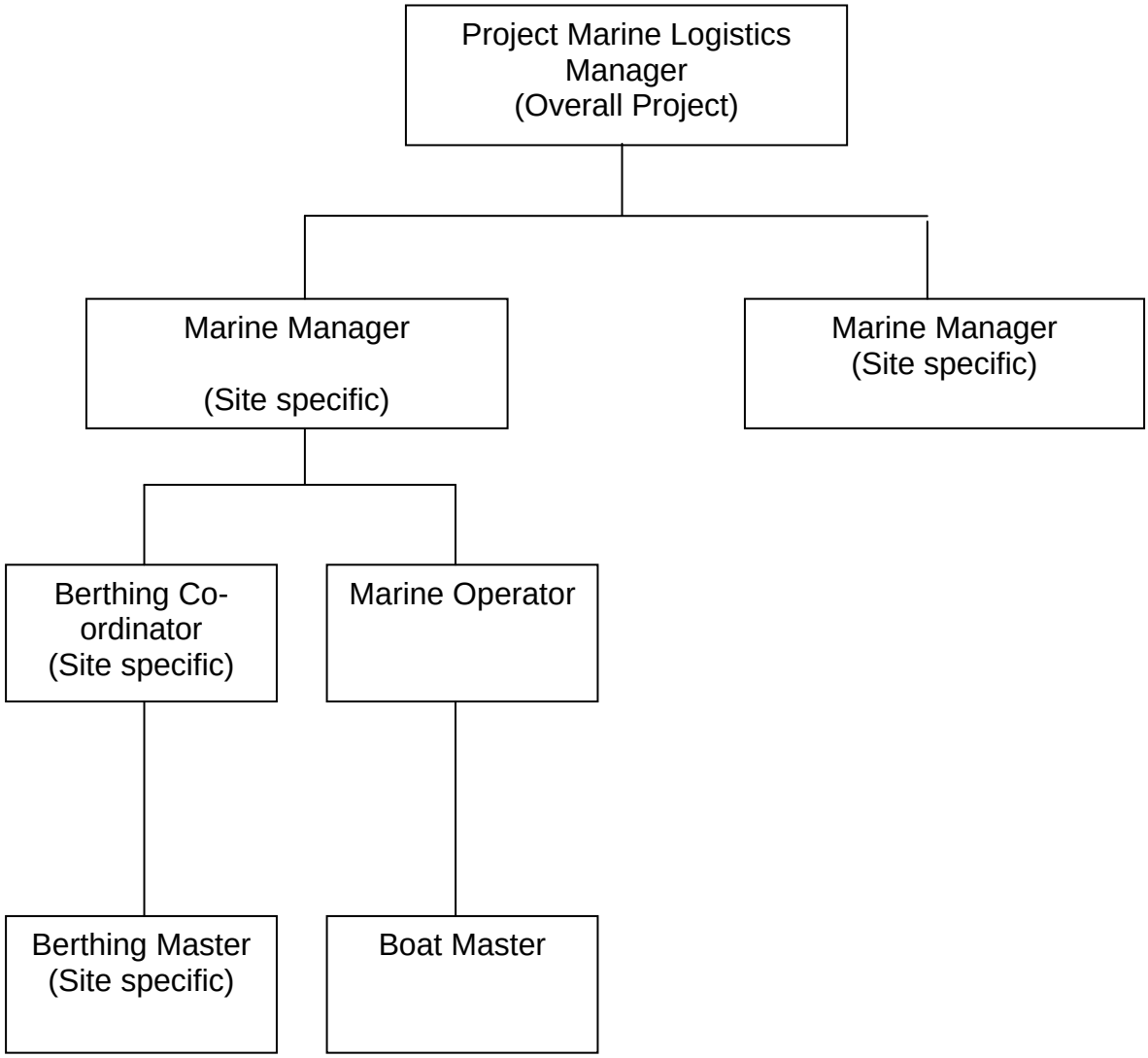
10.1.1 The project recommends implementing the mitigation measures set out in Section 6. Additionally, the below should be given consideration:

10.1.2 **Marine Logistics Manager:** Network Rail's major works at Blackfriars Bridge were highlighted as an example of how the river can be used for large scale civil engineering project's over an extended time period. Dedicated marine logistic managers and experienced marine staff are employed on this project to ensure that project and navigational safety requirements are met. The project recommends taking lessons learnt and best working practices from similar projects implementing then for this project.

10.1.3 **Berthing Co-ordinator:** The project recommends appointing a Berthing Co-ordinator to communicate with all commercial operators in order to facilitate safe berthing and departures from berths in close proximity to project operations. The co-ordinator would co-ordinate departures so that all freight operators, including project barges, could depart on time without adversely impacting on navigation on the tidal Thames.

10.1.4 Overall safety on the river is the PLA's responsibility; the Thames Barrier Navigation Centre monitoring traffic from Crayfordness to Teddington Lock.

Figure 10.1 Potential marine logistics hierarchy



Abbreviations

AIS	Automatic Identification System
ALARP	As low as reasonably practicable
CSO	Combined sewer overflow
LLAU	Limits of land to be acquired or used
NtM	Notice to Mariners
PLA	Port of London Authority

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Appendices

List of appendices in order

Appendix A: Project drawings

Appendix B: Freight tracks and AIS analysis

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Navigational Issues and Preliminary Risk Assessment

Doc Ref: **7.20.10**

Chambers Wharf

Appendix A

APFP Regulations 2009: Regulation **5(2)(q)**

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Thames Tideway Tunnel

Creating a cleaner, healthier River Thames

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Appendix A: Project drawings

Drawing title	Phase
Construction phases - Site setup	Phase A
Construction phases - Shaft construction	Phase B
Construction phases - Tunneling	Phase B
Construction phases - Secondary lining	Phase B
Construction phases - Site demobilisation	Phase D
Permanent works layout	
River foreshore zones of working	

