Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Navigational Issues and Preliminary Risk Assessment

Doc Ref: **7.20.05**

Carnwath Road Riverside

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

This page is intentionally left blank

Thames Tideway Tunnel

Navigational Issues and Preliminary Risk Assessment: Carnwath Road Riverside

List of contents

Page number

1 Executive summary 1

1.1 Introduction 1

1.2 Issues to be addressed 1

1.3 Interaction with existing freight traffic 2

1.4 Impact on existing recreational river users 2

1.5 Intrusion of potential jetty into river 2

2 Site overview 3

2.1 Purpose of this report 3

2.2 Introduction 3

2.3 Limits of land to be acquired or used 4

2.4 Construction methodology 5

2.5 Options 5

2.6 Phase A: Site set up - existing wharf strengthening 5

2.7 Phase A: Site set up - campshed construction 6

2.8 Phase A: Site set-up - construction of jetty 6

2.9 Phases B and C: Delivery and removal of materials 6

2.10 Phase D: Site restoration 7

2.11 Phase D: Removal of jetty 7

3 Study aim and area 9

3.1 Introduction 9

3.2 General navigation 9

3.3 Bridges 10

3.4 The authorised channel 11

3.5 Tide set 11

3.6 Dredging/levelling at the wharves 12

3.7 Existing river users 13

3.8 Existing vessel traffic movements 14

4 Summary of navigational issues 17

4.1 Interaction with existing freight traffic 17

4.2 Impact on existing recreational river users 17
4.3 Intrusion into the river (jetty option) 17
5 Stakeholder consultation 19
5.1 Consultation meetings 19
5.2 Observation notes 19
6 Current river operations 21
6.1 Freight and passenger vessel movements 21
7 Campshed and jetty option 23
7.1 Campshed 23
7.2 Jetty 23
8 Risk assessment 25
8.1 Risk assessment: Methodology 25
8.2 Risk assessment: Criteria 26
8.3 Risk matrix 28
8.4 Hazard identification 29
8.5 Mitigation strategy 29
9 Navigational issues and mitigation measures 31
9.1 General 31
9.2 Interaction with existing freight operators 31
9.3 Impact on existing recreational river users 33
9.4 Intrusion of jetty into river 34
10 General navigational hazards 37
10.2 Project phases B and C: Most likely 37
10.3 Project phases B and C: Worst credible 38
11 Mitigation measures 41
11.1 Existing mitigation 41
11.2 Proposed mitigation 41
11.3 Design 42
11.4 Physical 42
11.5 Operational 42
12 Conclusion 45
12.1 Assessment 45
12.2 Stakeholder engagement 45
12.3 Risk analysis 45
12.4 Overall 46
13 Recommendations 49
Abbreviations 51

Appendices 53
Annexes..... 55

List of figures

Page number

Figure 2.1 Main tunnel site structures (below ground) 4
Figure 3.1 Tide cycle at 0m level 12
Figure 3.2 Tidal cycle at 2m level 13
Figure 3.3 AIS tracks of Cory traffic in the vicinity of Carnwath Road 15
Figure 8.1 The ALARP principle 25
Figure 9.1 Cory movements at Carnwath Road 32
Figure 13.1 Potential marine logistics hierarchy 50

List of tables

Page number

Table 3.1 Individual arch bridge clearances above Mean High Water Springs (Wandsworth Bridge) 10
Table 3.2 Main navigational arch bridge clearance heights above (Wandsworth Bridge) 10
Table 3.3 Individual arch bridge clearances above Mean High Water Springs (Westminster Bridge) 10
Table 3.3.4 Arch No4 bridge clearance heights above (Westminster Bridge) 10
Table 8.1 Probability Criteria 26
Table 8.2 Severity Criteria: People 27
Table 8.3 Severity Criteria: Environment 27
Table 8.4 Severity Criteria: Operational Impact 27
Table 8.5 Severity Criteria: Media Attention 27
Table 8.6 Risk assessment matrix 28
Table 8.7 Risk classification 28
Table 10.1 Most likely risk scores 37
Table 10.2 Worst credible risk scores 38
Table 11.1 Existing safeguards 41
Table 11.2 Mitigation measures within the project's control 43
Table 12.1 Hazard overview: Most Likely 46
Table 12.2 Hazard overview: Worst Credible 46

This page is intentionally left blank

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Navigational Issues and Preliminary Risk Assessment

Doc Ref: **7.20.05**

Carnwath Road Riverside

Main Report

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

This page is intentionally blank

1 Executive summary

1.1 Introduction

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 Carnwath Road Riverside 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 a specific 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:

a. Phase A: site set-up (including strengthening of existing wall and construction / upgrade of campshed)

b. Phase B: removal of excavated material by barge

c. Phase C: delivery of materials to site by barge

d. Phase D: site restoration.

1.2 Issues to be addressed

1.2.1 The proposed site lies within Wandsworth Reach on the north bank of the River Thames and comprises of Whiffin, Hurlingham and Trinidad Wharves. There are several commercial and leisure stakeholders that operate within and transit the area.

1.2.2 Although the proposed site lies entirely on land and would require no permanent in river structures, the Limits of land to be acquired or used (LLAU) does however include a certain amount of water space for the mooring of barges used in delivery of materials and removal of excavation material.

1.2.3 The issues to be addressed for this site are:

a. interaction with existing freight traffic

b. impact with existing river users

c. potential intrusion of the jetty into the river.

1.3 Interaction with existing freight traffic

1.3.1 Observation of freight traffic was conducted at this location. The two main freight terminals are both on the south bank. Pier Wharf is an aggregates berth just to the west of Wandsworth Bridge serviced by GPS Marine Ltd and Cory Environmental Ltd.

1.3.2 Analysis of Global Positioning System (GPS) tracks was conducted for freight moving through and berthing in this location. Tug and tow tracks confirm that vessels use the No. 2/centre arch of Wandsworth Bridge before making a turn to port/south to berth at their respective wharves on inward journies. Outward bound trips also use the centre arch and vessels take up a course in the middle to south region of the authorised channel as far as their height and draft permit.

1.4 Impact on existing recreational river users

1.4.1 Throughout the period of its use, activities at this site would have an impact on existing river users. During the spring, summer and autumn, this stretch of river is frequented by private leisure cruisers and the Hurlingham Yacht Club has moorings approximately 220m upstream. The rowing community, based at Putney and Hammersmith also transit the area on training outings all year long when tidal conditions dictate. A passenger operation based at Westminster Pier moves through the reach between Easter and October on their way to and from Kew, Richmond and Hampton Court. Thames Clippers have just taken over the operation of a commuter service between Putney and central London. Other recreational craft transit the area and consideration of their movements has been given within this Preliminary Navigational Risk Assessment.

1.5 Intrusion of potential jetty into river

1.5.1 In this option, a jetty would be constructed in the river approximately 25m away from the river wall to support transport of materials to and from the site by barge. Care would be taken to ensure that any structures built out into the river would not unduly affect traffic in the area. Specifically Cory Environmental Ltd traffic is of concern due to their waste transfer facility being located in close proximity to the project site.

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 Carnwath Road Riverside 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

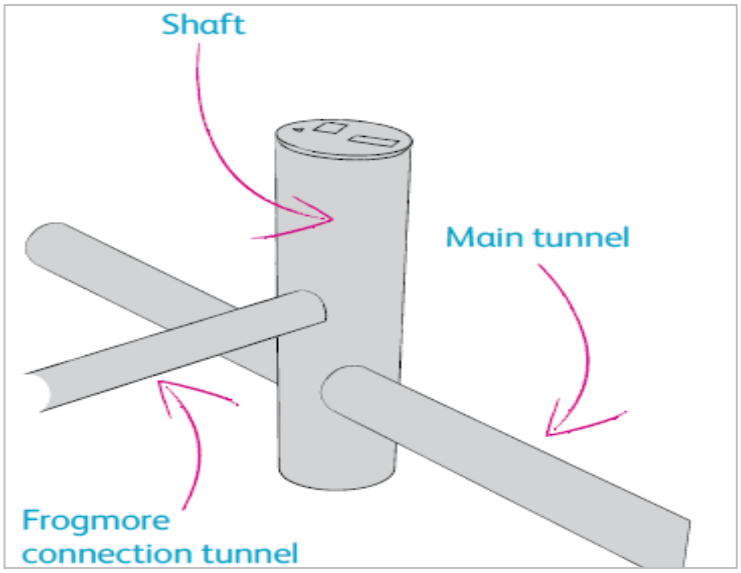
c. control of two CSOs by locally modifying the sewerage system requiring two system modification sites

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 Carnwath Road Riverside main tunnel site would be required to receive the main tunnel from Kirtling Street (east) and drive the main tunnel to Acton Storm Tanks (west). The proposed structures at this site are illustrated in Figure 2.1.

Figure 2.1 Main tunnel site structures (below ground)



2.2.5 It is proposed that Carnwath Road Riverside would operate as a main tunnel drive and reception site and would include:

a. main tunnel shaft – 25m internal diameter, approximately 50m deep
b. conveyor system to transfer excavated material
c. cranes
d. excavated material handling area
e. internal site roads
f. maintenance workshops
g. storage facilities for segments, grout etc.
h. 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 extends approximately 60m into the river. It does not however cross into the authorised channel. The sites eastern border starts 125m upstream from Wandsworth Bridge and continues approximately 300m to the west, towards Hurlingham Yacht Club.

2.3.2 The LLAU encompasses the maximum working area required during construction.

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

2.3.4 Appendix B details the various design, construction and site layout drawings. Project phases

2.3.5 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:

a. Phase A: site set-up(including strengthening of existing wall and construction / upgrade of campshed)

b. Phase B: removal of excavated material by barge

c. Phase C: delivery of materials to site by barge

d. Phase D: site restoration.

2.3.6 The feasibility and advantages of constructing a jetty at this site has been considered by the project team with a number of the considerations detailed in Section 7 of this report.

2.3.7 The delivery of materials and removal of excavated material have a similar risk profile and have been combined for the purpose of hazard logs.

2.4 Construction methodology

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

2.4.2 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.

2.4.3 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.

2.5 Options

2.5.1 The project design team considered two options for marine infrastructure at the site:

a. using the existing river frontage would likely require a structural enforcement or full replacement of the existing river wall.

b. alternatively, a jetty would be constructed approximately 25m from the river wall

2.5.2 More information is provided throughout Section 7.

2.6 Phase A: Site set up - existing wharf strengthening

2.6.1 It is not expected that any permanent in river structure would be required at this site provided that, on completion of structural surveys, the existing river wall is deemed suitable for use.

2.6.2 Any work required to update/strengthen the existing river wall is expected to be covered by a River Works License, issued by the PLA. A River

Works License application for new works or to vary existing works must be accompanied by the relevant supporting information including[1]:

a. method Statement

b. detailed construction drawings

c. contextual/background information on wider project

d. environmental and hydrodynamic assessments.

2.6.3 Works of a temporary nature (e.g. repair work to river walls) may not require a formal River Works License application but would require the written consent of the PLA.

2.7 Phase A: Site set up - campshed construction

2.7.1 The project and their appointed marine contractor may wish to reinstate the original campsheds that were used at this site.

2.7.2 The original campsheds have been removed and visually the remaining foreshore looks reasonably flat. Some levelling of the berth would be necessary to achieve a good trim when loading barges alongside.

2.7.3 The riverbed is mainly gravel in this area and could provide an adequate base for loading once levelled. The levelling would be performed from the shore with a long reach machine.

2.7.4 It is assumed that the refurbishment of existing campsheds or construction of new ones would be covered under a River Works License, as described above.

2.8 Phase A: Site set-up - construction of jetty

2.8.1 Should a jetty be chosen, the construction may involve piling from the shore to build the approach trestle and to use the construction to move out into the water to continue to build the approach trestle and then the jetty head.

2.8.2 There may be a need for workboats to bring in materials and to provide general support to the construction. The construction works are within the LLAU.

2.9 Phases B and C: Delivery and removal of materials

2.9.1 The main tunnel shaft, main tunnel and connection tunnel would be constructed from within Whiffin Wharf. The main tunnel shaft is currently assumed to be constructed by sprayed concrete lining.

2.9.2 An attendant excavator would load the excavation material 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 site or jetty.

[1] Information taken from PLA Website - www.pla.co.uk

2.10 Phase D: Site restoration

2.10.1 Site restoration work is not considered to impact on the river provided that the jetty option isn't used.

2.11 Phase D: Removal of jetty

2.11.1 Removal of the jetty would likely be the reverse of installation. It would involve working from the jetty head to remove decking and piles and working back towards the shore. It is anticipated that workboats would provide support to removal operations. The construction works are within the limits of land to be acquired or used.

This page is intentionally left blank

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 in the Carnwath Road/Hurlingham Wharf area and assess how the proposed phases of the project would likely impact on existing river users and river infrastructure.

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 It is acknowledged that tug and tow operations are not new on this section of the River Thames, with a number of freight services operating daily on the river, transporting a variety of materials in a variety of craft. This assessment does not assess those operations but examines the additional hazards that this project presents.

3.1.5 There are two options for in-river structures to support river transport at the Carnwath Road Riverside site, either:

a. a campshed, or

b. a temporary jetty for material delivery/excavation material removal purposes.

3.1.6 The proposed development site is located directly opposite the Smugglers Way Western Riverside Waste Authority (WRWA) facility. The potential effects of having significant levels of barge movements in close proximity to Cory's site were assessed.

3.1.7 The proximity of Pier Wharf and the barge service provided by GPS Marine Ltd, currently 3 to 4 days per week, was also.

3.2 General navigation

3.2.1 The Wandsworth Reach is extensively used by commuter, passenger and private pleasure craft, the whole range of rowing shells, tugs and tows and various recreational vessels.

3.2.2 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.

3.2.3 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.

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

3.2.5 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 Bridges

3.3.1 Wandsworth Bridge has 3 arches but only one is available for navigation, the centre arch No2. The smaller side arches can be used by rowers but only under certain tidal conditions.

Table 3.1 Individual arch bridge clearances above Mean High Water Springs (Wandsworth Bridge)

Bridge Arch	1	2	3
Arch Clearance	3.1 m	5.8 m	3.1 m

Table 3.2 Main navigational arch bridge clearance heights above (Wandsworth Bridge)

Tide Set	Chart Datum	MHWN	MLWN	MLWS	HAT
Arch Clearance	11.9m	7.0m	11.4m	11.8m	5.2m

3.3.2 Westminster Bridge has the lowest available navigational arch clearance heights of the remaining bridges through Central London.

3.3.3 Westminster Bridge has seven main arches, all of which are available for navigation with arches No3, 4, 5 & 6 designated as working arches.

Table 3.3 Individual arch bridge clearances above Mean High Water Springs (Westminster Bridge)

Bridge Arch	1	2	3	**4**	5	6	7
Arch Clearance	4.2 m	4.8 m	5.2 m	**5.4 m**	5.2 m	4.8 m	4.2 m

Table 3.3.4 Arch No4 bridge clearance heights above (Westminster Bridge)

Tide set	Chart Datum	MHWN	MLWN	MLWS	HAT
Arch Clearance	12.2 m	6.5 m	11.1 m	11.8 m	4.8 m

3.4 The authorised channel

3.4.1 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.

3.4.2 The authorised channel in the Carnwath Road Riverside area varies between 65m and 85m wide and incorporates the working arches of the various bridges. Directly adjacent to the proposed project site the authorised channel is 75m wide.

3.4.3 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".*

3.5 Tide set

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

3.5.2 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.

3.5.3 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.

3.5.4 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.

3.5.5 The tide set in the area around Wandsworth Bridge is assessed as moderate south on the flood and slight south on the ebb.