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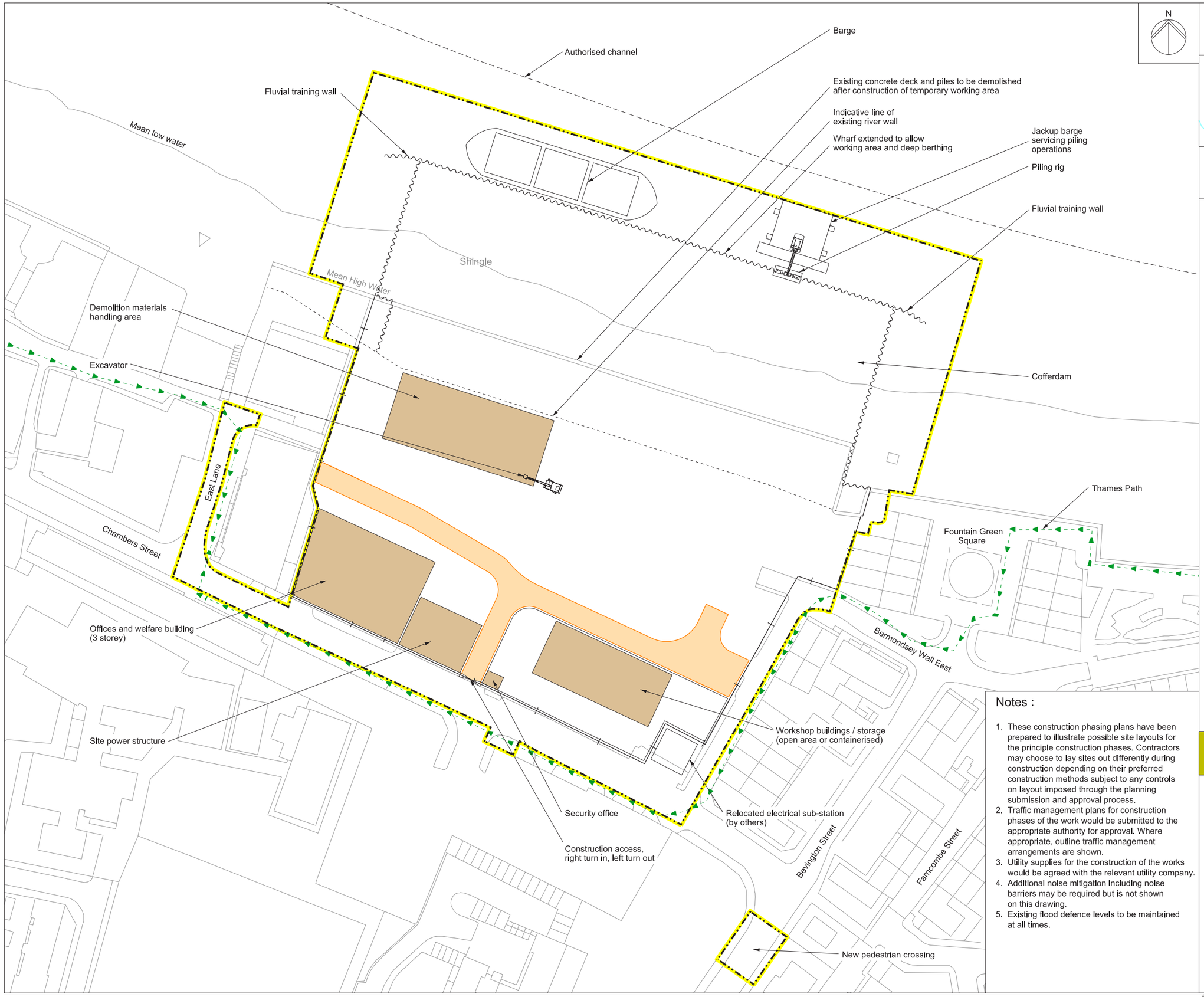


N

Keyplan:

Coordinates are to be Ordnance Survey Datum OSGB36. All levels are in metres and relate to the Tunnel Datum which is 100 metres below Ordnance Datum Newlyn.

Key:

- Limits of land to be acquired or used (LLAU)
- Hoarding
- Maximum extent of working area
- Existing public right of way
- Site access
- Access / haul route
- Sheet piles

10m 0 40m

Scale 1:500 at A1
1:1000 if reproduced at A3

Notes :

1. These construction phasing plans have been prepared to illustrate possible site layouts for the principle construction phases. Contractors may choose to lay sites out differently during construction depending on their preferred construction methods subject to any controls on layout imposed through the planning submission and approval process.
2. Traffic management plans for construction phases of the work would be submitted to the appropriate authority for approval. Where appropriate, outline traffic management arrangements are shown.
3. Utility supplies for the construction of the works would be agreed with the relevant utility company.
4. Additional noise mitigation including noise barriers may be required but is not shown on this drawing.
5. Existing flood defence levels to be maintained at all times.

ILLUSTRATIVE

Location

Chambers Wharf
London Borough of Southwark

Document Information

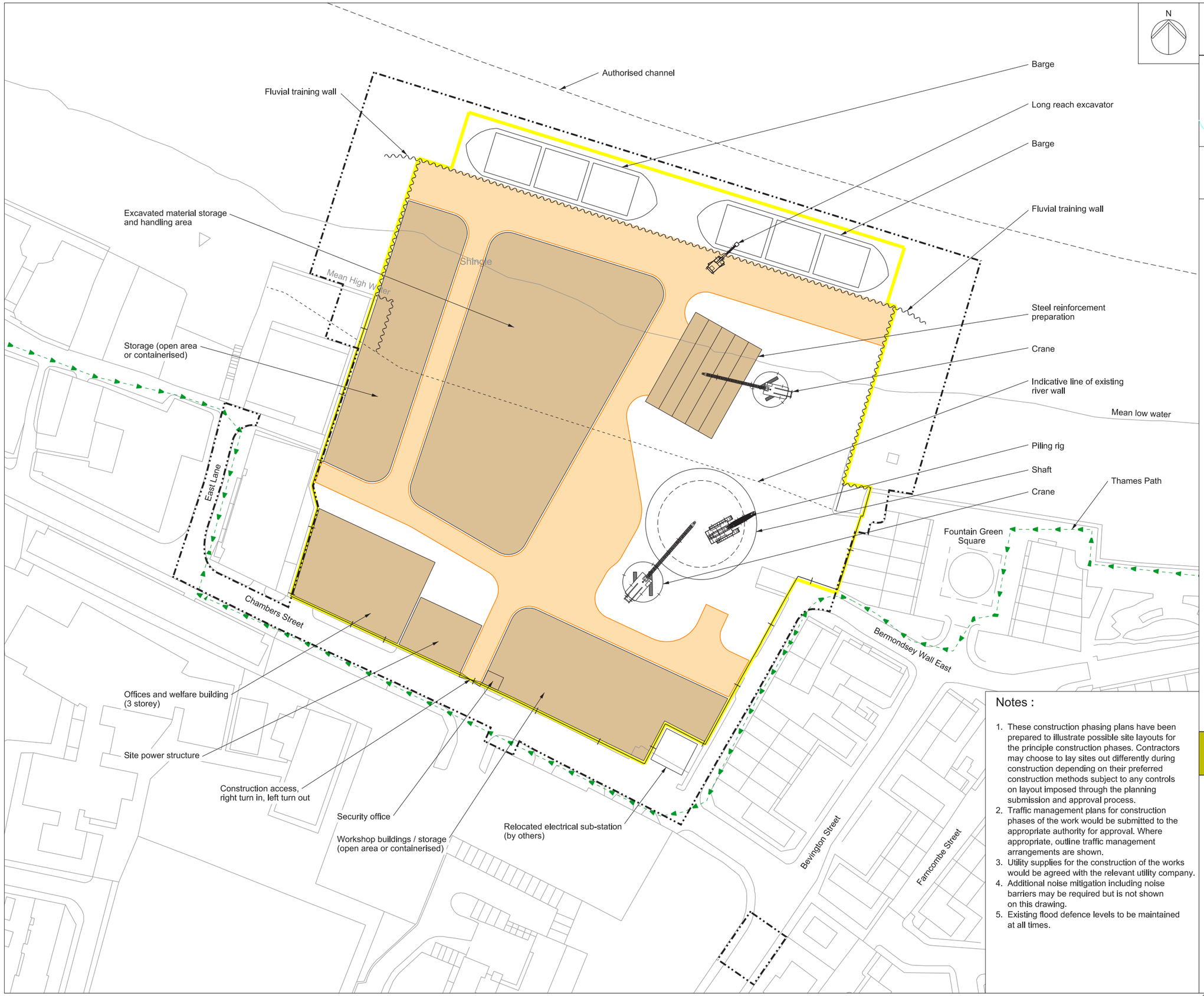
Application for Development Consent

Construction phases - phase 1
Site setup
Book of plans - section 21

DCO-PP-19X-CHAWF-210014
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

Thames Water



Keyplan:

Coordinates are to be Ordance Survey Datum OSGB36. All levels are in metres and relate to the Tunnel Datum which is 100 metres below Ordnance Datum Newlyn.

Key:

- Limits of land to be acquired or used (LLAU)
- Hoarding
- Maximum extent of working area
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- Site access
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- Sheet piles

10m 0 40m

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2. Traffic management plans for construction phases of the work would be submitted to the appropriate authority for approval. Where appropriate, outline traffic management arrangements are shown.
3. Utility supplies for the construction of the works would be agreed with the relevant utility company.
4. Additional noise mitigation including noise barriers may be required but is not shown on this drawing.
5. Existing flood defence levels to be maintained at all times.

ILLUSTRATIVE

Location

Chambers Wharf
London Borough of Southwark

Document Information

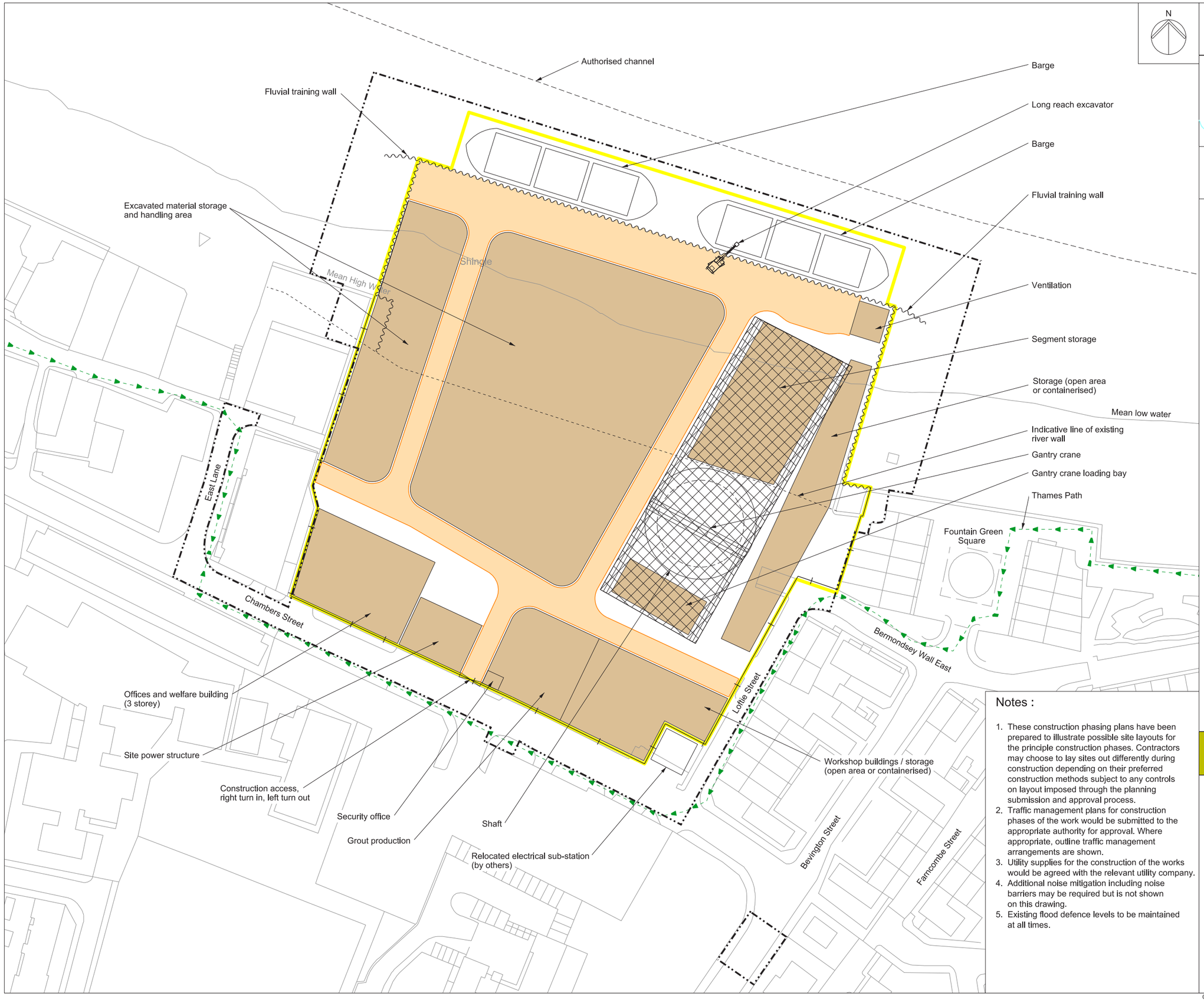
Application for Development Consent

Construction phases - phase 2
Shaft construction
Book of plans - section 21

DCO-PP-19X-CHAWF-210015
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

Thames Water



Keyplan:

Coordinates are to be Ordance Survey Datum OSGB36. All levels are in metres and relate to the Tunnel Datum which is 100 metres below Ordnance Datum Newlyn.

Key:

- Limits of land to be acquired or used (LLAU)
- Hoarding
- Maximum extent of working area
- Existing public right of way
- Site access
- Access / haul route
- Sheet piles
- Noise enclosure over shaft and gantry crane

10m 0 40m

Scale 1:500 at A1
1:1000 if reproduced at A3

Notes :

1. These construction phasing plans have been prepared to illustrate possible site layouts for the principle construction phases. Contractors may choose to lay sites out differently during construction depending on their preferred construction methods subject to any controls on layout imposed through the planning submission and approval process.
2. Traffic management plans for construction phases of the work would be submitted to the appropriate authority for approval. Where appropriate, outline traffic management arrangements are shown.
3. Utility supplies for the construction of the works would be agreed with the relevant utility company.
4. Additional noise mitigation including noise barriers may be required but is not shown on this drawing.
5. Existing flood defence levels to be maintained at all times.