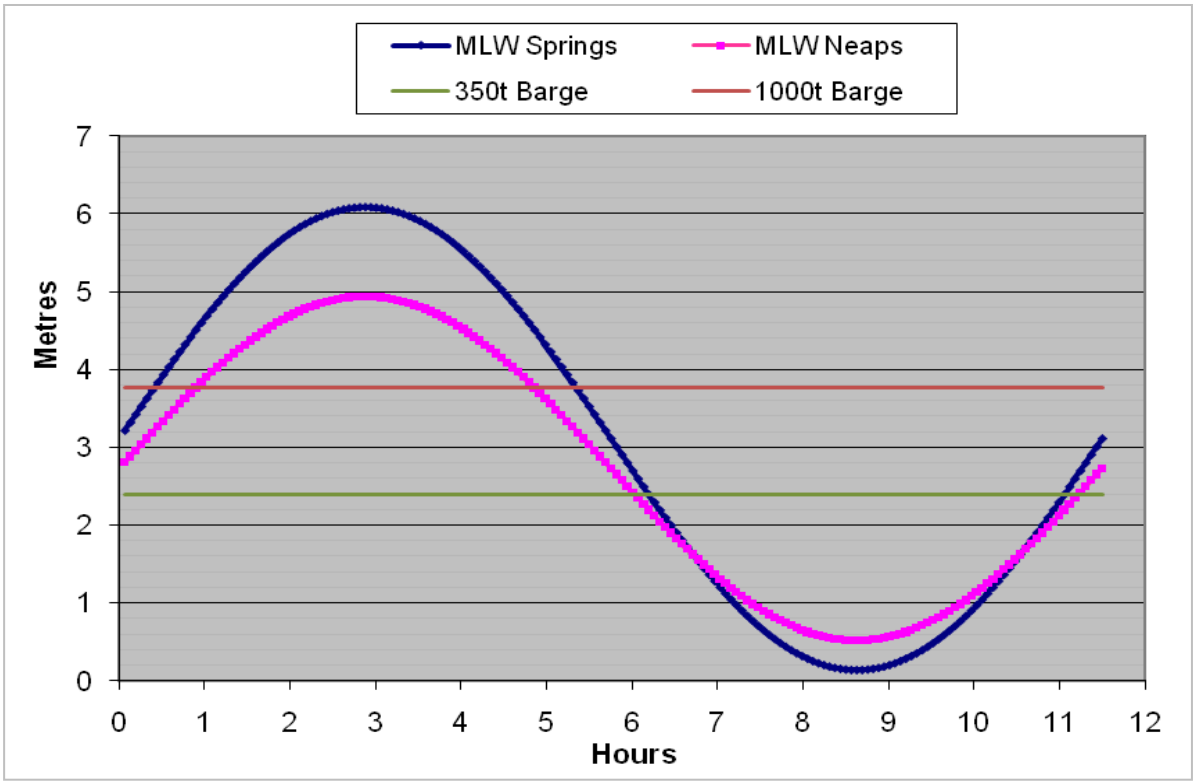
3.6 Dredging/levelling at the wharves

3.6.1 The following figure shows the available tidal windows for 350 and 1000 tonne barges assuming that dredging to the 0 datum mark is carried out. This quantity of dredging is for illustration purposes only.

3.6.2 It is estimated that for each tidal window there would be a 6 hour 50 minute access window (approximately) at the Carnwath Road site for 350 tonne barges on the Neap Tide, increasing to approximately 7 hours 10 minutes on the Spring tide.

3.6.3 For 1000t barges a tidal window of approximately 4 hours on the Neap Tide and 4 hours 50 minutes on the Spring Tide is available. The Neap tide occurs twice a month, and is the tide during which the difference between high and low tide is the least.

Figure 3.1 Tide cycle at 0m level

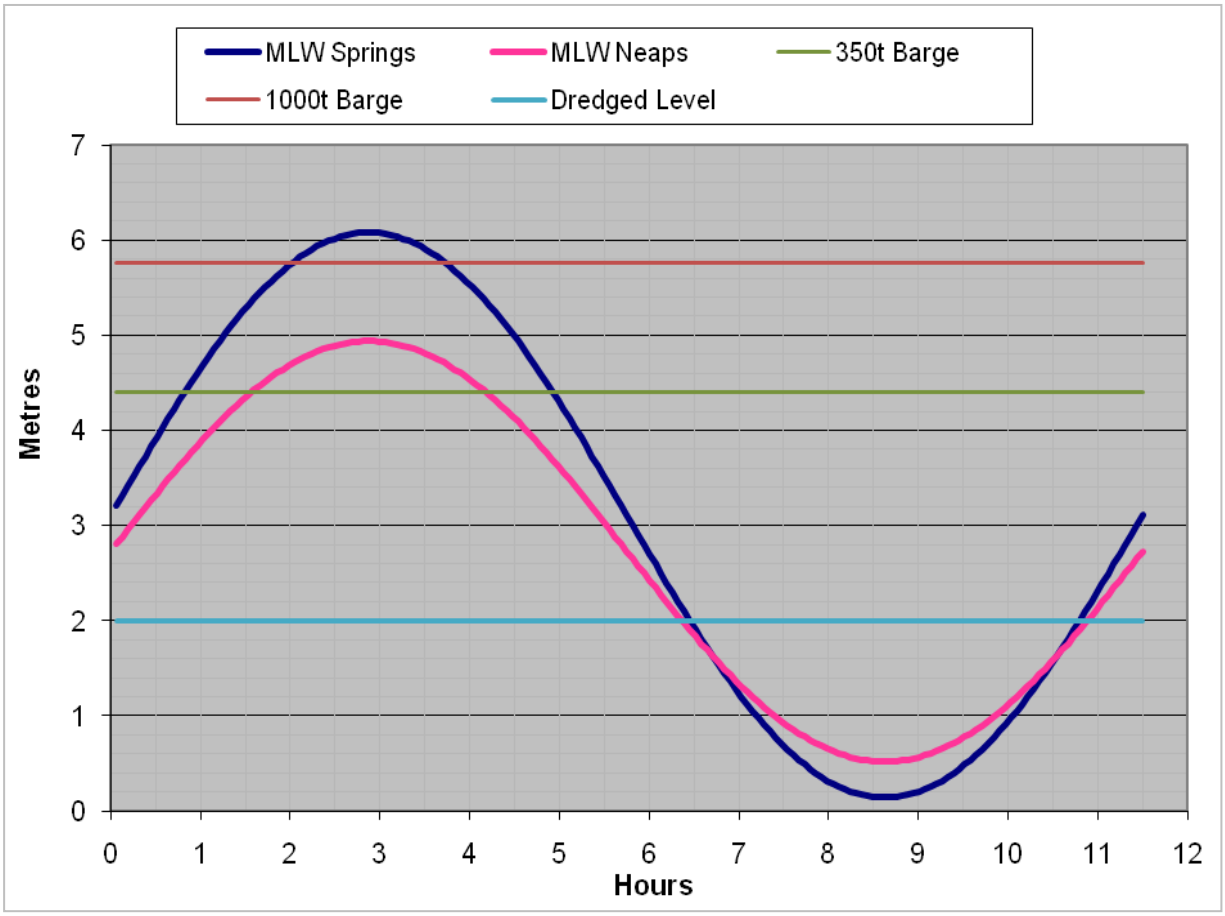


3.6.4 Figure 3.2 shows the available tidal window assuming that dredging to -2m charted depth is carried out. It shows available windows for 350 and 1000 tonne barges.

3.6.5 It is estimated that for each tidal window there would be a 2 ½ hour access window (approximately) to the site at Trinidad Wharf for 350 tonne barges on the Neap Tide, increasing to approximately 4 hours on the Spring tide.

3.6.6 For 1000t barges a tidal window of approximately 1 hour 40 minutes on the Spring Tide is available. 1000t barges would be unable to access the site on the Neap tide.

Figure 3.2 Tidal cycle at 2m level



3.7 Existing river users

3.7.1 During the period from two hours before High Water until one hour after, Wandsworth Reach can be busy but not to the extremes seen in the central area.

3.7.2 Cory currently operates a daily freight service to and from the Smugglers Way waste transfer facility, which is located on the opposite side of the river. Loaded containerised waste barges are towed down river to an incinerator at Belvedere. Typically, two to four empty barges are delivered to the wharf daily. There are occasions when the wharf requires a service at weekends and/or on a bank holiday. Figure 3.3 shows typical Cory barge tracks to the Smugglers Way waste transfer facility.

3.7.3 GPS Marine Ltd. provides an aggregate service three to four days per week to Pier Wharf from the Medway and Halls Jetty, Northfleet.

3.7.4 Thames Clippers have just begun an AM/PM peak-only commuter service from central London to Putney to replace the Thames River Taxi.

3.7.5 A passenger boat service runs daily from Easter to October from Westminster Pier to Kew, Richmond and Hampton Court.

3.7.6 There is potential for private charter vessels to transit the area during periods of optimal tidal conditions. It is difficult to put a finite number on these vessel movements as they are largely based on individual client

requirements, however Putney Pier is a popular embarkation / disembarkation point for customers from the west and south west who do not wish to travel into central London.

3.7.7 Recreational craft frequent the area during the summer months, particularly during the periods around High Water. The rowing community, based at Putney and Hammersmith, use the area year round.

3.8 Existing vessel traffic movements

3.8.1 The majority of inward bound freight movements can be expected to pass through the study area approximately two hours before high water (HW). For Cory in particular, the outbound journey begins an hour before HW to ensure that the tows are below Westminster Bridge by HW. GPS have a slightly different operating window as they bring in loaded craft and take away empty barges. Therefore they arrive approximately an hour before HW and depart an hour afterwards to ensure enough clearance at the critical bridges on the outward journey.

3.8.2 The river is used by tourist passenger services that begin in the central area and consequently traffic levels are higher during the summertime. However the upriver service is not as popular as the trips to the Tower of London and Greenwich.

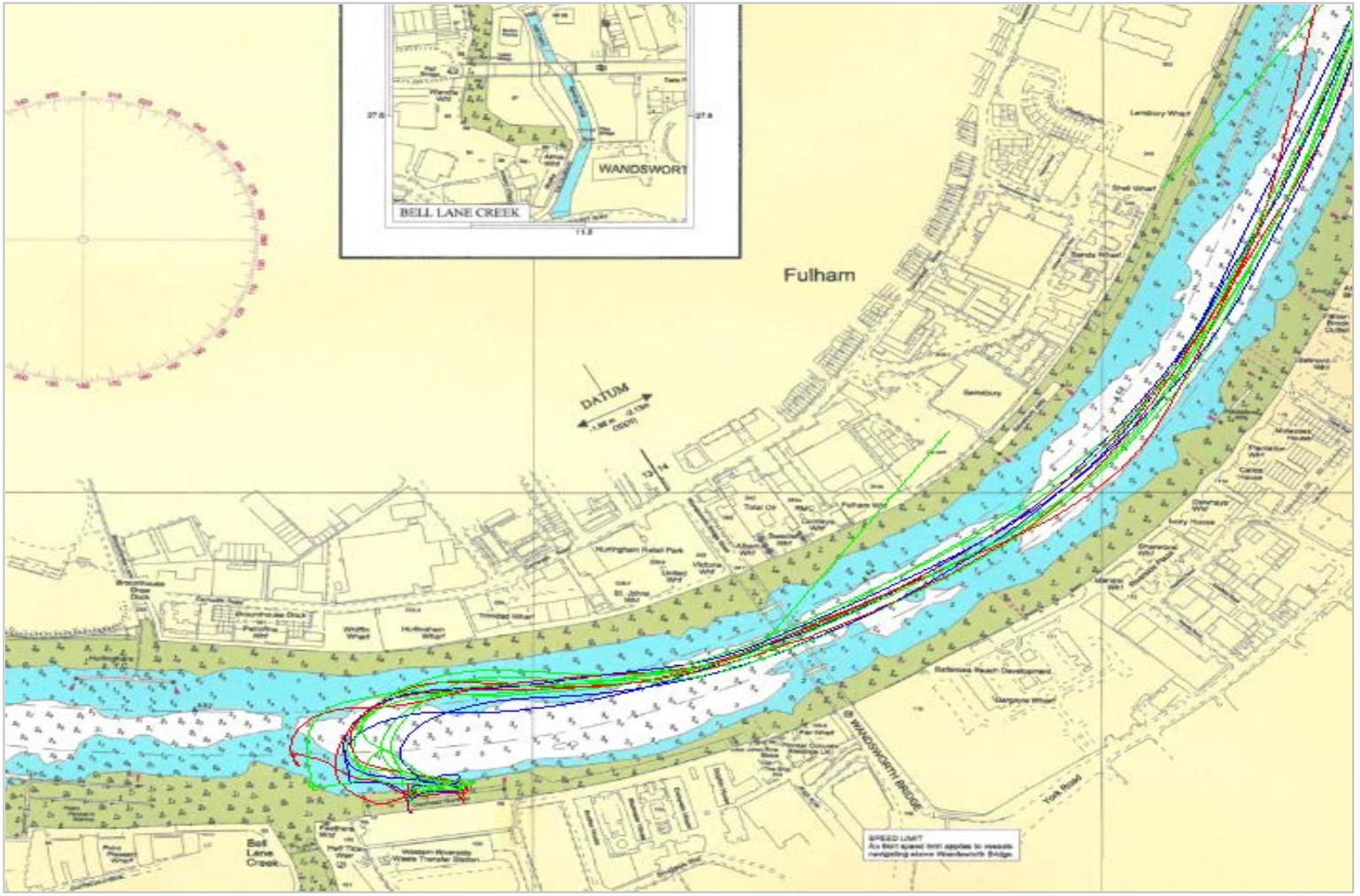
3.8.3 Charter traffic reaches a peak during the summer months and again in the lead up to Christmas.

3.8.4 Private leisure use peaks during the summer, particularly during bank holiday weekends. The rowing community use the river all year round.

3.8.5 Scheduled passenger services transit through the study area two or three times during the morning and evening peaks, with more frequent services planned.

3.8.6 Figure 3.3 shows inward bound Cory barge movements to the Wandsworth facility.

Figure 3.3 AIS tracks of Cory traffic in the vicinity of Carnwath Road



This page is intentionally left blank

4 Summary of navigational issues

4.1 Interaction with existing freight traffic

4.1.1 Movements of barge traffic to and from the worksite would have an operating window similar as that currently used by both Cory Environmental Ltd and GPS Marine Ltd, who also operate barges in the vicinity

4.1.2 The interaction of the project's barges with those of existing freight operators has been identified as a potential navigational hazard.

4.2 Impact on existing recreational river users

4.2.1 An increase in freight traffic movements in the Wandsworth Reach would result in an impact on existing and future stakeholders and is assessed as a marine issue in this report with mitigation measures identified in Section 9.

4.3 Intrusion into the river (jetty option)

4.3.1 In this option, a jetty would be constructed in the river approximately 25m away from the river wall to support transport of materials to and from the site by barge. At its closest end, the jetty would be located approximately 33m from the authorised channel and 40m at its furthest. Barges moored to the jetty would be located between 20m and 27m respectively from the authorised channel.

4.3.2 The proximity to the authorised channel at this location has been identified as a potential navigational hazard to existing river users.

This page is intentionally left blank

5 Stakeholder consultation

5.1 Consultation meetings

5.1.1 Discussions and meetings were held with Cory Environmental Ltd, GPS Marine Ltd, upriver passenger operators, Thames Clippers and the rowing and leisure/recreational users. The consultation is ongoing.

5.2 Observation notes

5.2.1 Automatic Identification Systems (AIS) track analyses of Cory movements were conducted and show the typical routes that Cory tug and tow barges in this area take. It should be noted that currently, Cory are unconstrained in their movements at this site and therefore there is capacity for them to conduct a tighter turn, away from Carnwath Road, towards the Smugglers Way waste transfer facility.

5.2.2 GPS Marine Ltd movements to Pier Wharf also need to be considered, along with passenger boats, leisure users and the Thames Clipper service.

This page is intentionally left blank

6 Current river operations

6.1 Freight and passenger vessel movements

6.1.1 Freight vessels using Pier Wharf and the Smugglers Way waste transfer facility have been observed on several occasions.

6.1.2 Pier Wharf is an aggregate berth serviced by GPS Marine Ltd. They deliver one 750 ton barge of mixed ballast. The tug, with the barge alongside, passes beneath Wandsworth Bridge to the north of the centre and then makes a turn to port prior to berthing. The outward journey begins with the tug moving with the light barge to the middle of the river before passing beneath Wandsworth Bridge to proceed outward bound.

6.1.3 Smugglers Way is a waste transfer station operated and serviced by Cory Environmental Ltd. The tugs approach the wharf after making a turn to port from the north side of the river. Unlike GPS Marine Ltd, the barges are towed astern and manoeuvred to the quayside using the tow ropes in a method known as sheering. This enables the tug master to get the craft alongside without grounding the tug. The Wharf bosuns prepare the loaded barges for the outward trip so that the tug crews only have to make fast the tow ropes. The tug would then take a course to the centre of the river prior to passing beneath Wandsworth Bridge.

6.1.4 The first Westminster passenger service departs the pier at approximately 10.30 and the last boat upriver leaves at 14.00. The Hampton Court service begins after the Whitsun bank holiday and ends when the school summer holidays finish. Outside of these times, the service runs to Kew Gardens and back.

6.1.5 Thames Clippers intend to operate a 40 minute AM/PM peak service to Putney.

This page is intentionally left blank

7 Campshed and jetty option

7.1 Campshed

7.1.1 The total available berth space against the existing river wall is approximately 200m in length with the following water depths:

a. at low water the berth currently dries to a height of between 1m and 2.6m above chart datum

b. at Mean High Water Springs (MHWS) there would be approximately 3.6m water depth

c. at Mean High Water Neaps (MHWN) there would be approximately 2.5m water depth.

7.1.2 The original campsheds have been removed and remaining foreshore appears to be reasonably flat. Some levelling of the berth would be necessary to achieve a good trim when loading barges alongside. The river bed is mainly gravel in this area and could provide an adequate base for loading once levelled. The levelling could be performed from the shore with a long reach excavator. Reinstating the campshed would require dredging so as not to reduce the tidal window. Levelling to provide a second bottom loading capability would be prudent for the following reasons:

a. it would increase the capacity of the wharf to deal with spikes in excavated material production

b. it would create spare barge capacity in case of inclement weather or any other factors that could affect the barge service.

7.1.3 The use of a campshed against the river wall could require the strengthening or full replacement of the existing river wall, if found structurally unsound.

7.2 Jetty

7.2.1 Constructing a temporary jetty 25m from the river wall would place the structure between approximately 40m at the eastern to 33m at the western extremities from the northern boundary of the authorised channel. This distance would be reduced to approximately 37m and 23m respectively with an 800t barge berthed alongside.

7.2.2 The depth of the river bed is 0m relative to chart datum 25m away from the river wall. This would permit access for 800 t barges for approximately 4 hours per tide. This limited access means that the berth face requirements for this option would be similar to that for the campsheds against the river wall.

7.2.3 This location would result in the berth drying out and a requirement for some dredging.

7.2.4 PLA charts have been examined for this section of the river with relevant water depths taken from them and a preliminary survey at the foreshore

has been conducted. It is recommended that a ground survey be undertaken at the foreshore site to ascertain the exact nature of the river bed and its suitability to berth and load barges over a prolonged period of time.

8 Risk assessment

8.1 Risk assessment: Methodology

8.1.1 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.

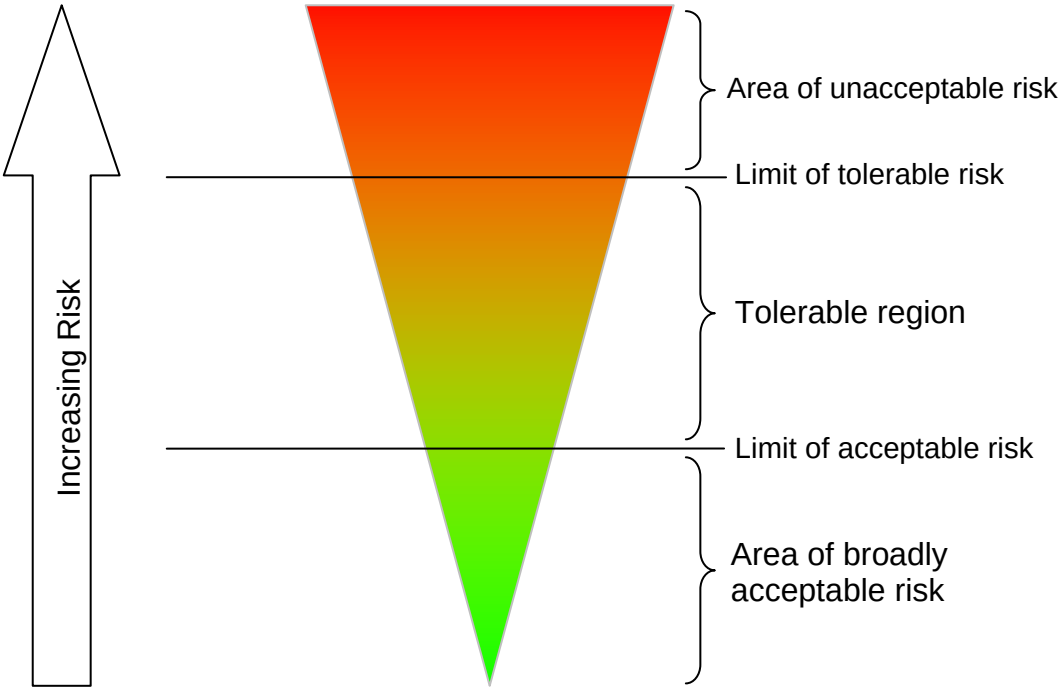
b. Risk: a relative measure of harm or loss, derived from the combination of the severity of a particular consequence together with the probability of the consequence occurring.

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).

8.1.2 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 8.1.

Figure 8.1 The ALARP principle



8.1.3 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.

8.1.4 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.

8.2 Risk assessment: Criteria

8.2.1 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.

8.2.2 Consultation with the PLA highlighted the PLA's desire to use a project specific risk terminology, as well as an alternative assessment matrix and risk classification scorecard. These changes have been incorporated.

8.2.3 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.

8.2.4 Table 8.1 details the 'probability' criteria used to assess how likely each hazard is to occur in terms of average frequency in the PLAs jurisdiction.

Table 8.1 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

8.2.5 Table 8.2 details the severity criteria applied to the safety-related consequences of each hazard.

Table 8.2 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

8.2.6 Table 8.3 details the severity criteria applied to the environmental loss related consequences of each hazard.

Table 8.3 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

8.2.7 Table 8.4 details the severity criteria applied to the property loss/damage related consequences of each hazard.

Table 8.4 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

8.2.8 Table 8.5 details the severity criteria applied to negative media attention/coverage consequences of each hazard.

Table 8.5 Severity Criteria: Media Attention	Level
No Coverage	1
Local coverage	2
Regional coverage	3
National coverage	4
International coverage	5

8.3 Risk matrix

8.3.1 The risk matrix in Table 8.6 was used to provide a risk score, combining severity of a particular consequence with the likelihood (probability) of the consequence occurring.

Table 8.6 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

8.3.2 The risk score in Table 8.7 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 8.7 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.

8.4 Hazard identification

8.4.1 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.

8.4.2 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. Metropolitan Police Marine Policing Unit
g. Royal national Lifeboat Institute (RNLI)

8.4.3 Several site visits to HR Wallingford's physical model were also undertaken during the risk assessment process. This allowed Captain David Phillips (former PLA Harbour Master (Upper)), freight (Cory Environmental) and commercial (Thames Clippers) operators 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 works at various locations. However, the site at Carnwath Road Riverside was not included in this physical model.

8.5 Mitigation strategy

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

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

This page is intentionally left blank

9 Navigational issues and mitigation measures

9.1 General

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

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

9.1.3 For the purpose of this assessment, mitigation measures (risk control options) were classified as three types;

a. Design: measures that can be implemented by the project at the design stage.

b. Physical: measures that the project can implement during the construction and operational phases.

c. Operational: measures that the project can implement in conjunction with the PLA at all stages of the project.

9.1.4 Of course, some proposed mitigation measures would be beyond the project's control, such as emergency plans, or operating procedures.

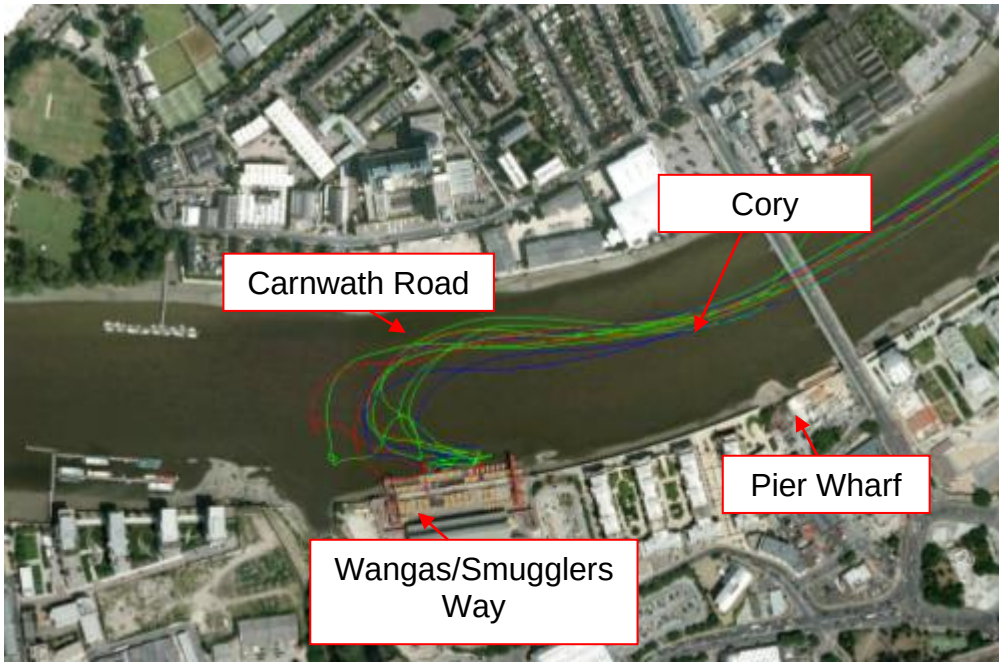
9.2 Interaction with existing freight operators

9.2.1 The Carnwath Road Riverside site includes three wharves, known as Whiffin Wharf, Trinidad Wharf and Hurlingham Wharf.

9.2.2 The Smugglers Way waste transfer facility, a facility serviced by a daily (Mon - Fri) tug and barge operation is located direct opposite the site.

9.2.3 GPS Marine Ltd currently delivers aggregates (typically 750 tonnes) three to four times a week to Pier Wharf, which is opposite the site, a short distance downstream.

Figure 9.1 Cory movements at Carnwath Road



9.2.4 The project proposes to use barges to transport the majority of excavated material away from the site during main tunnel shaft construction and tunnelling activities. In addition, aggregates would be transported by barge to the site during secondary lining of the main tunnel.

9.2.5 The interaction of the project's barges and river-based construction activities with existing river users has been identified as presenting a potential navigational hazard.

Actions required

9.2.6 A number of actions, specific to the issues, 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. conduct analysis of Cory freight movements operating to and from Smugglers Way(AIS data)

b. identify typical river traffic that uses this section of the river and its frequency

c. analyse other passenger and freight vessel movements through this section of the river.

Mitigation of issues: Design

9.2.7 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. no permanent in river structures are required at this site

b. a potential jetty would be located between 40 and 33m from the authorised channel on either end of the structure. With a barge moored, this would reduce to 27 and 20m.

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

Mitigation of issues: Physical

a. Assessment and understanding of operating procedures to ensure minimum disruption/interaction with existing users.

Mitigation of issues: River operations

b. scheduling of barge movements and passage planning and publication of planned operations

c. appoint Berthing Co-ordination Manager who would liaise and be in communication with all operators in the local area and be on hand to deal with potential areas of concern or conflict

d. issue Notice to Mariners informing operators & river users of planned operations in area, highlighting times when project barges are likely to be servicing the site

e. regular communication with Cory and GPS Marine to inform of them project operations and planned work.

9.3 Impact on existing recreational river users

9.3.1 There are a number of leisure and recreational clubs/moorings close by including:

a. Hurlingham Yacht Club have a jetty and mooring facilities approximately 220m from the western boundary of the proposed site.

b. Wandsworth Riverside Quarter Pier is located on the south bank of the river approximately 300m from the western boundary.

c. There are numerous small craft moorings upriver of the site.

9.3.2 The project is proposing to use barges to transport excavated material away from the site during main tunnel shaft construction and tunnelling activities, and to bring in sand and aggregates for secondary lining by river.

9.3.3 A potential jetty would be located between 40 and 33m from the authorised channel on either end of the structure. With a barge moored, this would reduce to 27 and 20m.

9.3.4 The interaction of the project's barges and construction activities with existing recreational river users has been identified as presenting a potential navigational hazard.

Actions required

9.3.5 A number of actions, specific to the issues, 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. analysis of passenger and recreational vessel movements through this section of the river

b. investigate the possibility of ground moorings to provide additional level of mooring security for project barges.

Mitigation of issues: Design

9.3.6 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. no permanent in river structures are required at this site

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

Mitigation of issues: Physical

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

b. provide additional ground moorings to provide additional level of mooring security.

Mitigation of issues: River operations

c. scheduling of barge movements and passage planning and publication of planned operations.

d. appoint Berthing Co-ordinator who would liaise and be in communication with all operators in the local area and be on hand to deal with potential areas of concern or conflict

e. issue Notice to Mariners informing operators & river users of planned operations in area, highlighting times when project barges are likely to be servicing the site

f. regular communication with local stakeholders and clubs to inform them of project operations and planned work.

9.4 Intrusion of jetty into river

9.4.1 The application for development consent includes a temporary jetty to service the construction site. The location of the jetty is shown on the Construction phasing plans listed in Appendix A. The jetty is between approximately 40 and 33m from the authorised channel. The proximity of project operations to the authorised channel would reduce to 27 and 20m with barges moored alongside the jetty.

9.4.2 The proximity to the authorised channel at this location has been identified as presenting a navigational hazard to existing river users.

Actions required

9.4.3 A number of actions, specific to the issues, 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. review current Cory barge operations and proximity of their barges to the proposed jetty

b. observe and record Cory barge tracks

c. consult with Cory to understand their operations and areas of concern

d. analyse tidal operating window and provide diagrams and images to show when the project vessels are likely to interact with other freight traffic in the area

e. Analyse AIS, CCTV and photographic data of existing operations at the site.

Mitigation of issues: Design

9.4.4 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 jetty is between 40 and 33m from the authorised channel, and a moored barge would be approximately 27 and 20m from the authorised channel

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

Mitigation of issues: Physical

a. Assessment and understanding of operating procedures to ensure minimum disruption/interaction with existing users.

Mitigation of issues: River operations

b. Scheduling of barge movements and passage planning to minimise conflict

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

This page is intentionally left blank

10 General navigational hazards

10.1.1 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.

10.1.2 ‘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’.

10.1.3 Full hazard details are contained in Annex is A - I.

10.2 Project phases B and C: Most likely

Table 10.1 Most likely risk scores

			Score			
Hazard Id	Hazard title	Hazard description	People	Environment	Operational	Media
1A	Interaction with Cory Environmental Ltd operations	It is acknowledged that project and Cory barges would be operating in the area in close proximity and at the same time. Any delays to Cory's operations are likely to have a negative impact on their ability to operate this service. Due to the proximity of the potential project jetty to Cory operations, a river incident occurs.	6	6	9	6
2A	Mooring breakout	A vessel involved in construction activities breaks free from temporary/layup moorings.	2	2	2	2
3A	Collision - commercial freight operator (delivery)	A vessel conducting project delivery activities collides with a commercial freight operator in the vicinity of Carnwath Road.	9	6	9	6
4A	Collision - high speed passenger vessel (delivery)	A vessel conducting project delivery activities collides with a High Speed Passenger Vessel in the vicinity of Carnwath Road.	6	2	6	4

Hazard Id	Hazard title	Hazard description	Score			
			People	Environment	Operational	Media
5A	Collision - Class V Passenger vessel (delivery)	A vessel conducting project delivery activities collides with a Class V passenger vessel in the vicinity of Carnwath Road.	9	3	9	6
6A	Collision - private leisure vessel (delivery)	A vessel conducting project delivery activities collides with a private leisure vessel in the vicinity of Carnwath Road.	9	3	9	6
7A	Collision - commercial freight operator (material removal)	A vessel conducting project material removal activities collides with a commercial freight operator in the vicinity of Carnwath Road.	9	6	9	6
8A	Collision - Class V passenger vessel (material removal)	A vessel conducting project material removal activities collides with a Class V passenger vessel in the vicinity of Carnwath Road.	6	4	6	6
9A	Collision - high speed passenger vessel (material removal)	A vessel conducting project material removal activities collides with a high speed passenger vessel in the vicinity of Carnwath Road.	6	4	6	6
10A	Collision - private leisure passenger vessel (material removal)	A vessel conducting project material removal activities collides with a private leisure vessel in the vicinity of Carnwath Road.	9	6	9	9

10.3 Project phases B and C: Worst credible

Table 10.2 Worst credible risk scores

Hazard Id	Hazard title	Hazard description	Score			
			People	Environment	Operational	Media
1B	Interaction with Cory Environmental	It is acknowledged that project and Cory barges would be operating in the area in close	8	4	8	6

			Score			
Hazard Id	Hazard title	Hazard description	People	Environment	Operational	Media
	Ltd operations	proximity and at the same time. Any delays to Cory's operations are likely to have a negative impact on their ability to operate this service. Due to the proximity of the Thames Tunnel jetty to Cory operations, a river incident occurs.				
2B	Mooring breakout	A vessel involved in construction activities breaks free from temporary/layup moorings.	3	2	3	2
3B	Collision - commercial freight operator (delivery)	A vessel conducting project delivery activities collides with a commercial freight operator in the vicinity of Carnwath Road.	8	6	8	6
4B	Collision - high speed passenger vessel (delivery)	A vessel conducting project delivery activities collides with a High Speed Passenger Vessel in the vicinity of Carnwath Road.	4	2	4	4
5B	Collision - Class V Passenger vessel (delivery)	A vessel conducting project delivery activities collides with a Class V passenger vessel in the vicinity of Carnwath Road.	4	2	4	4
6B	Collision - private leisure vessel (delivery)	A vessel conducting project delivery activities collides with a private leisure vessel in the vicinity of Carnwath Road.	10	2	10	8
7	Collision - commercial freight operator (material removal)	A vessel conducting project material removal activities collides with a commercial freight operator in the vicinity of Carnwath Road.	8	6	8	6
8	Collision - Class V passenger vessel	A vessel conducting project material removal activities collides with a Class V passenger vessel in the vicinity of Carnwath Road.	4	2	4	4

Hazard Id	Hazard title	Hazard description	Score			
			People	Environment	Operational	Media
	(material removal)					
9	Collision - high speed passenger vessel (material removal)	A vessel conducting project material removal activities collides with a high speed passenger vessel in the vicinity of Carnwath Road.	4	2	4	4
10	Collision - private leisure passenger vessel (material removal)	A vessel conducting project material removal activities collides with a private leisure vessel in the vicinity of Carnwath Road.	10	2	10	8

11 Mitigation measures

11.1 Existing mitigation

11.1.1 Existing safeguards (measures that manage the risk) in the form of control measures and relevant PLA guidance, are set out in Table 11.1 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 11.1 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
• Code of practice for Craft Towage Operations 2011	• Code of Safe Working Practices for Merchant Seamen(MCA)
• IMSBC Code	

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

11.2 Proposed mitigation

11.2.1 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.