ILLUSTRATIVE

Location
Chambers Wharf
London Borough of Southwark

Document Information
Application for Development Consent

Construction phases - phase 3
Tunnelling
Book of plans - section 21

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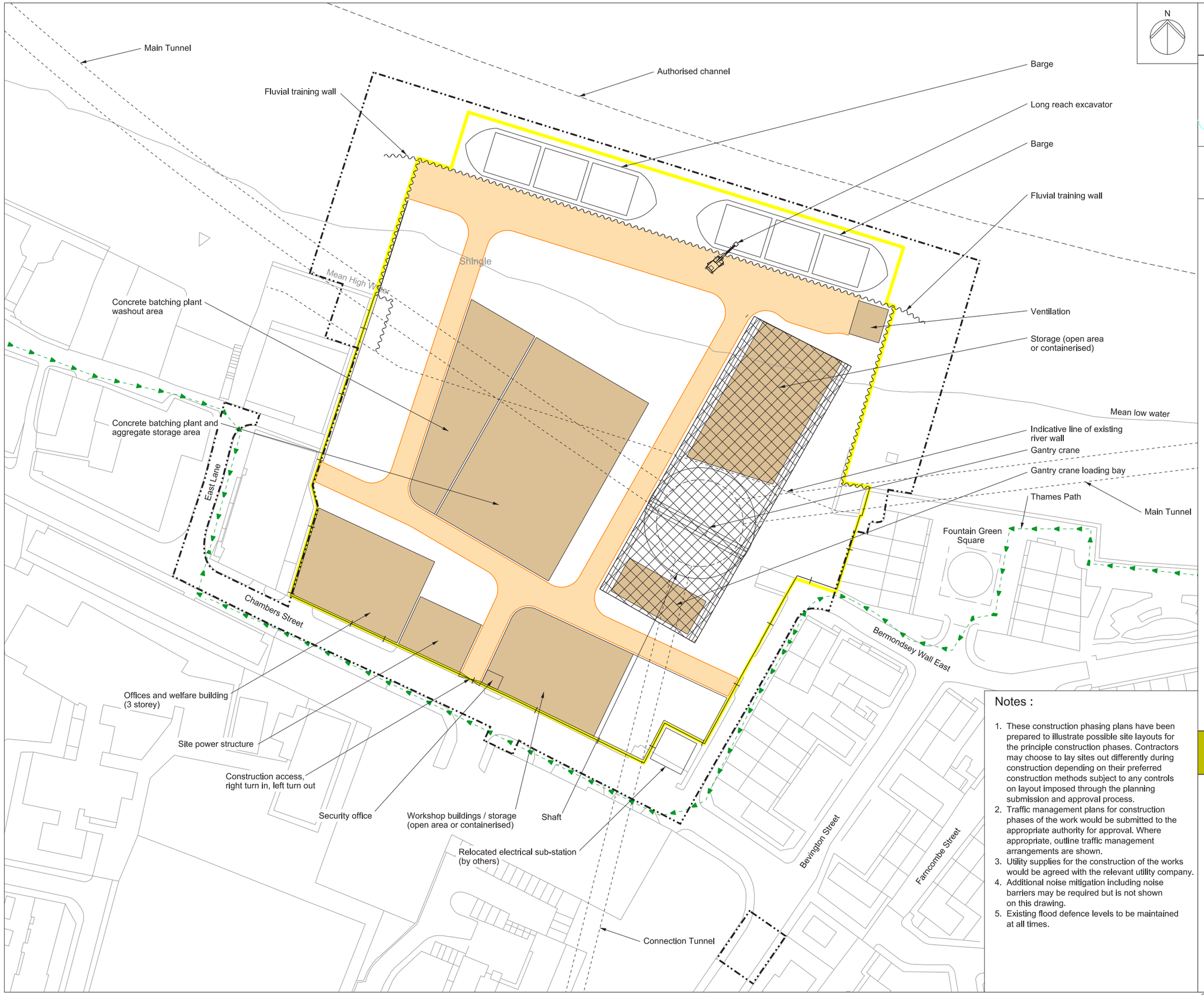
Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

Thames Water



Keyplan:

Coordinates are to be Ordance Survey Datum OSGB36. All levels are in metres and relate to the Tunnel Datum which is 100 metres below Ordnance Datum Newlyn.

Key:

- Limits of land to be acquired or used (LLAU)
- Hoarding
- Maximum extent of working area
- Existing public right of way
- Site access
- Access / haul route
- Sheet piles
- Noise enclosure over shaft and gantry crane

10m 0 40m

Scale 1:500 at A1
1:1000 if reproduced at A3

Notes :

1. These construction phasing plans have been prepared to illustrate possible site layouts for the principle construction phases. Contractors may choose to lay sites out differently during construction depending on their preferred construction methods subject to any controls on layout imposed through the planning submission and approval process.
2. Traffic management plans for construction phases of the work would be submitted to the appropriate authority for approval. Where appropriate, outline traffic management arrangements are shown.
3. Utility supplies for the construction of the works would be agreed with the relevant utility company.
4. Additional noise mitigation including noise barriers may be required but is not shown on this drawing.
5. Existing flood defence levels to be maintained at all times.

ILLUSTRATIVE

Location
Chambers Wharf
London Borough of Southwark

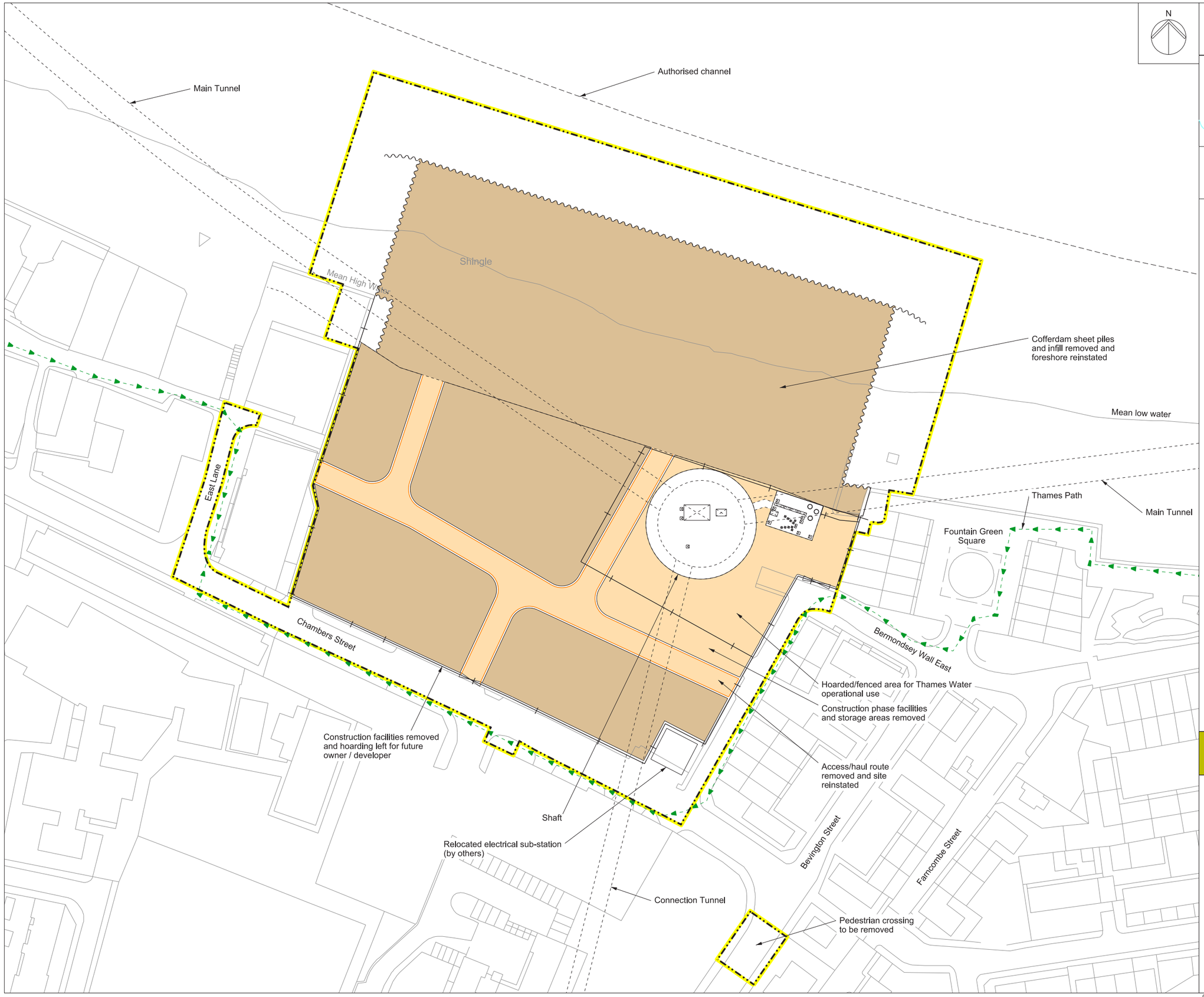
Document Information
Application for Development Consent

Construction phases - phase 4
Secondary lining
Book of plans - section 21

DCO-PP-19X-CHAWF-210017
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

Thames Water



Keyplan:

Coordinates are to be Ordance Survey Datum OSGB36. All levels are in metres and relate to the Tunnel Datum which is 100 metres below Ordnance Datum Newlyn.