11.3 Design

11.3.1 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 jetty is between 40 and 33m on either end of the jetty from the authorised channel, and a moored barge would be reduce this to approximately 27 and 30m respectively from the authorised channel

b. There are no permanent works in the river

11.3.2 The Carnwath Road Riverside site was a working wharf until the 1990s and apart from the obvious increase in traffic volumes caused there is not considered to be any significant additional navigational risk.

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

11.4 Physical

a. Assessment and understanding of operating procedures to ensure minimum disruption/interaction with existing stakeholders.

b. hold meetings with stakeholders to get their views and input into issues and working relationships.

c. provide ground moorings to provide additional level of mooring security.

11.5 Operational

a. scheduling of barge movements and passage planning and publication of planned operations

b. appoint Berthing Co-ordination Manager to liaise and be in communication with all operators in the local area and be on hand to deal with potential areas of concern or conflict

c. promulgation of daily, weekly and where possible, monthly tug schedules to stakeholders and Middle and Upper Harbour Masters by the project's Berthing co-ordinator

a. Notices to Mariners informing operators and river users of planned operations in area, highlighting times when project barges are likely to be servicing the site.

b. regular communication with Cory and GPS marine to inform of them project operations and planned work.

Table 11.2 Mitigation measures 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 onsite 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
Make use of "can test" to quantify the level of moisture in excavation material cargoes.				New Tide Gauges / Markers
Towing C of P				

This page is intentionally left blank

12 Conclusion

12.1 Assessment

12.1.1 This *Navigation Issues and Preliminary Risk Assessment* assessed the potential impact of the proposed works at Carnwath Road Riverside on existing users.

12.1.2 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.

12.1.3 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.

12.2 Stakeholder engagement

12.2.1 A number of issues were identified throughout the risk assessment process, including:

a. interaction with existing freight traffic

b. impact on existing recreational river users.

c. intrusion of a potential jetty

12.3 Risk analysis

12.3.1 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.

12.3.2 Annexes A and B provide full details of the hazards identified and their overall scores. The analysis is summarised below in Table 12.1 and Table 12.2:

Table 12.1 Hazard overview: Most Likely

Most Likely	Phase B&C
Extreme: Intolerable risk. Job is not authorised	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
Moderate: Efforts should be made to reduce risk to ALARP level. Job can be performed under direct supervision of Senior Officer.	30
Minor: No additional controls are required, monitoring is required to ensure no changes in circumstances.	5
Slight: No action is required.	5

Table 12.2 Hazard overview: Worst Credible

Worst Credible	Phase B&C
Extreme: Intolerable risk. Job is not authorised	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.	4
Moderate: Efforts should be made to reduce risk to ALARP level. Job can be performed under direct supervision of Senior Officer.	13
Minor: No additional controls are required, monitoring is required to ensure no changes in circumstances.	15
Slight: No action is required.	8

12.3.3 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.

12.3.4 For ‘Worst Credible’ scenarios, the majority of hazards fell within the ‘minor risk’ category with a low number falling in the ‘high risk’ category.

12.4 Overall

12.4.1 The Wandsworth Reach has, in the past, managed high densities of both freight and passenger craft whilst coping with leisure and recreational vessels at peak times. In recent years, commercial freight volumes have

declined, along with the passenger boat trade. However, there has been a marked increase in private leisure traffic combined with the establishment of several houseboat communities in the area.

12.4.2 The proposed project works at Carnwath Road Riverside would introduce additional freight movements.

12.4.3 The navigational issues were summarised as follows:

a. interaction with existing freight river users, notably Cory Environmental Ltd who operate from the opposite site of the river

b. impact on existing recreational river users, of which the local rowing community may be the most affected

c. intrusion of a potential jetty by approximately 40 and 33m at either end of the jetty from the authorised channel, reducing to 27 and 20m respectively with a barge moored alongside the facility.

12.4.4 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.

This page is intentionally left blank

13 Recommendations

13.1.1 The project recommends implementing the mitigations set out in Section 9. Additionally, the following should be given consideration.

13.1.2 **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.

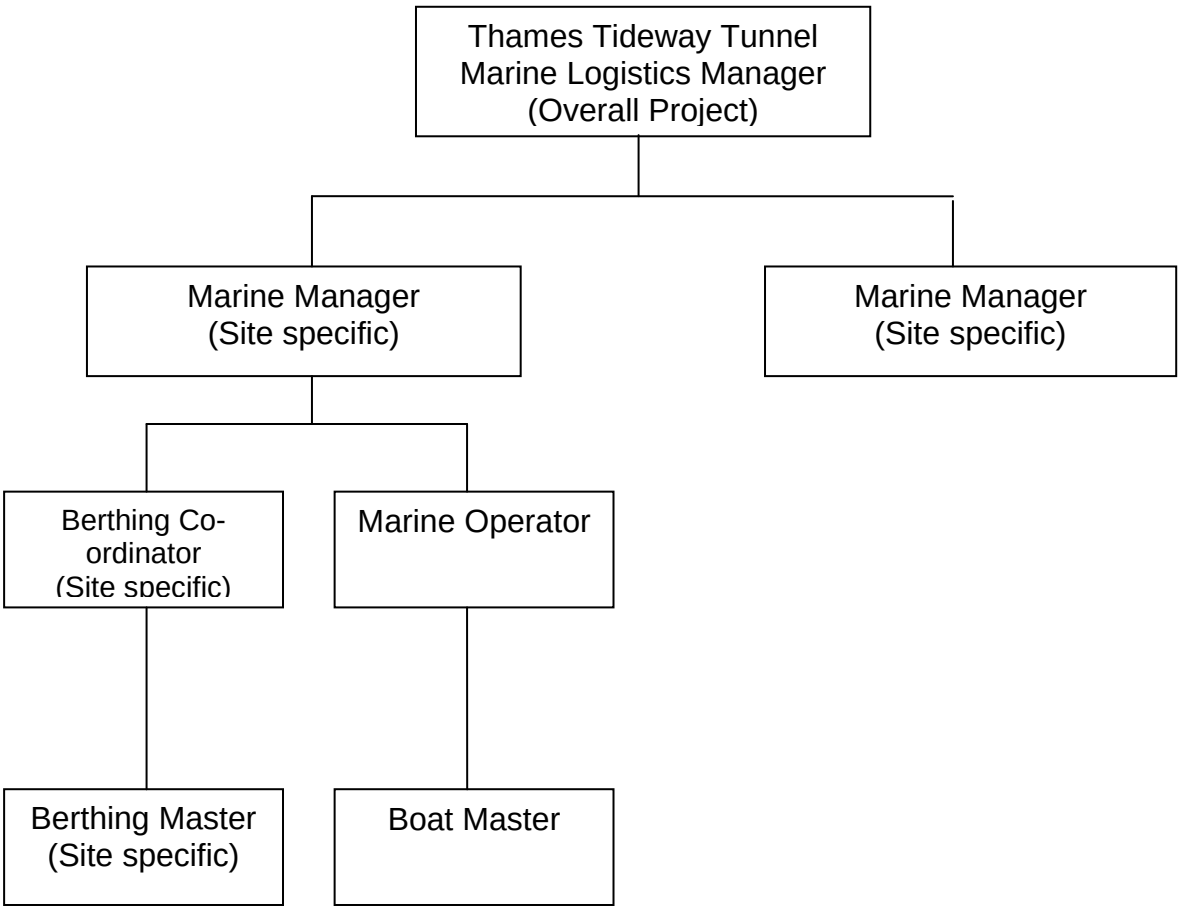
13.1.3 The project recommends considering the designated Berthing Co-ordinator's authority and responsibilities. One responsibility of the Berth Co-ordinator would be to liaise regularly with the PLA and local stakeholders. Clear lines of delegation and responsibilities would need to be established prior to commencing project works to ensure that potential conflict of interest issues would be managed and to prevent confusion to mariners and authorities regarding various traffic control systems.

13.1.4 Overall safety on the river is the PLA's responsibility: the Thames Barrier Navigation Centre assists the PLA by managing and directing traffic from Crayfordness to Teddington Lock.

13.1.5 The Berthing Co-ordinator would need to liaise with the rowing community, particularly the schools i.e. Dulwich College, Westminster, Emmanuel, etc who use the river at all states of tide Monday to Friday.

13.1.6 Scheduling of barge movements to assist with existing river events: Consultation between the PLA, the project and marine sub-contractor is recommended in order to identify specific events that are likely to see an increase in river traffic, require additional consideration or introduce extra navigational safety requirements. This consultation would allow the marine sub-contractor to schedule barge movements in a manner as to reduce the impact of Thames Tideway Tunnel activities on these events.

Figure 13.1 Potential marine logistics hierarchy



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

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

This page is intentionally left blank

Appendices

List of appendices in order

Appendix A: Project Drawings

Appendix B: Freight tracks and AIS analysis

This page is intentionally left blank

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Navigational Issues and Preliminary Risk Assessment

Doc Ref: **7.20.05**

Carnwath Road Riverside

Appendix A

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

Hard copy available in

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

Thames Tideway Tunnel

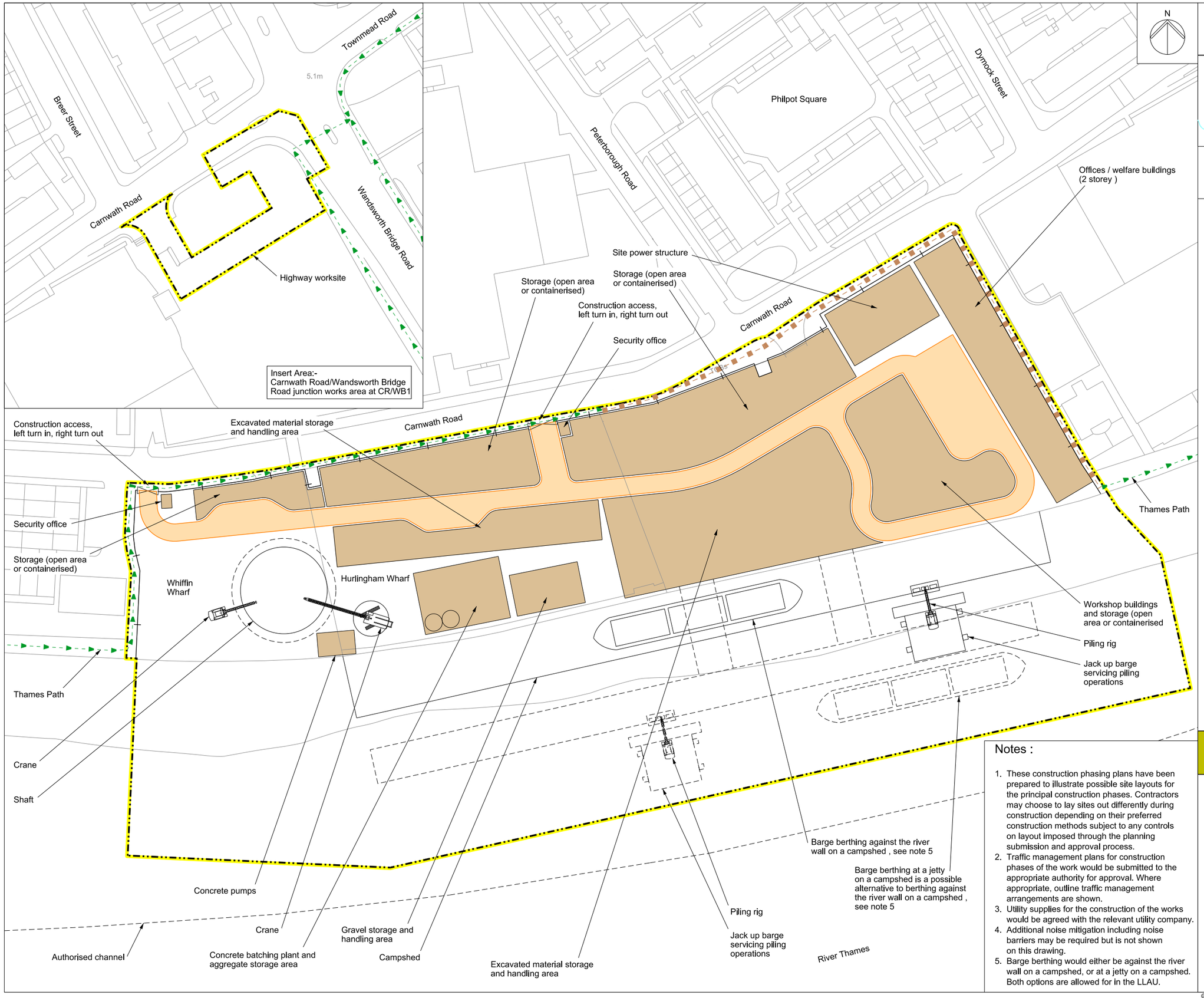
Creating a cleaner, healthier River Thames

This page is intentionally blank

Appendix A: Project drawings

Drawing title	Phase
Construction phases - Site setup and shaft construction	Phase A
Construction phases - Tunnelling	Phase B
Construction phases - Secondary lining	Phase C
Construction phases - Site demobilisation	Phase D
Permanent works layout	
River foreshore zones of working	

This page is intentionally blank



Mapping reproduced by permission of Ordnance Survey on behalf of HMSO. © Crown Copyright and Database right 2012. All rights reserved. Ordance Survey licence number 100019345

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
- Route of temporary diversion of right of way
- Site access
- Access / haul route

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 principal 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. Barge berthing would either be against the river wall on a campshed, or at a jetty on a campshed. Both options are allowed for in the LLAU.

ILLUSTRATIVE

Location

Carnwath Road RIverside
London Borough of Hammersmith & Fulham

Document Information

Application for Development Consent

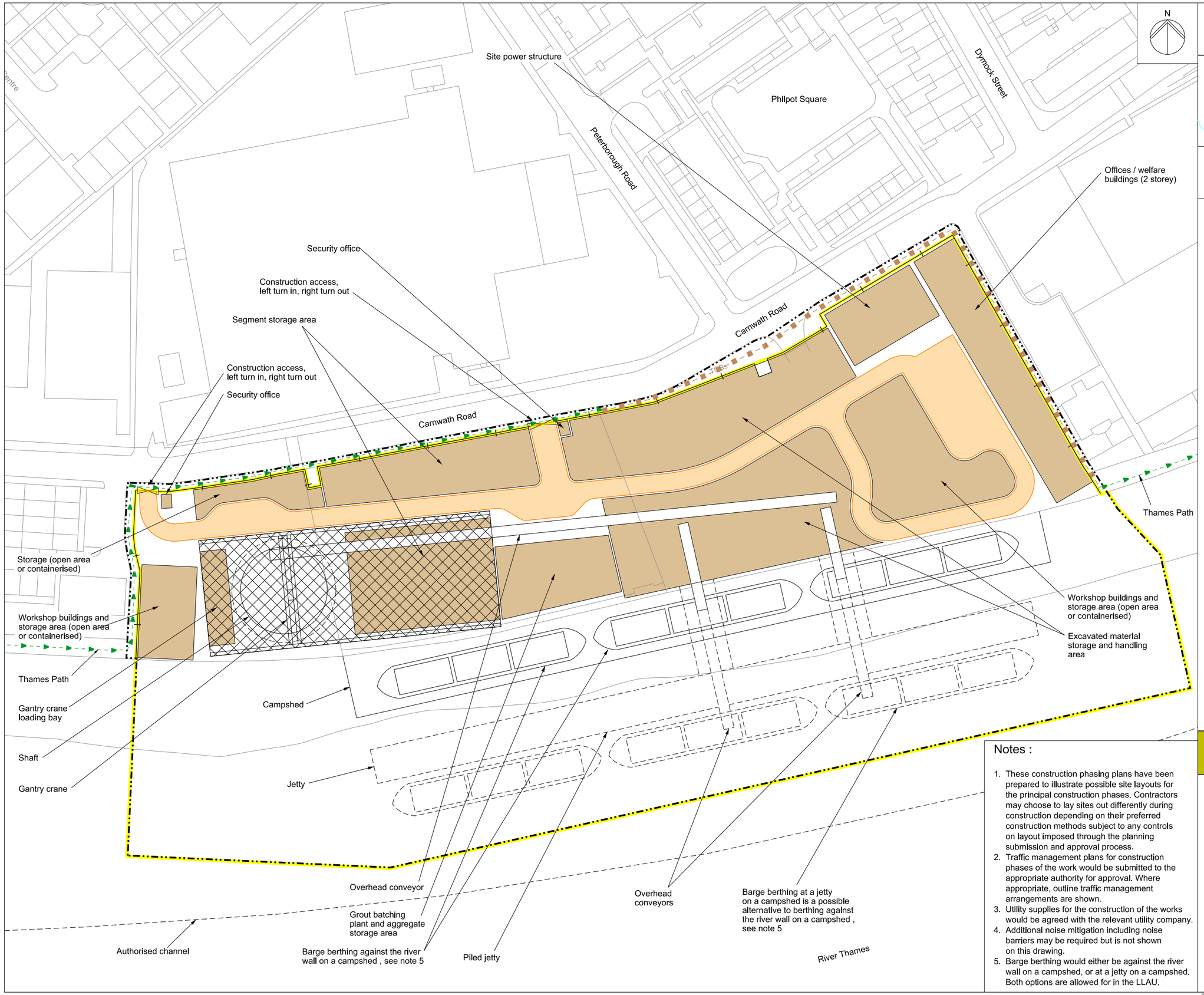
Construction phases - phase 1
Site setup & shaft construction
Book of plans - section 9

DCO-PP-06X-CARRR-090014
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

Thames Water

© Thames Water Utilities Ltd 2008



Mapping reproduced by permission of Ordnance Survey on behalf of HMSO. © Crown Copyright and Database right 2012. All rights reserved. Ordance Survey licence number 100019345

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 Ordance Datum Newlyn.

Key:

- Limits of land to be acquired or used (LLAU)
- Hoarding
- Maximum extent of working area
- Existing public right of way
- Route of temporary diversion of right of way
- Site access
- Access / haul route
- 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 principal 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. Barge berthing would either be against the river wall on a campshed, or at a jetty on a campshed. Both options are allowed for in the LLAU.

ILLUSTRATIVE

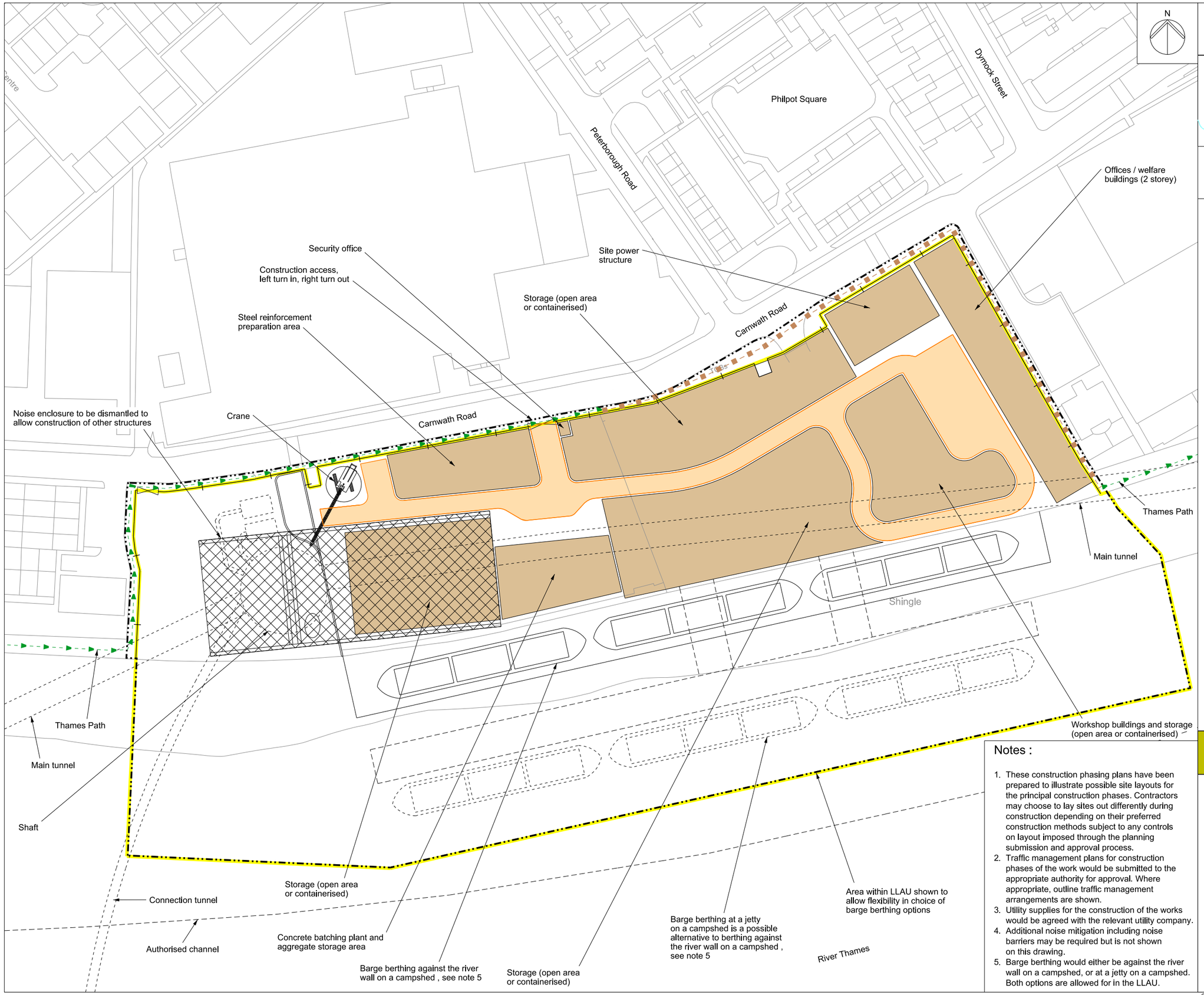
Location
Carnwath Road Riverside
London Borough of Hammersmith & Fulham

Document Information
Application for Development Consent
Construction phases - phase 2
Tunnelling
Book of plans - section 9
DCO-PP-06X-CARRR-090015
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

Thames Water

© Thames Water Utilities Ltd 2008



Mapping reproduced by permission of Ordnance Survey on behalf of HMSO. © Crown Copyright and Database right 2012. All rights reserved. Ordance Survey licence number 100019345

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
- Route of temporary diversion of right of way
- Site access
- Access / haul route
- 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 principal 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. Barge berthing would either be against the river wall on a campshed, or at a jetty on a campshed. Both options are allowed for in the LLAU.

ILLUSTRATIVE

Location
Carnwath Road RIverside
London Borough of Hammersmith & Fulham

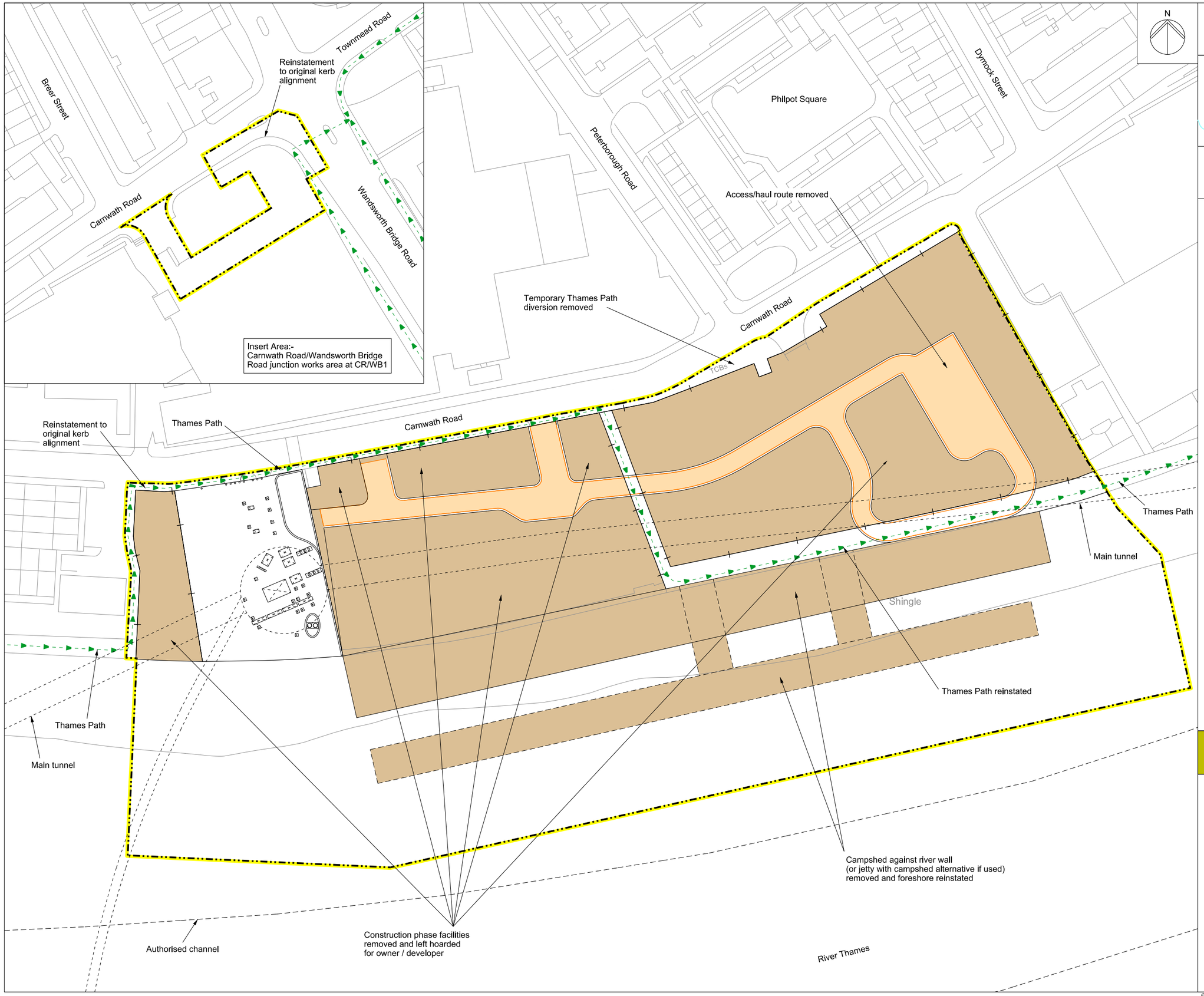
Document Information
Application for Development Consent
Construction phases - phase 3
Secondary lining & other structures
Book of plans - section 9

DCO-PP-06X-CARRR-090016
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

Thames Water

© Thames Water Utilities Ltd 2008



Mapping reproduced by permission of Ordnance Survey on behalf of HMSO. © Crown Copyright and Database right 2012. All rights reserved. Ordance Survey licence number 100019345

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 Ordance Datum Newlyn.

Key:

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

10m 0 40m

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

ILLUSTRATIVE

Location

Carnwath Road Riverside
London Borough of Hammersmith & Fulham

Document Information

Application for Development Consent

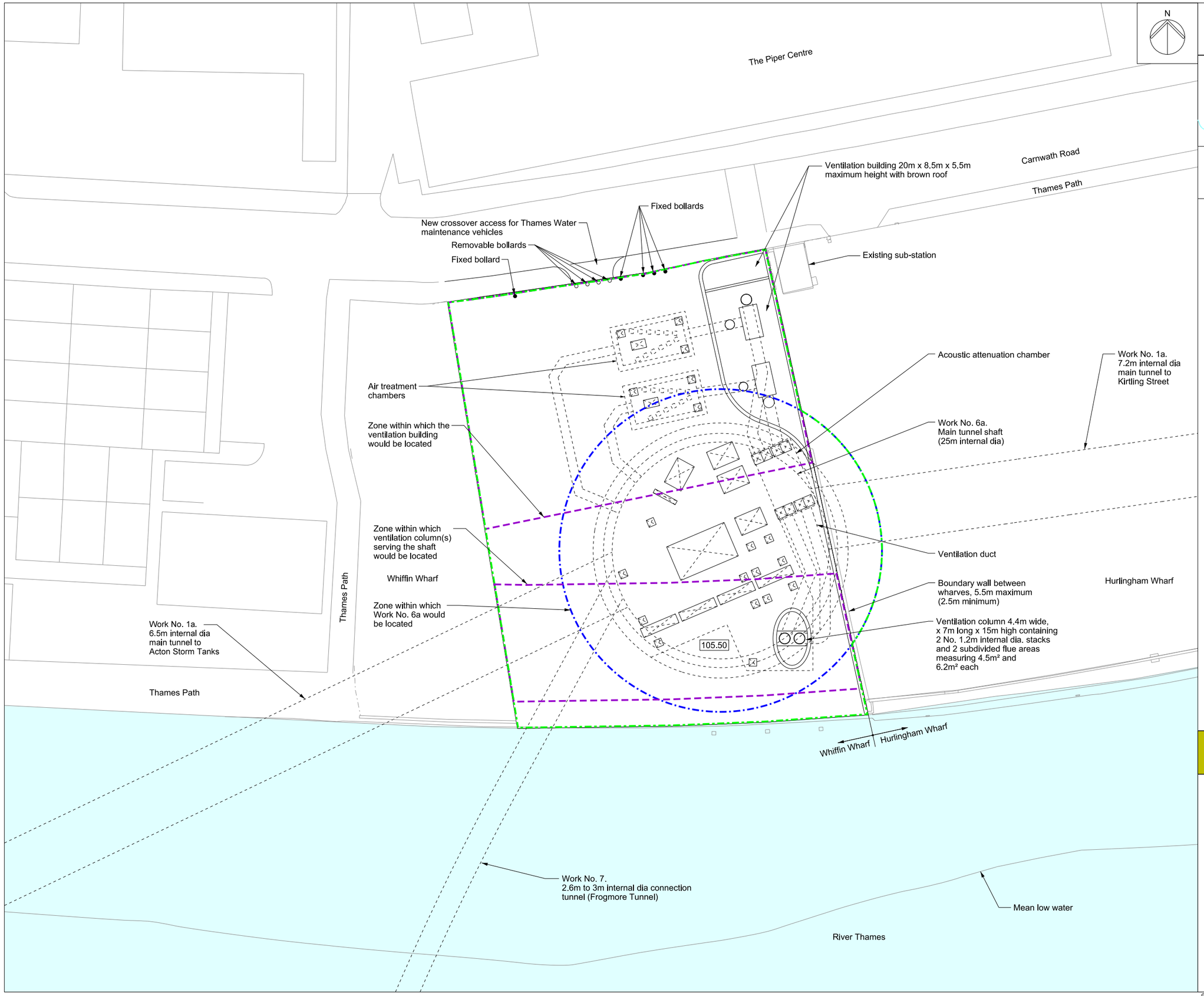
Construction phases - phase 4
Site demobilisation
Book of plans - section 9

DCO-PP-06X-CARRR-090017
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

Thames Water

© Thames Water Utilities Ltd 2008



Mapping reproduced by permission of Ordnance Survey on behalf of HMSO. © Crown Copyright and Database right 2012. All rights reserved. Ordnance Survey licence number 100019345

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)
- Proposed access cover
- 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

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.