Key:

- Limits of land to be acquired or used (LLAU)
- Hoarding
- Maximum extent of working area
- Existing public right of way
- Site access
- Access / haul route
- Sheet piles

10m 0 40m

Scale 1:500 at A1
1:1000 if reproduced at A3

ILLUSTRATIVE

Location

Chambers Wharf
London Borough of Southwark

Document Information

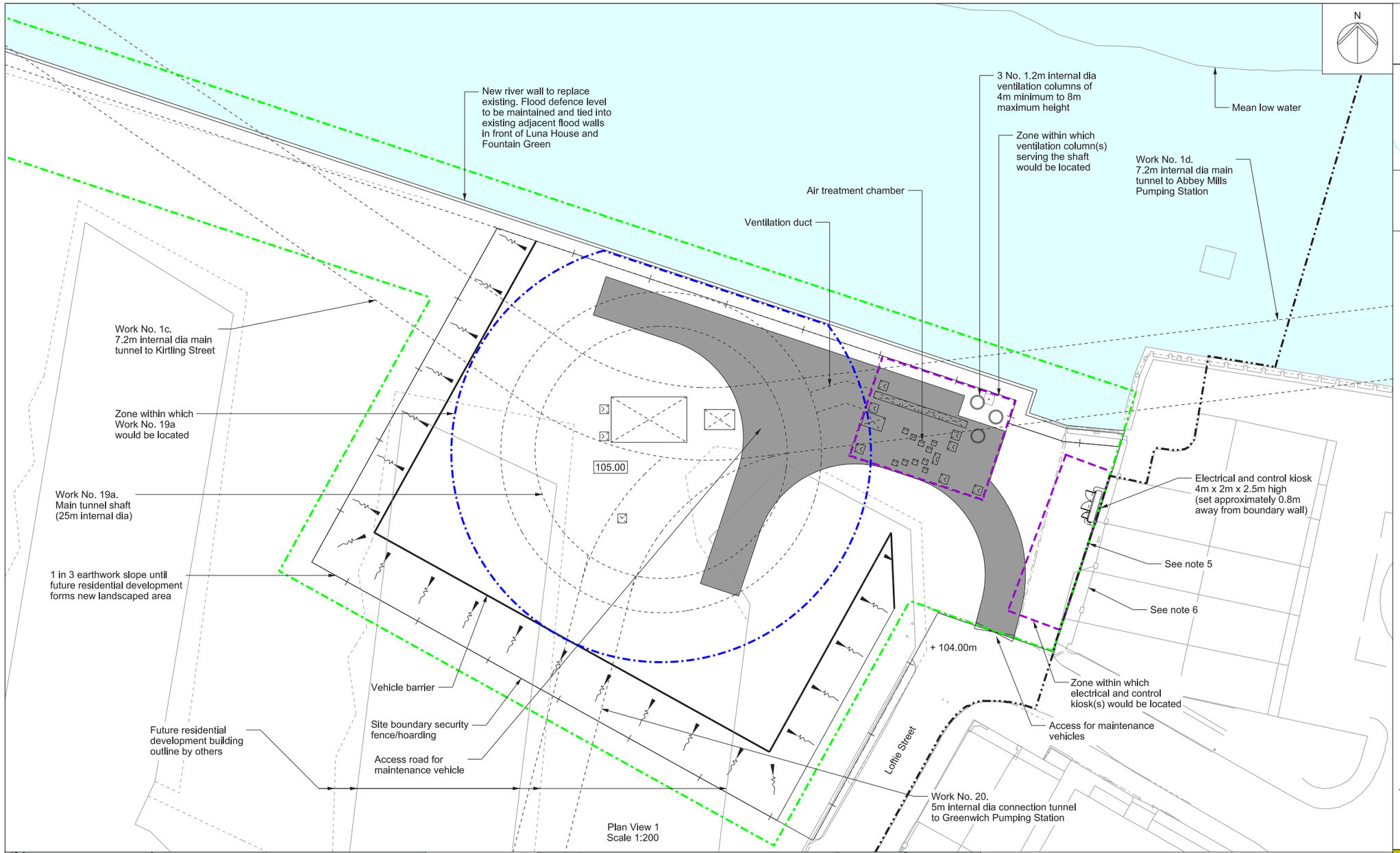
Application for Development Consent

Construction phases - phase 5
Site demobilisation
Book of plans - section 21

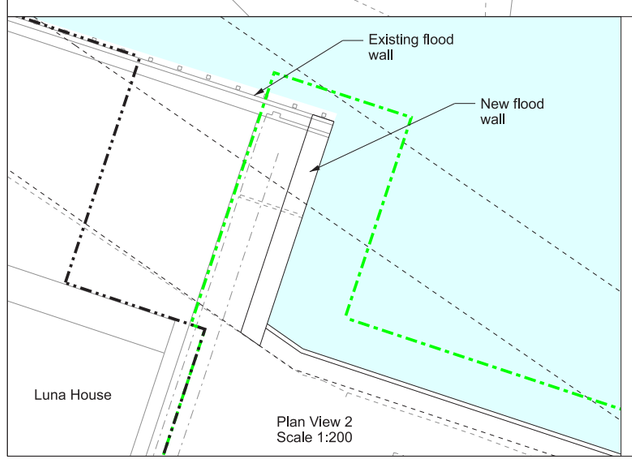
DCO-PP-19X-CHAWF-210018
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

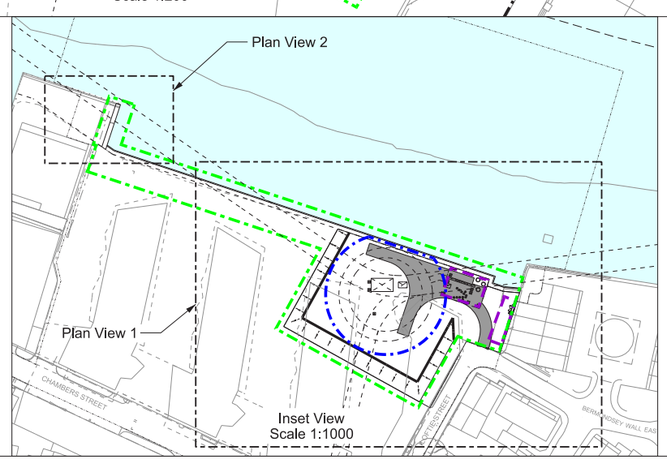
Thames Water



Plan View 1
Scale 1:200



Plan View 2
Scale 1:200



Notes:

1. All dimensions and levels are approximate.
2. Any discrepancy between the location of structures and the parameters marked on the drawings are due to differences between the Ordnance Survey base and topographical survey base, both of which have been used in the preparation of this drawing.
3. This drawing shows permanent site structures only. Landscaping hard works and soft works are shown on the Proposed landscape plan and/or Proposed site features plan.
4. Future residential development (by others) layout shown taken from third party drawing No. 7153AL_SITE(00)011.
5. The LLAU and zone parameters here runs along the boundary wall between the site and Fountain Green Square properties as shown on the Ordnance Survey base.
6. The line here runs along the boundary wall between the site and Fountain Green Square properties as shown on the topographical survey base.
7. The lines described in notes 5 and 6 represent the same boundary wall. The discrepancy between how they are shown is due to the differences between Ordnance Survey base and topographical survey base (see note 2).

Keyplan:

Coordinates are to be Ordance Survey Datum OSGB36. All levels are in metres and relate to the Tunnel Datum which is 100 metres below Ordnance Datum Newlyn.

Key:

- Limits of land to be acquired or used (LLAU)
- Proposed access cover
- + 104.10m — Existing Level (shown in metres above tunnel datum)
- 104.50 — Proposed level (shown in metres above tunnel datum)
- Zone within which all permanent site structures would be located
- Zone within which the shaft would be located
- Zone within which permanent above ground structures would be located

10m 0 10m

Scale 1:200 at A1
1:400 if reproduced at A3

10m 0 100m

Scale 1:1000 at A1
1:2000 if reproduced at A3

ILLUSTRATIVE

Location

Chambers Wharf
London Borough of Southwark

Document Information

Application for Development Consent

Permanent works layout

Book of plans - section 21

DCO-PP-19X-CHAWF-210007
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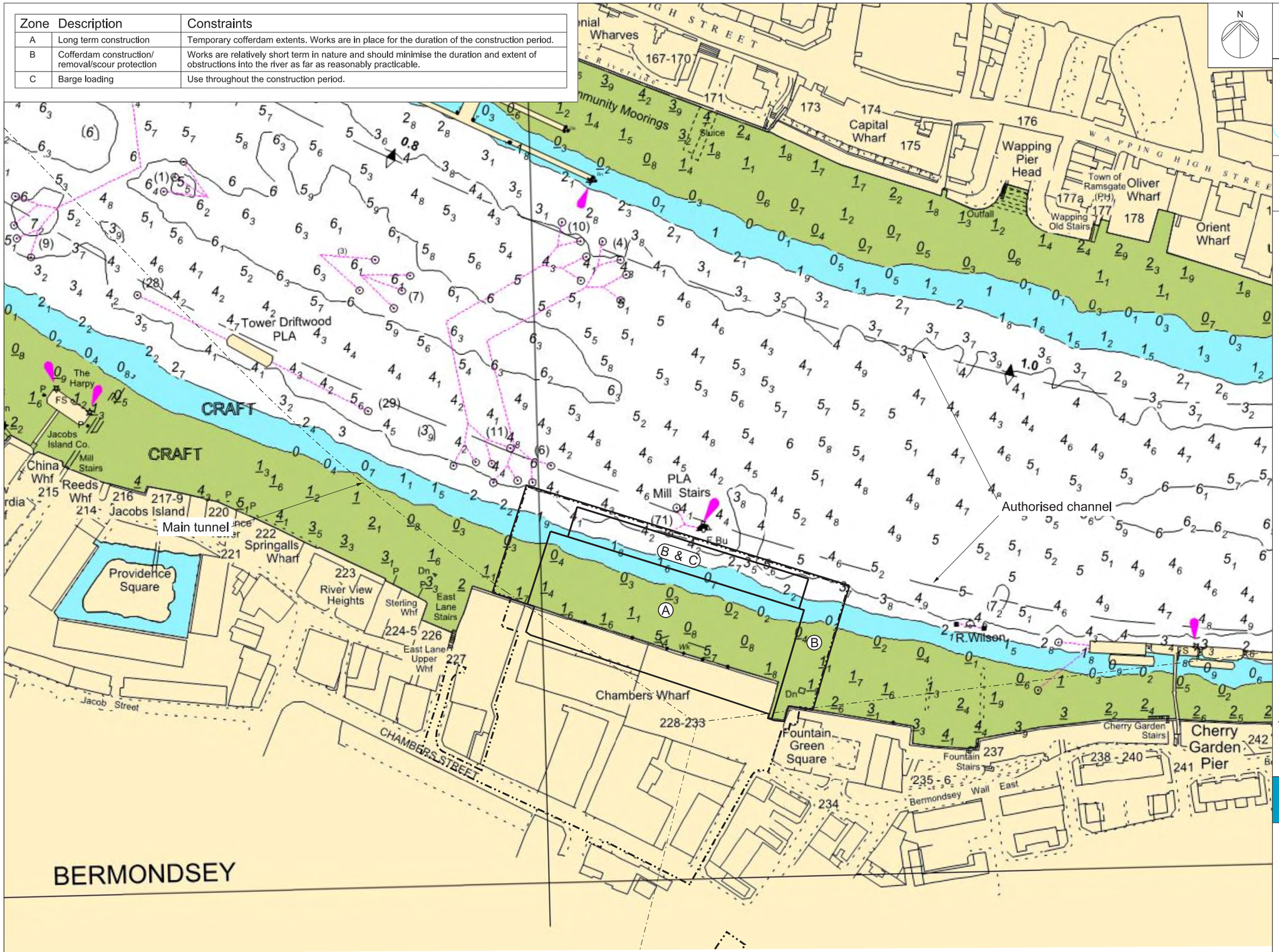
Zone	Description	Constraints
A	Long term construction	Temporary cofferdam extents. Works are in place for the duration of the construction period.
B	Cofferdam construction/ removal/scour protection	Works are relatively short term in nature and should minimise the duration and extent of obstructions into the river as far as reasonably practicable.
C	Barge loading	Use throughout the construction period.



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Keyplan:

Coordinates are to be Ordance Survey Datum OSGB36. All levels are in metres and relate to the Tunnel Datum which is 100 metres below Ordnance Datum Newlyn.

Key:

Limits of land to be acquired or used (LLAU)

Notes:

1. All levels are in metres and relate to chart datum.
2. Background information shown on this drawing is taken from:

   River Thames - Upper Pool

   Port of London Authority Hydrographic Service

   H.O. Ref. No....113-318-248....Date....12/01/2011

10m 0 100m

Scale 1:1000 at A1
1:2000 if reproduced at A3

FOR INFORMATION

Location
Chambers Wharf
London Borough of Southwark

Document Information
Application for Development Consent
River foreshore zones of working

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Navigational Issues and Preliminary Risk Assessment

Doc Ref: **7.20.10**

Chambers Wharf

Appendix B

APFP Regulations 2009: Regulation **5(2)(q)**

Hard copy available in

Box **57** Folder **B**
January 2013

Thames Tideway Tunnel

Creating a cleaner, healthier River Thames

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Appendix B: Freight tracks & AIS analysis

B.1.1 The project propose to use the Chambers Wharf site for construction work and to accommodate permanent structures required to operate the main tunnel. The site would be used to drive the main tunnel to Abbey Mills Pumping Station and receive the main tunnel from Kirtling Street. In addition, three existing local CSOs would be connected via a long connection tunnel.