10m 0 10m

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

ILLUSTRATIVE

Location

Carnwath Road Riverside
London Borough of Hammersmith & Fulham

Document Information

Application for Development Consent

Permanent works layout

Book of plans - section 9

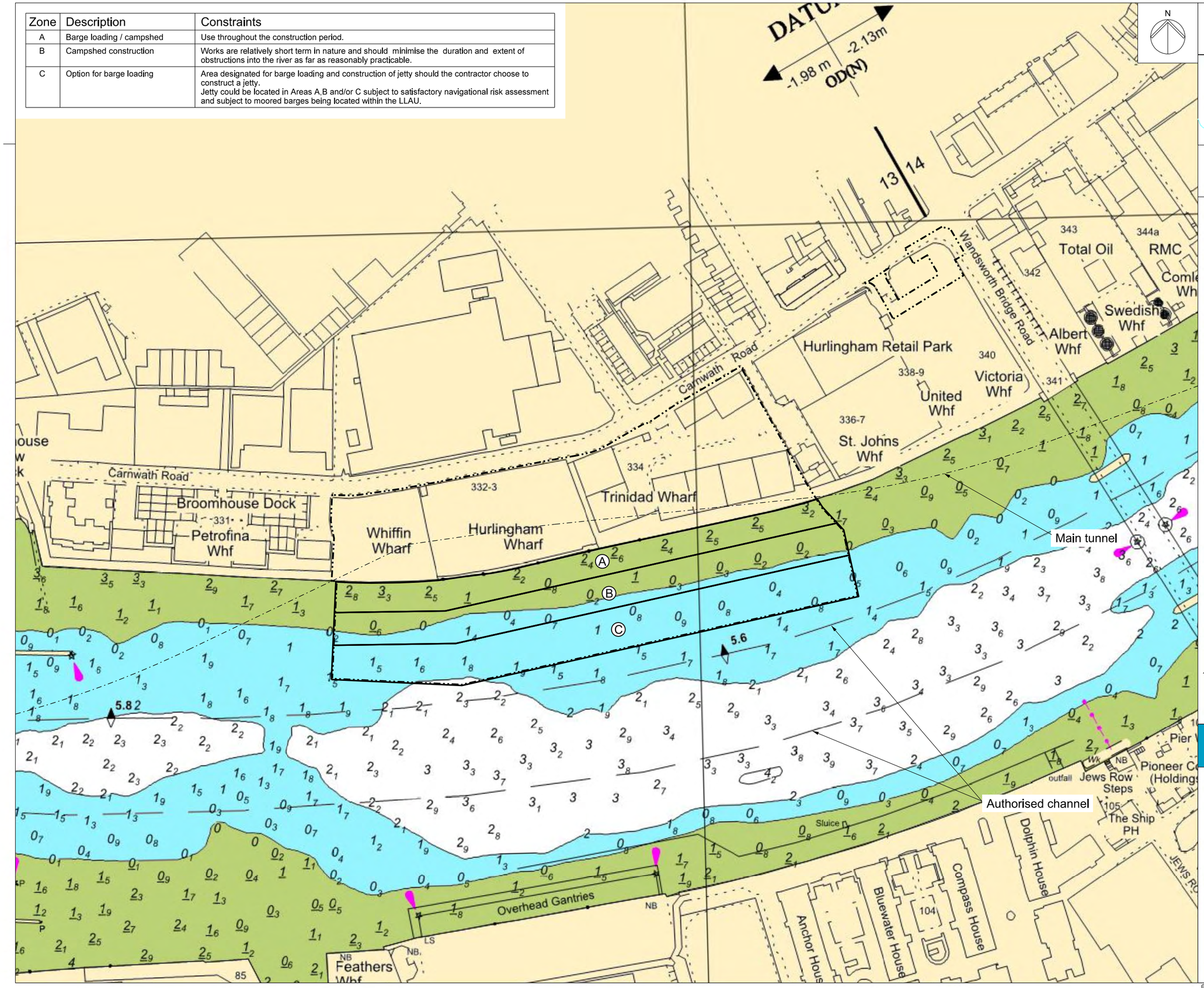
DCO-PP-06X-CARRR-090007
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

Thames Water

© Thames Water Utilities Ltd 2008

Zone	Description	Constraints
A	Barge loading / campshed	Use throughout the construction period.
B	Campshed construction	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	Option for barge loading	Area designated for barge loading and construction of jetty should the contractor choose to construct a jetty. Jetty could be located in Areas A,B and/or C subject to satisfactory navigational risk assessment and subject to moored barges being located within the LLAU.



Mapping reproduced by permission of Ordnance Survey on behalf of HMSO. © Crown Copyright and Database right 2012. All rights reserved. Ordance Survey licence number 100019345

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 - Wandsworth Reach to Battersea Reach

   Port of London Authority Hydrographic Service

   H.O. Ref. No....113-313-026....Date....22/12/2010

10m 0 100m

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

FOR INFORMATION

Location
Carnwath Road RIverside
London Borough of Hammersmith & Fulham

Document Information
Application for Development Consent
River foreshore zones of working

DCO-PP-06X-CARRR-090019
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

Thames Water

© Thames Water Utilities Ltd 2008

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Navigational Issues and Preliminary Risk Assessment

Doc Ref: **7.20.05**

Carnwath Road Riverside

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

This page is intentionally blank

Appendix B: Freight tracks and AIS analysis

B.1 Introduction

B.1.1 The proposed Carnwath Road Riverside site is located in Wandsworth Reach on the north bank of the river and comprises of Whiffin, Hurlingham and Trinidad Wharves respectively. There are several commercial and leisure stakeholders that operate within and transit the area.

B.1.2 The proposed site would be entirely on land and would require no permanent in-river structures, the limits of land to be acquired or used (LLAU) would however include a certain amount of water space for the mooring of barges which would used in delivery of materials and removal of spoil.

B.1.3 It is proposed that the site at Carnwath Road Riverside would be used as a main tunnel drive site. The project are proposing to drive the main tunnel towards Acton Storm Tanks and receive the main tunnel from Kirtling Street.

B.1.4 A review of AIS track information of inbound freight movements passing through this section of the river was undertaken. 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 The Carnwath Road Riverside site is directly opposite the Smugglers Way Western Riverside Waste Transfer Station. The facility is serviced by Cory Environmental Ltd tug and barges.

B.2.2 GPS Marine Ltd delivers aggregates and materials to Pier Wharf, down river from the site, a number of times a week.

B.2.3 Passenger vessel movements in this area are relatively light compared to those of the central pool area.

B.2.4 The AIS track data used for this analysis shows Cory Environmental Ltd tug and tows completing a turn on to Smugglers Way. The river is relatively wide in this location and there is sufficient capacity for Cory to turn un-restricted on to Smugglers Way.

B.2.5 The tracks (Figure B.2) show that tugs and tows occupy the north side of the river although it should be noted that the turn is currently unconstrained and that a tighter turn, away from Carnwath Road Riverside is achievable.

Site Layout

B.2.6 The proposed LLAU for the site would extend approximately 60 metres into the river and would not impact on the navigation channel. The sites eastern border would start 125m upstream from Wandsworth Bridge and would continue approximately 300m to the west, towards Hurlingham Yacht Club.

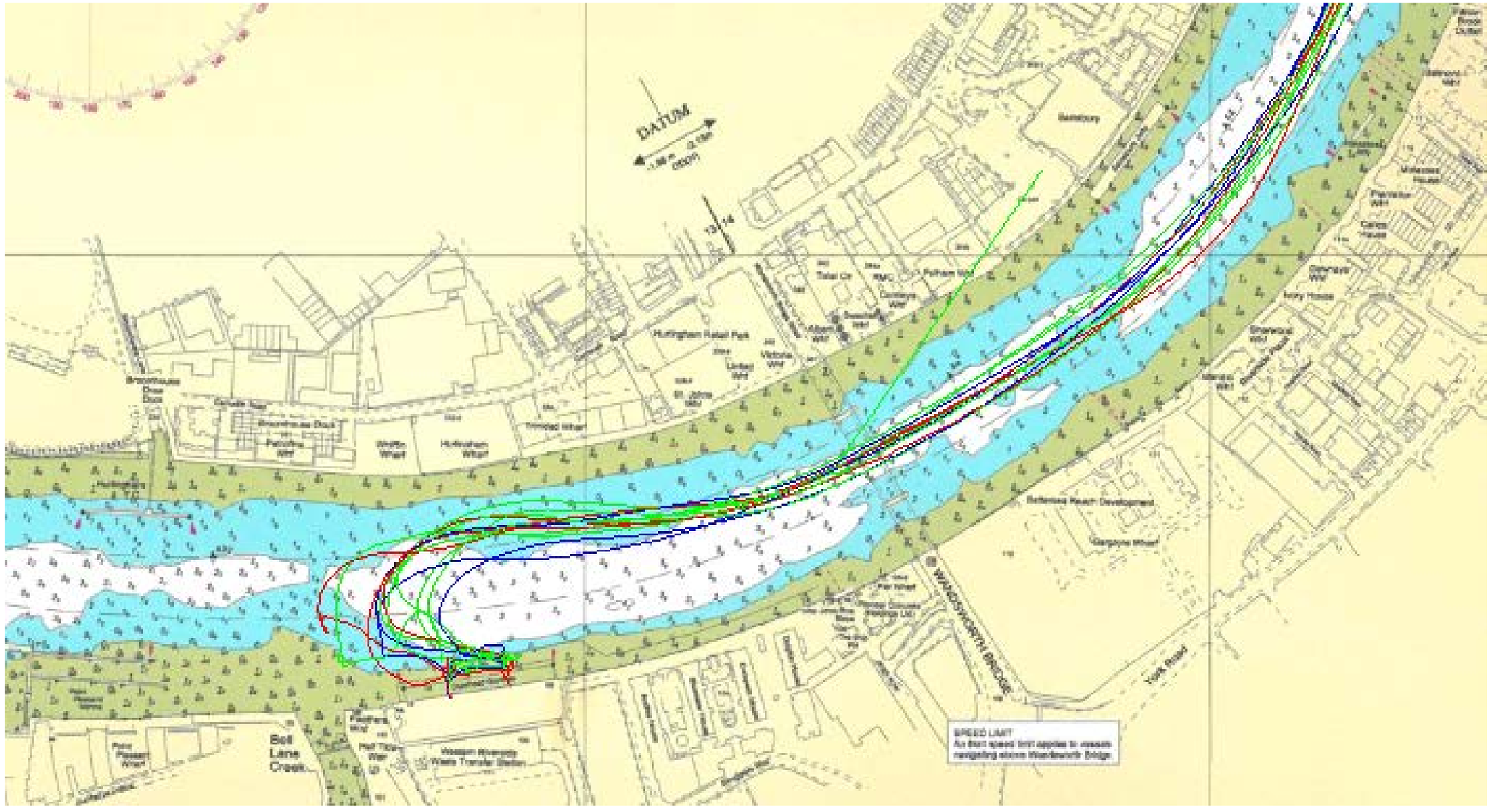
B.2.7 The image in Figure B.1 indicates the extent of the portion of the LLAU which is on land.

Figure B.1 Land portion of the limits of land to be acquired or Used - Carnwath Road Riverside

Cory Tug & Tow Upstream GPS tracks

B.2.8 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.2 is a GIS output of all tracks overlaid over a chart of the Carnwath Road Riverside area.

Figure B.2 All AIS Tracks



This page is intentionally left blank

Track analysis

B.2.9 By individually investigating each of the tracks supplied it waspossible to assess the potential impact that project operations in this area may have on existing freight services.

B.2.10 For each track supplied, an image was created displaying a wide ‘bar’ type line. This line represents the path taken by the tug and tow, with the width being representative of the width a tug towing two barges (side by side). However due to Carnwath Road Riverside’s position in the river only 11 tracks show barge movements in this area. These 11 (highlighted yellow in Table B.1 below) represent a good cross section of possible routes taken by Cory Environmental.

Cory GPS summary

B.2.11 Table B.1 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. Time entering chart area – approximate time at which the tug entered the displayed chart area

h. Wind Direction - Approximate Wind Direction

i. Wind Speed - Wind speed in m/s

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

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

l. Notes/Comments – any pertinent notes or comments on this specific track data

m. Path Figure – reference in this document for the image of the GPS tracks.

This page is intentionally blank

Table B.1 Cory GPS summary

Date	Colour	Tug	Head rank port	Head rank stb'd	Second rank	Time entering chart area	Wind direction	Wind Speed (m/s)	High tide at	Tidal height (m)	Notes / Comments	Path Figure
07/11/11	Red	Resource	Cringle	Cringle			NE	3	11:21	6.2	No data in this area	
07/11/11	Blue	Reclaim	Cringle	Cringle	Walbrook		NE	3	11:21	6.2	No data in this area	
07/11/11	Green	Recovery	Cringle	Wangas		08:30	NE	3	11:21	6.2	Data incomplete in this area	
08/11/11	Red	Reclaim	Cringle	Cringle	Cringle		SE	9	12:10	6.5	No data in this area	
08/11/11	Blue	Regain	Cringle	Cringle			SE	8	12:10	6.5	No data in this area	
08/11/11	Green	Resource	Cringle	Cringle	Wangas		SE	8	12:10	6.5	No data in this area	
09/11/11	Red	Resource	Cringle	Walbrook			SE	3	12:51	6.7	No data in this area	
09/11/11	Blue	Recovery	Cringle	Wangas	Wangas	11:03	SE	3	12:51	6.7		Figure B.3
09/11/11	Green	Redoubt	Cringle	Cringle	Wangas	11:03	SE	5	12:51	6.7		Figure B.4
10/11/11	Red	Resource	Cringle	Cringle	Wangas	11:32	E	3	13:27	6.8		Figure B.5
10/11/11	Blue	Regain	Cringle	Cringle	Wangas	11:30	E	4	13:27	6.8		Figure B.6
11/11/11	Red	Reclaim	Cringle	Cringle	Wangas		E	4	14:00	6.9	No data in this area	
11/11/11	Blue	Recovery	Walbrook	Cringle			SE	4	14:00	6.9	No data in this area	
11/11/11	Green	Resource	Cringle	Cringle	Wangas	12:15	SE	4	14:00	6.9		Figure B.7
14/11/11	Red	Resource	Wangas	Cringle			E	4	15:39	6.9	No data in this area	
14/11/11	Blue	Recovery	Walbrook	Cringle			E	4	15:39	6.9	No data in this area	
14/11/11	Green	Regain	Wangas	Cringle		13:46	E	4	15:39	6.9		Figure B.8
15/11/11	Green	Reclaim	Cringle	Cringle			NE	4	16:16	6.8	No data in this area	
16/11/11	Red	Redoubt	Walbrook	Cringle			SE	3	16:55	6.7	No data in this area	
16/11/11	Blue	Reclaim	Cringle	Cringle	Cringle		E	3	16:55	6.7	No data in this area	
16/11/11	Green	Recovery	Cringle	Wangas	Cringle		E	3	16:55	6.7	No data in this area	
17/11/11	Red	Redoubt	Cringle	Cringle	Cringle		SW	5	17:40	6.6	No data in this area	
17/11/11	Blue	Reclaim	Wangas	Wangas			SW	5	17:40	6.6	No data in this area	
18/11/11	Red	Regain	Cringle	Wangas	Cringle	16:59	S	5	18:33	6.4		Figure B.9
18/11/11	Blue	Recovery	Cringle	Cringle			S	4	18:33	6.4	No data in this area	
22/11/11	Red	Regain	Wangas	Wangas			E	2	10:34	6.5	No data in this area	
22/11/11	Blue	Recovery	Cringle	Cringle	Cringle		E	2	10:34	6.5	No data in this area	
22/11/11	Green	Reclaim	Cringle	Cringle		08:25	E	2	10:34	6.5		Figure B.10
23/11/11	Red	Reclaim	Wangas	Wangas		09:41	SW	2	11:35	6.8		Figure B.11
23/11/11	Blue	Redoubt	Cringle	Walbrook			SW	2	11:35	6.8	No data in this area	
23/11/11	Green	Regain	Transponder on tug				SW	2	11:35	6.8	No data in this area	
24/11/11	Red	Resource	Wangas	Wangas			SW	4	12:31	7.1	No data in this area	
24/11/11	Blue	Reclaim	Cringle	Cringle	Cringle		SW	4	12:31	7.1	No data in this area	
24/11/11	Green	Recovery	Cringle	Cringle	Cringle	10:24	SW	4	12:31	7.1		Figure B.12
25/11/11	Red	Resource	Walbrook	Cringle			W	10	13:22	7.2	No data in this area	
25/11/11	Blue	Recovery	Wangas	Wangas		12:07	W	10	13:22	7.2		Figure B.13
25/11/11	Green	Redoubt	Cringle	Cringle	Cringle		W	10	13:22	7.2	No data in this area	