B.1.2 A 25m wide internal diameter shaft would be constructed, which would be approximately 57m deep. This would be used to lower a tunnel boring machine for the Abbey Mills drive along with recovery of the tunnel boring machines from both the Kirtling Street and Greenwich drives.

B.1.3 As the shaft construction works would take place on land, permanent structures extending into the river would not be required. A temporary cofferdam would extend into the river to provide the necessary workspace to complete construction.

B.1.4 A review of AIS track information of inbound freight movements passing through this section of the river wasundertaken. The track data was captured in November 2011 and provided by Cory Environmental Ltd. An AIS transponder was sited on the starboard rear quarter of the rearmost rank of barges, enabling analysis of vessel track data for the entire duration of the journey.

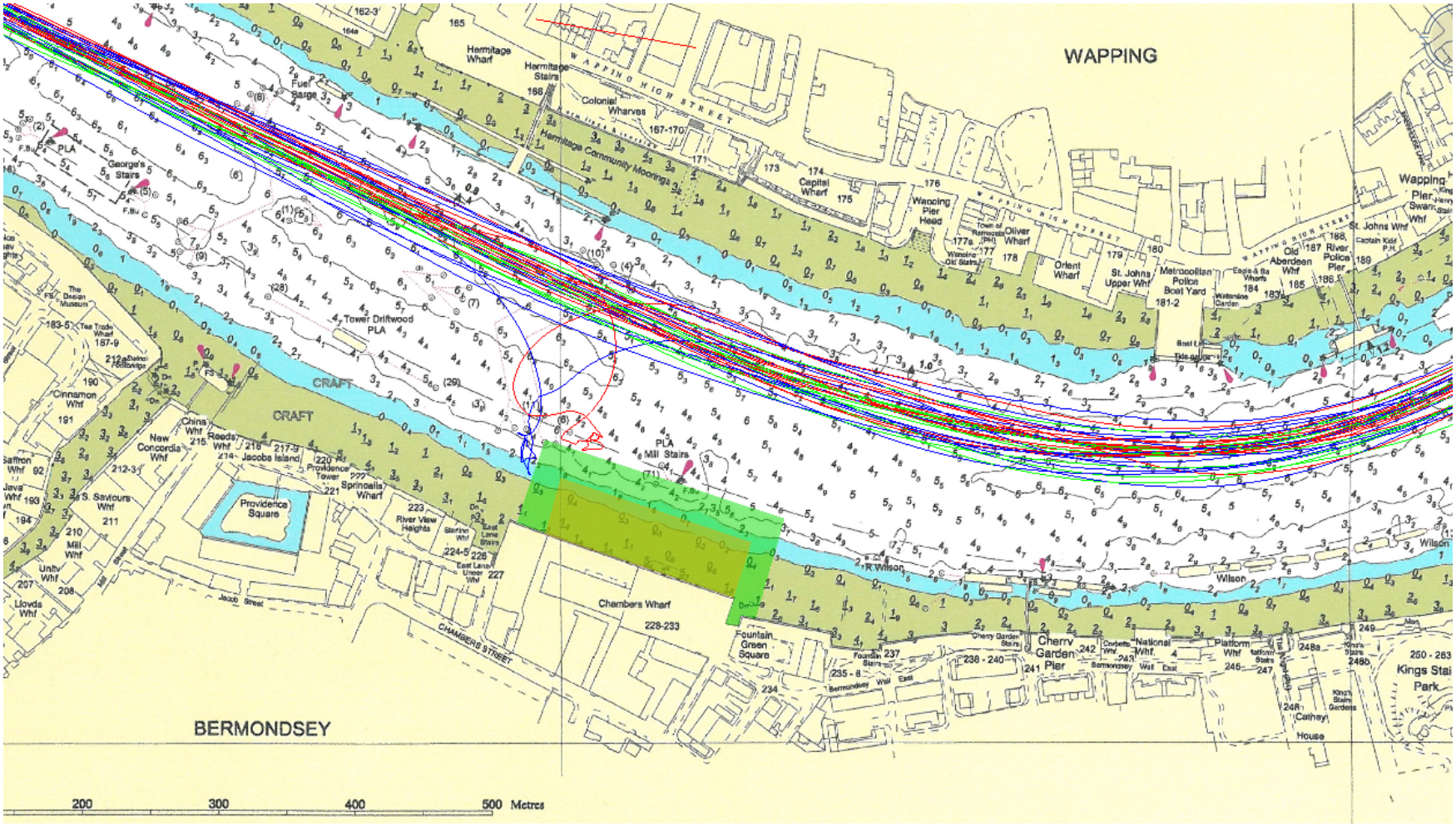
B.2 Summary of results

B.2.1 Cory environmental supplied the project with a set of GPS data showing the movements of their tugs and barges. The data covered 14 days in November 2011, a total of 35 tug movements. This data was analysed and visualised to inform various sections of this report. Included below in Figure B.1 is a GIS output of all tracks overlaid over a chart of the Chambers Wharf area.

B.2.2 By individually investigating each of the tracks supplied it waspossible to speculate on the potential impacts of the various phases of development.

B.2.3 For each track supplied, an image was created displaying a wide ‘bar’ type line. This line represented the path taken by the tug in question, with the width being representative of the width a tug towing at least two barges (side by side). However due to the similarities between the vast majority of these lines, only five have been included in this report. These five (highlighted yellow in Table B.1) represent a good cross section of possible routes taken by Cory Environmental

Figure B.1 GPS Tracks of Cory tugs and barges



Cory Track Summary

B.2.4 Table B.1 - Cory AIS Data has the following headings:

a. Date – Date the GPS data was collected

b. Colour – colour system assigned by Cory tugs to enable identification of individual tugs

c. Tug – The name of the tug in question

d. Head Rank Port – The name of the barge being towed in the port position

e. Head Rank stb'd - the name of the barge being towed in the starboard position

f. Second rank – the name of the barge being towed in the rear position (where applicable)

g. Wind Direction - Approximate Wind Direction

h. Wind Speed - Wind speed in m/s

i. High tide – time at which high tide was (taken from the PLA 2011 tide times booklet)

j. Tidal height – projected height of tide at Tower Bridge (taken from the PLA 2011 tide times booklet)

k. Figure – reference in this document for the image of the GPS track.