Cory Individual Tracks

Figure B.3 09/11/2011 - Blue Track image

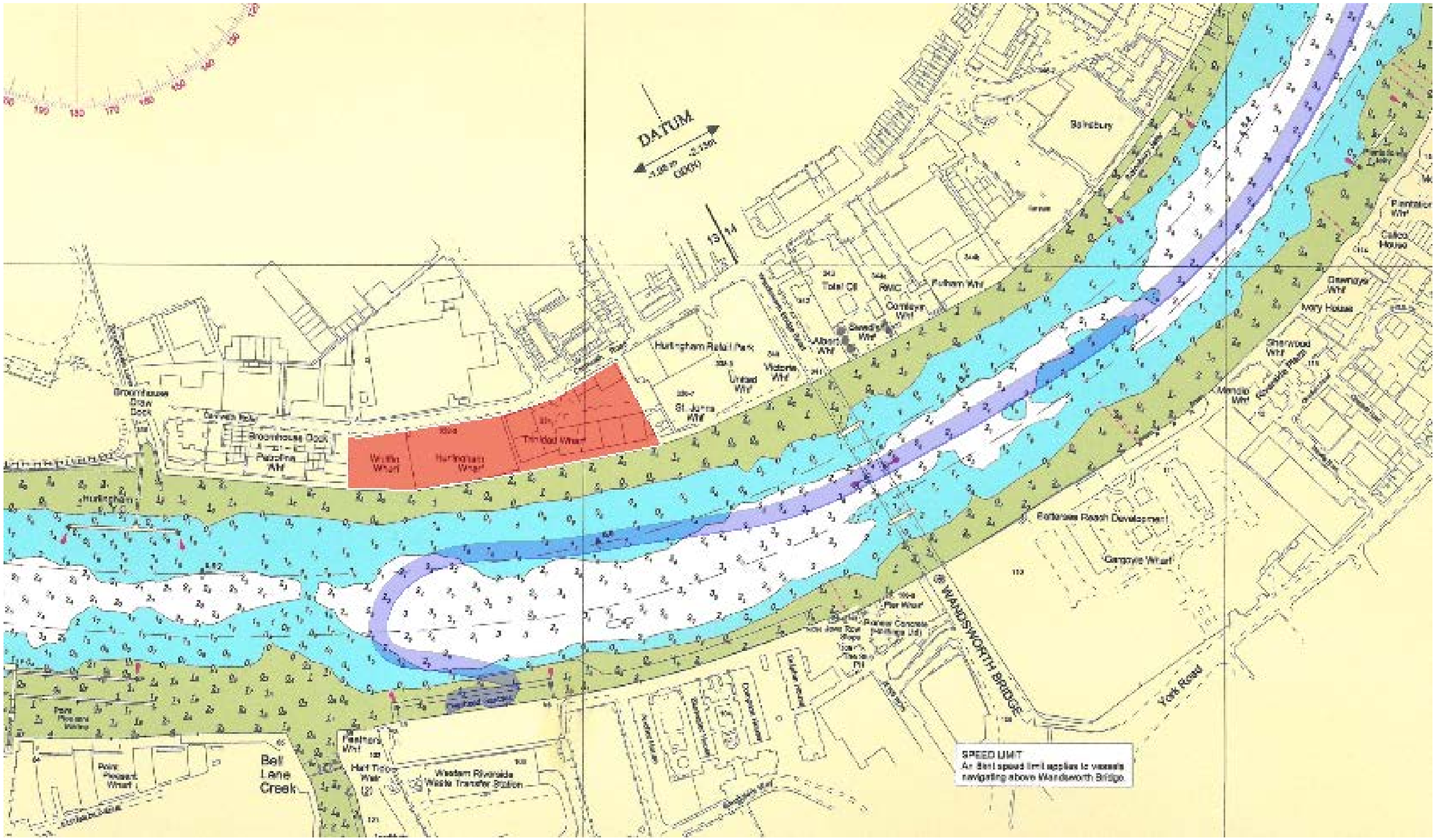


Figure B.4 09/11/2011 - Green Track image

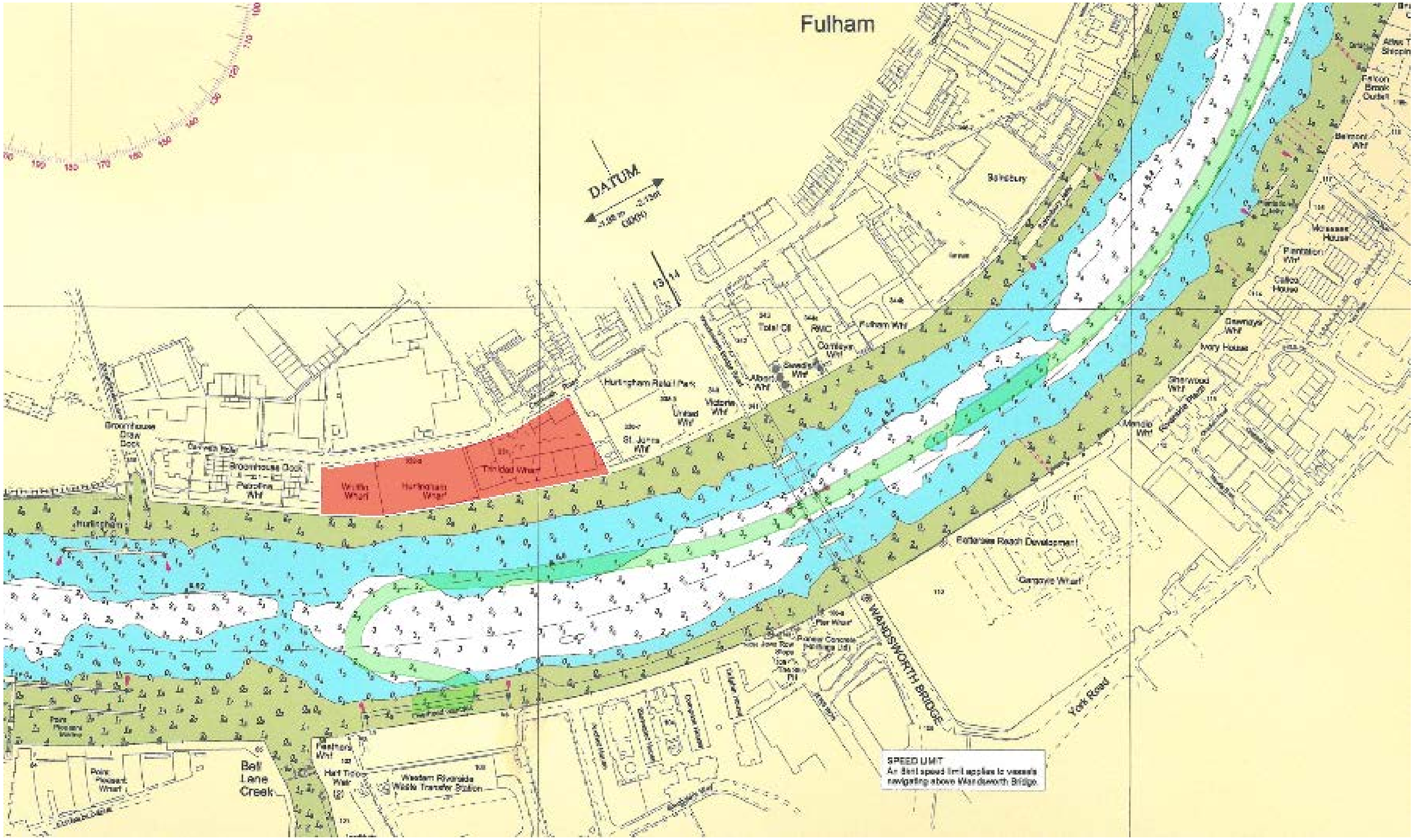


Figure B.5 10/11/2011 - Blue Track image

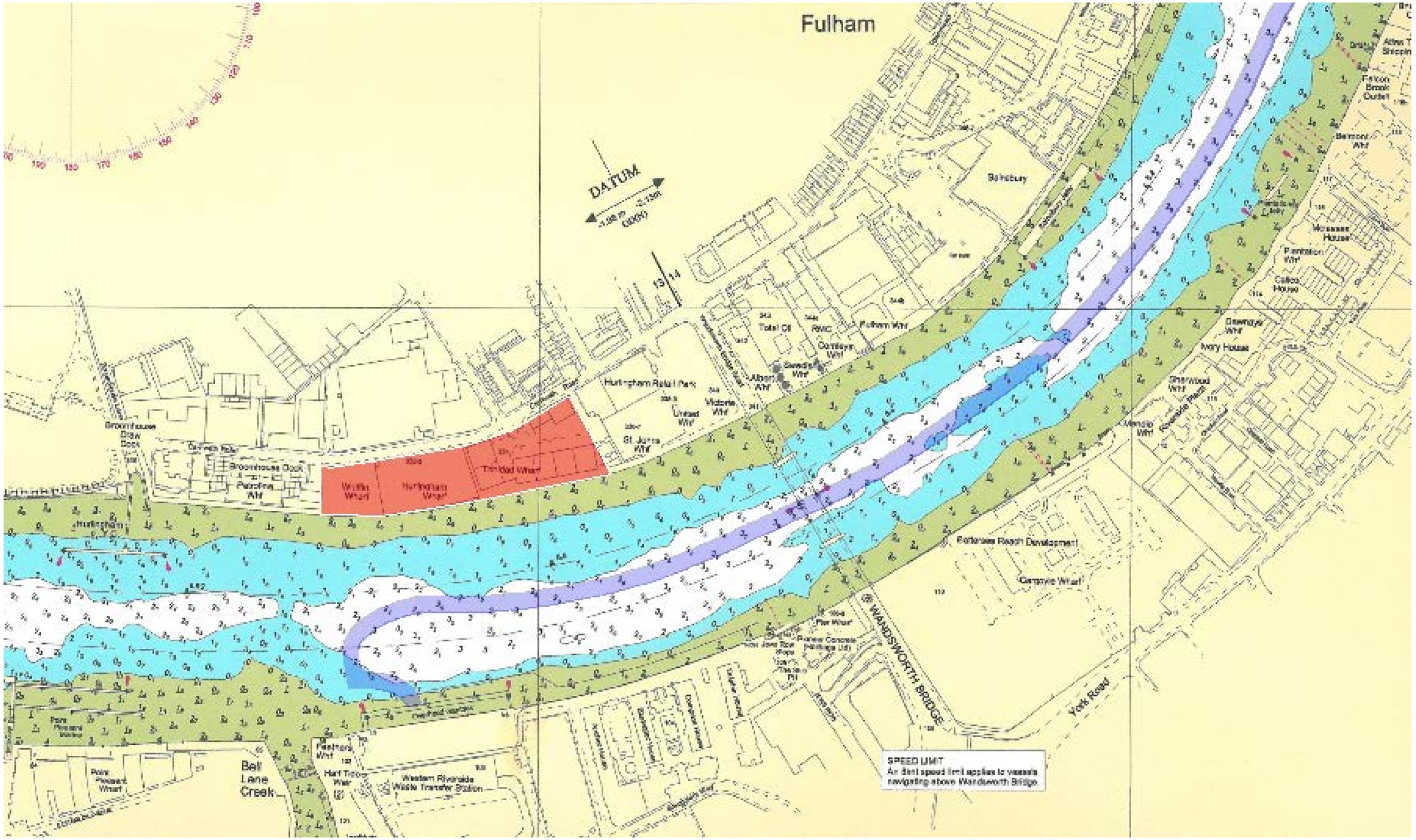


Figure B.6 10/11/2011 - Green Track image

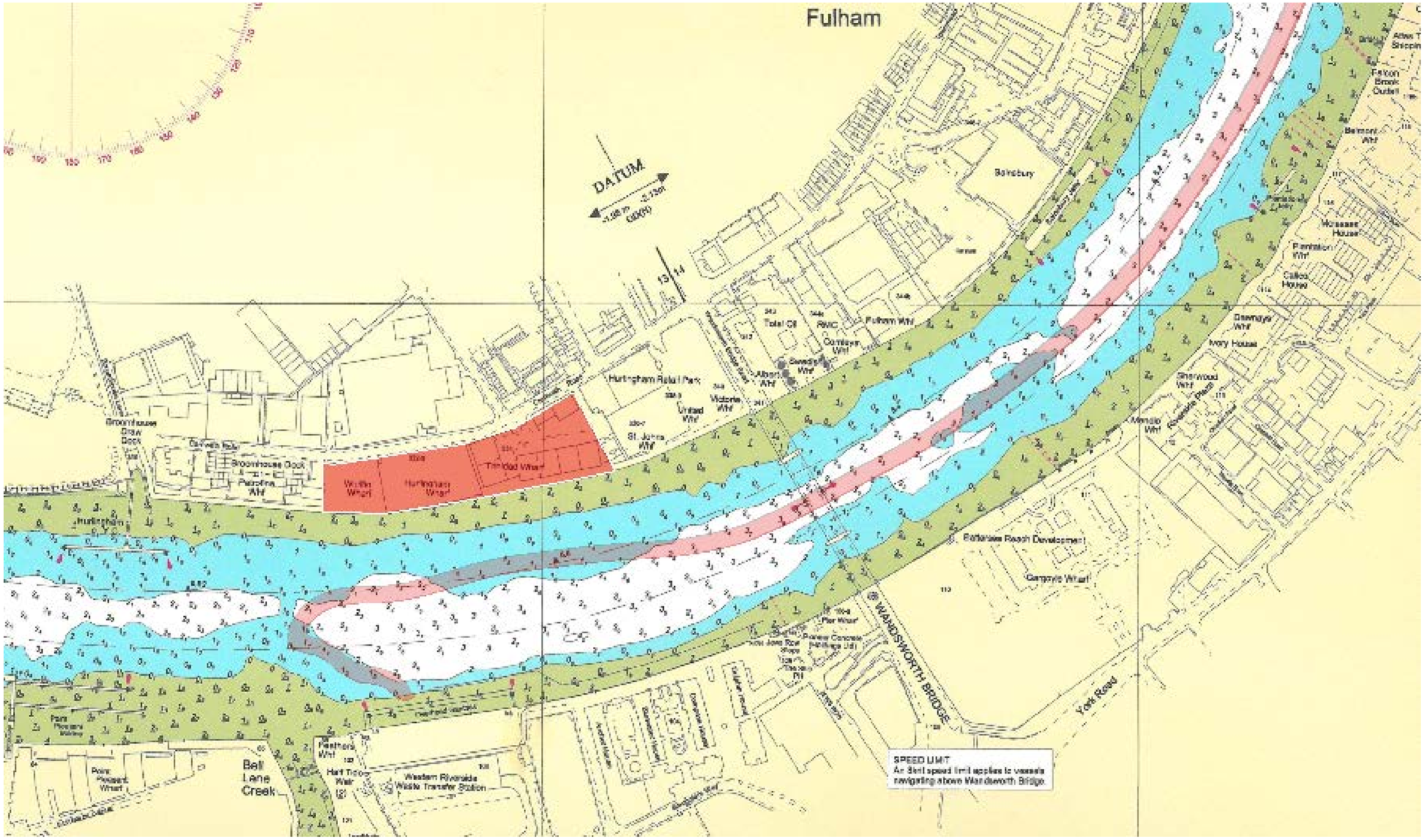


Figure B.7 11/11/2011 - Green Track image