Table B.1 Cory AIS Data

Date	Colour	Tug	Head rank port	Head rank stb'd	Second rank	Wind direction	Wind Speed (m/s)	High tide at	Tidal height (m)	Figure
07/11/11	Red	Resource	Cringle	Cringle		NE	3	11:21	6.2	
07/11/11	Blue	Reclaim	Cringle	Cringle	Walbrook	NE	3	11:21	6.2	
07/11/11	Green	Recovery	Cringle	Wangas		NE	3	11:21	6.2	
08/11/11	Red	Reclaim	Cringle	Cringle	Cringle	SE	9	12:10	6.5	
08/11/11	Blue	Regain	Cringle	Cringle		SE	8	12:10	6.5	Figure B.2
08/11/11	Green	Resource	Cringle	Cringle	Wangas	SE	8	12:10	6.5	
09/11/11	Red	Resource	Cringle	Walbrook		SE	3	12:51	6.7	
09/11/11	Blue	Recovery	Cringle	Wangas	Wangas	SE	3	12:51	6.7	
09/11/11	Green	Redoubt	Cringle	Cringle	Wangas	SE	5	12:51	6.7	
10/11/11	Red	Resource	Cringle	Cringle	Wangas	E	3	13:27	6.8	
10/11/11	Blue	Regain	Cringle	Cringle	Wangas	E	4	13:27	6.8	
11/11/11	Red	Reclaim	Cringle	Cringle	Wangas	E	4	14:00	6.9	
11/11/11	Blue	Recovery	Walbrook	Cringle		SE	4	14:00	6.9	
11/11/11	Green	Resource	Cringle	Cringle	Wangas	SE	4	14:00	6.9	Figure B.3
14/11/11	Red	Resource	Wangas	Cringle		E	4	15:39	6.9	
14/11/11	Blue	Recovery	Walbrook	Cringle		E	4	15:39	6.9	Figure B.4
14/11/11	Green	Regain	Wangas	Cringle		E	4	15:39	6.9	

Date	Colour	Tug	Head rank port	Head rank stb'd	Second rank	Wind direction	Wind Speed (m/s)	High tide at	Tidal height (m)	Figure
16/11/11	Red	Redoubt	Walbrook	Cringle		SE	3	16:55	6.7	
16/11/11	Blue	Reclaim	Cringle	Cringle	Cringle	E	3	16:55	6.7	
16/11/11	Green	Recovery	Cringle	Wangas	Cringle	E	3	16:55	6.7	
17/11/11	Red	Redoubt	Cringle	Cringle	Cringle	SW	5	17:40	6.6	
17/11/11	Blue	Reclaim	Wangas	Wangas		SW	5	17:40	6.6	
18/11/11	Red	Regain	Cringle	Wangas	Cringle	S	5	18:33	6.4	
18/11/11	Blue	Recovery	Cringle	Cringle		S	4	18:33	6.4	
22/11/11	Red	Regain	Wangas	Wangas		E	2	10:34	6.5	
22/11/11	Blue	Recovery	Cringle	Cringle	Cringle	E	2	10:34	6.5	
22/11/11	Green	Reclaim	Cringle	Cringle		E	2	10:34	6.5	
23/11/11	Red	Reclaim	Wangas	Wangas		SW	2	11:35	6.8	Figure B.5
23/11/11	Blue	Redoubt	Cringle	Walbrook		SW	2	11:35	6.8	Figure B.6
23/11/11	Green	Regain	Transponder on tug			SW	2	11:35	6.8	
24/11/11	Red	Resource	Wangas	Wangas		SW	4	12:31	7.1	
24/11/11	Blue	Reclaim	Cringle	Cringle	Cringle	SW	4	12:31	7.1	
24/11/11	Green	Recovery	Cringle	Cringle	Cringle	SW	4	12:31	7.1	
25/11/11	Red	Resource	Walbrook	Cringle		W	10	13:22	7.2	
25/11/11	Blue	Recovery	Wangas	Wangas		W	10	13:22	7.2	
25/11/11	Green	Redoubt	Cringle	Cringle	Cringle	W	10	13:22	7.2	

Cory Individual Tracks

Figure B.2 08/11/2011 - Blue Track image

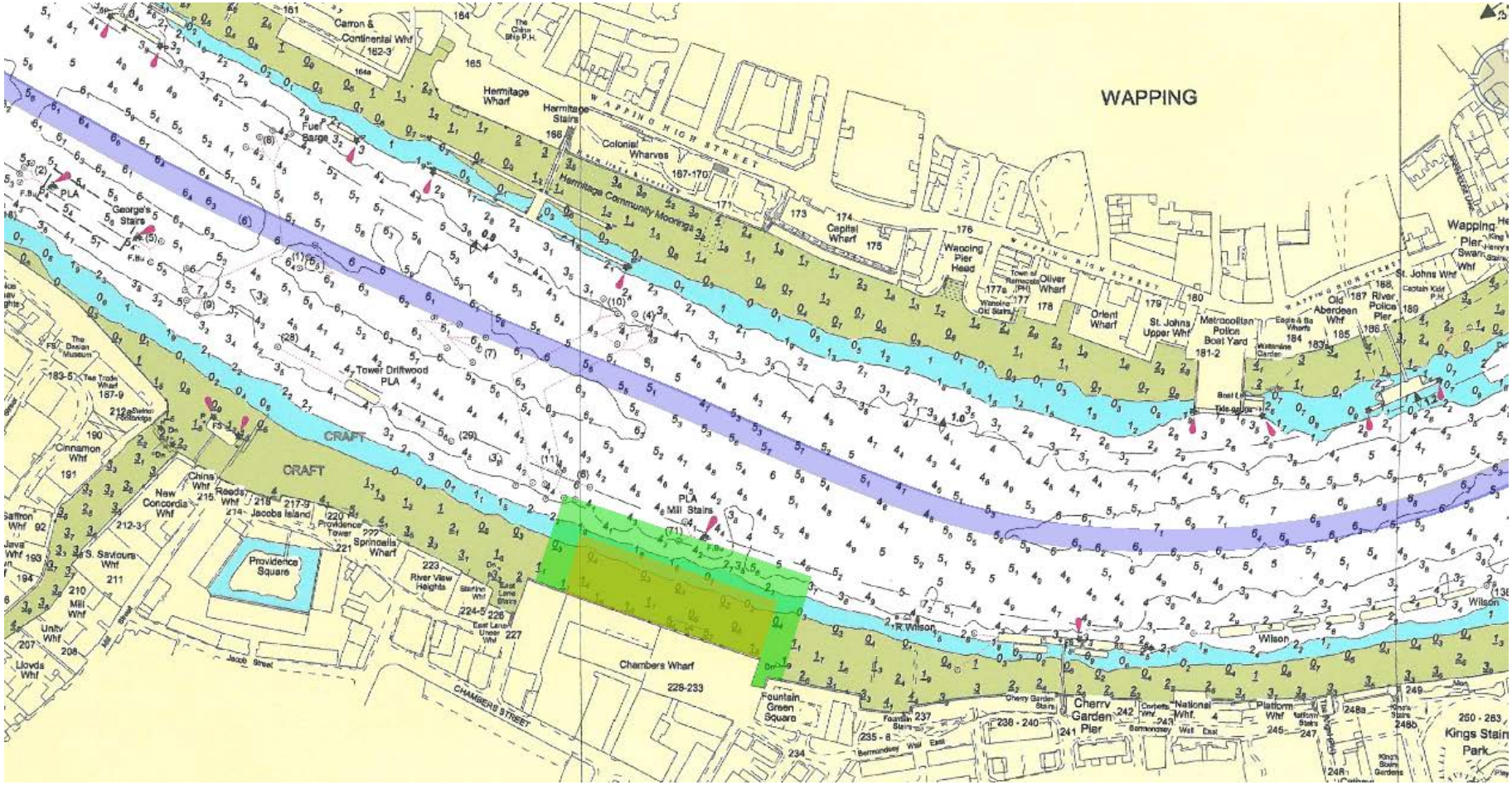


Figure B.3 11/11/2011 - Green Track image

Figure B.4 14/11/2011 - Blue Track image

Figure B.5 23/11/2011 – Red Track image

Figure B.6 23/11/2011 - Blue Track image

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