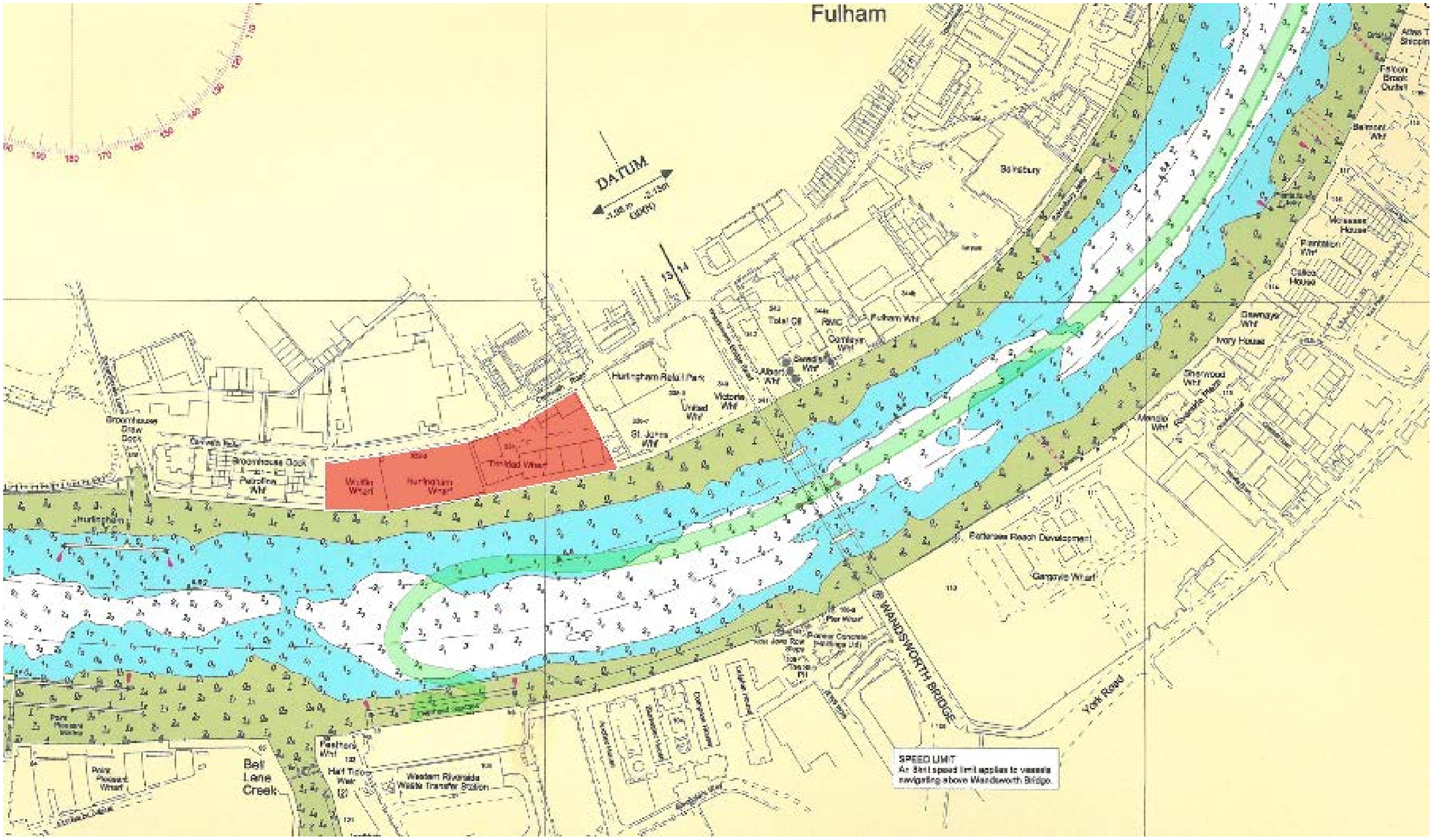


Figure B.8 14/11/2011 - Green Track image

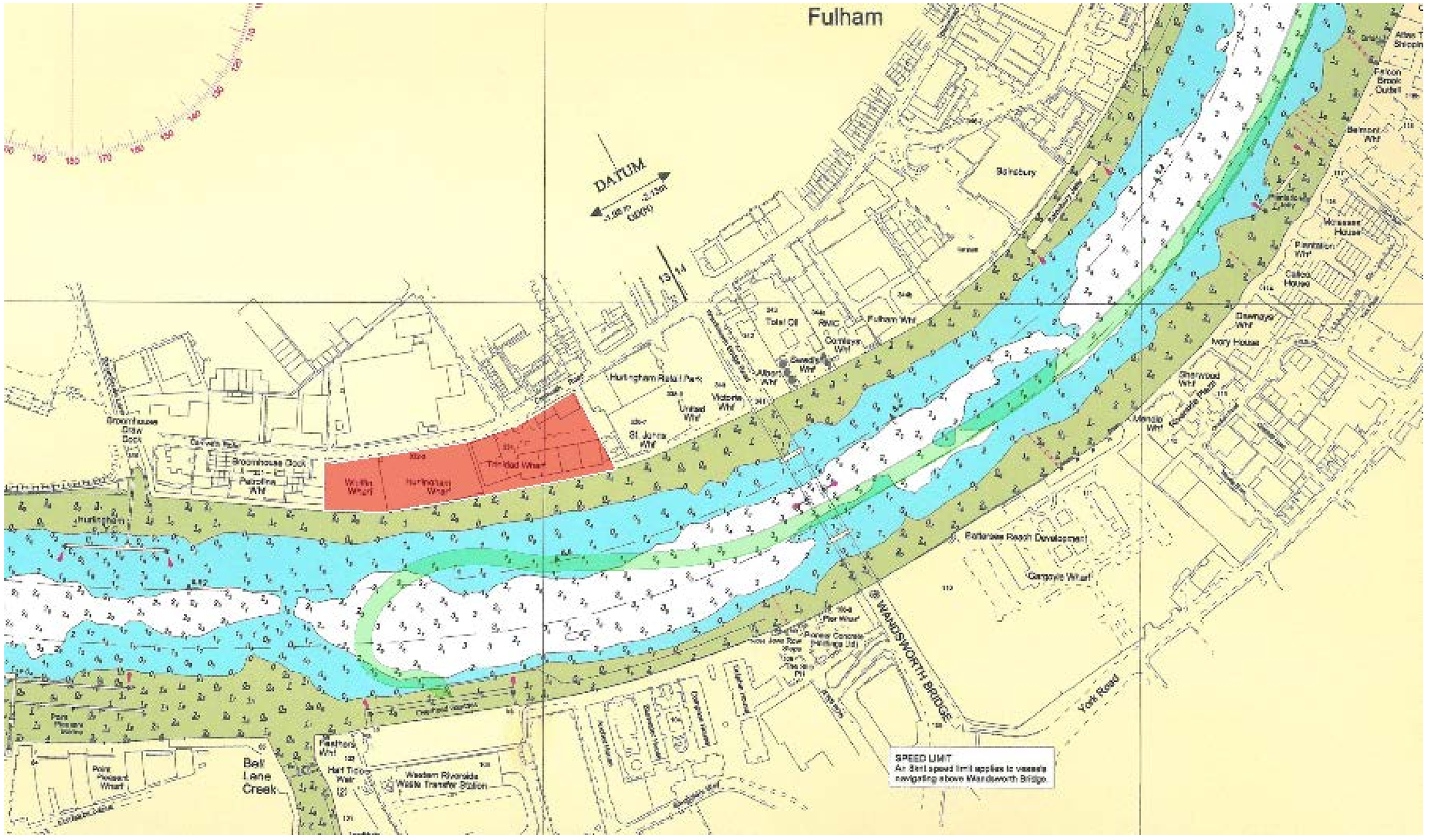


Figure B.9 18/11/2011 - Red Track image

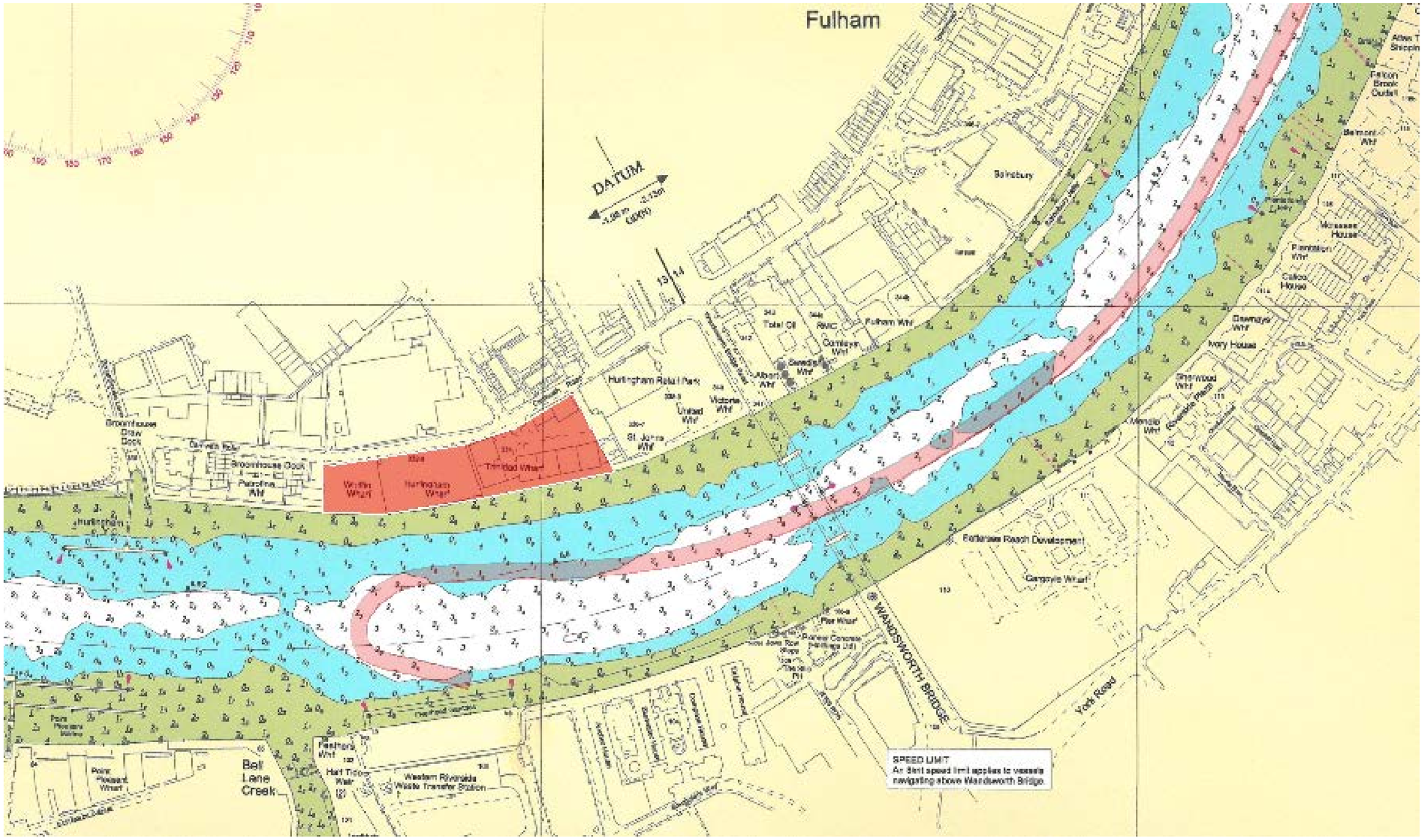


Figure B.10 22/11/2011 - Green Track image

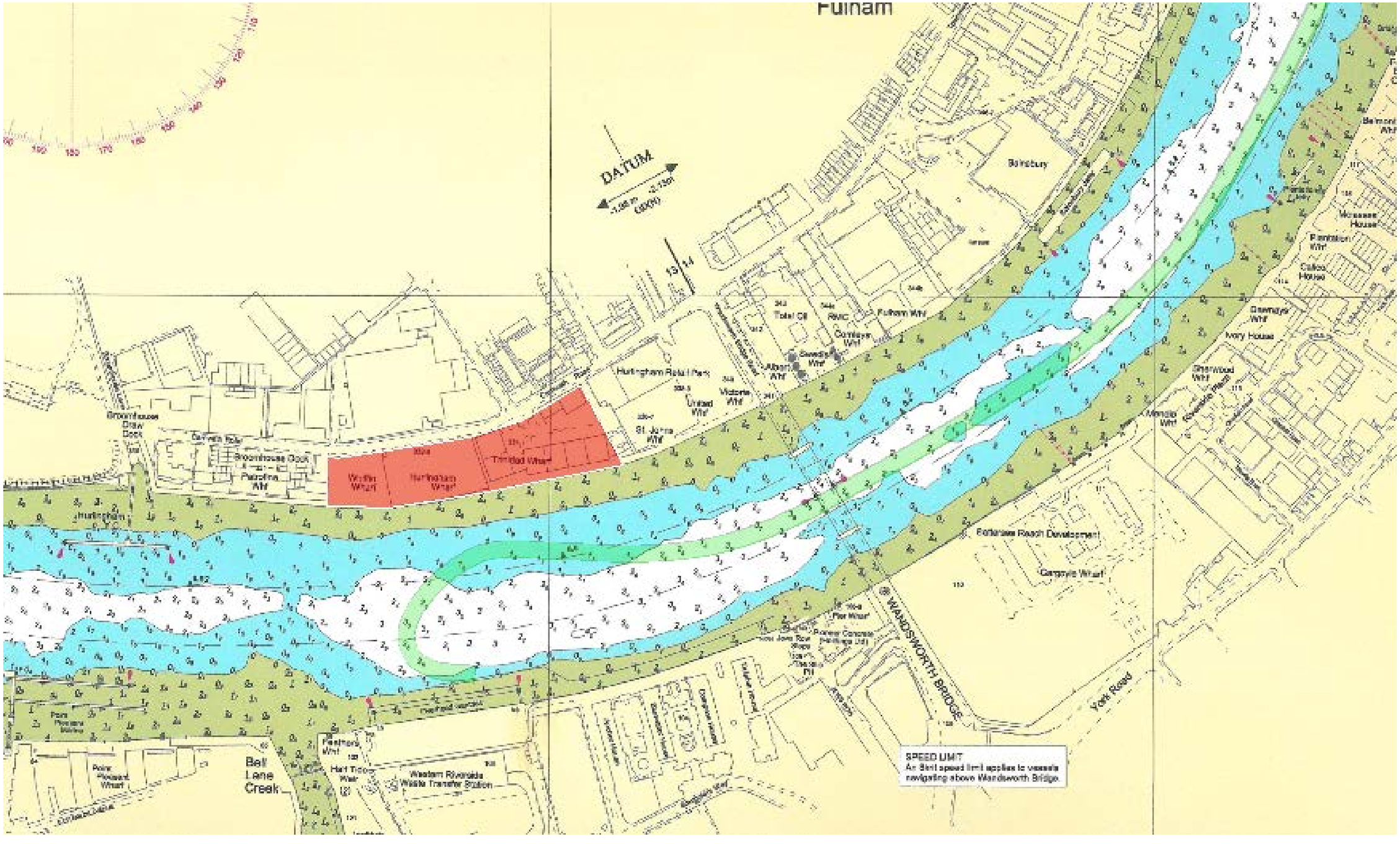


Figure B.11 23/11/2011 - Red Track image

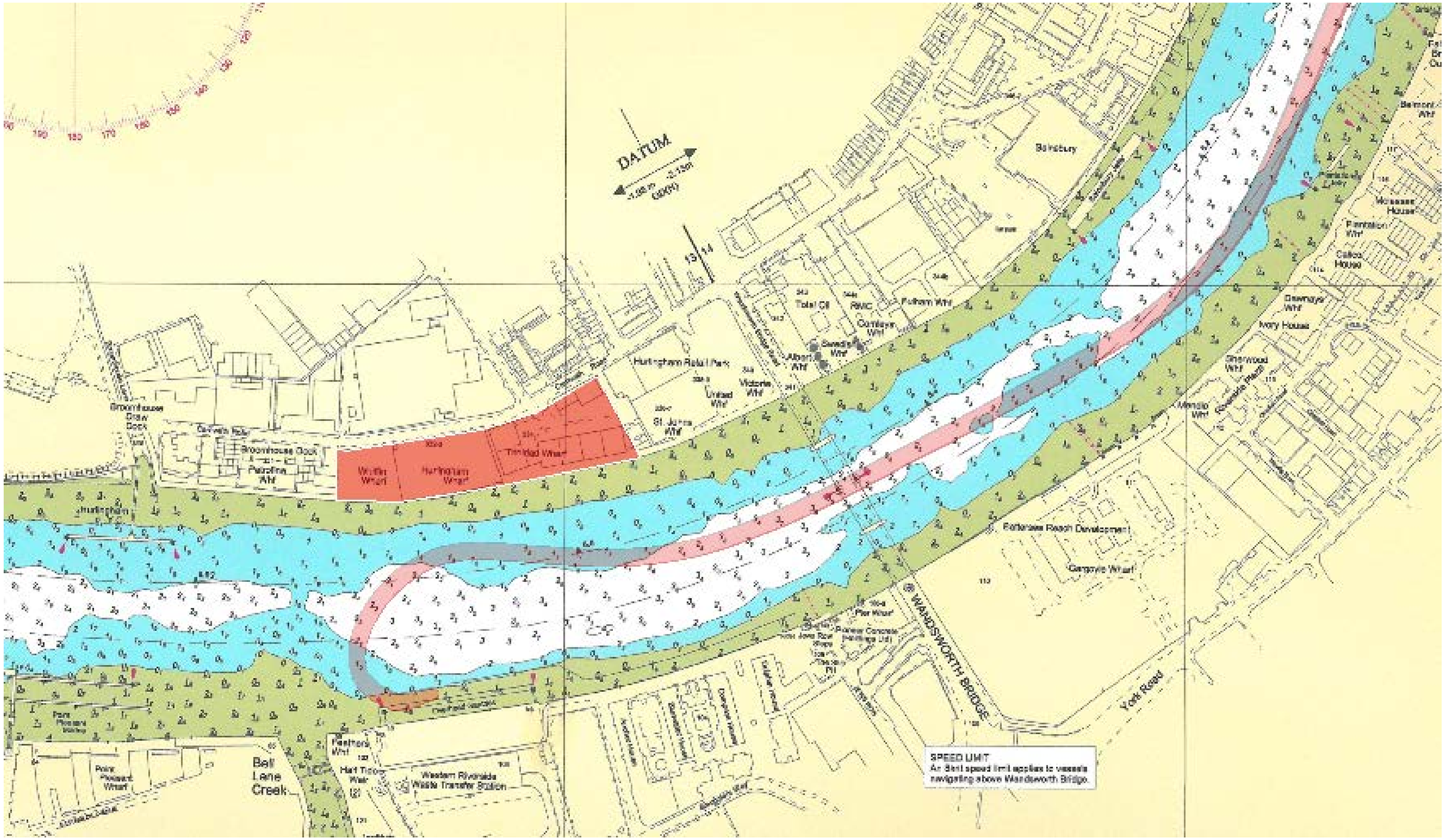


Figure B.12 24/11/2011 - Green Track image

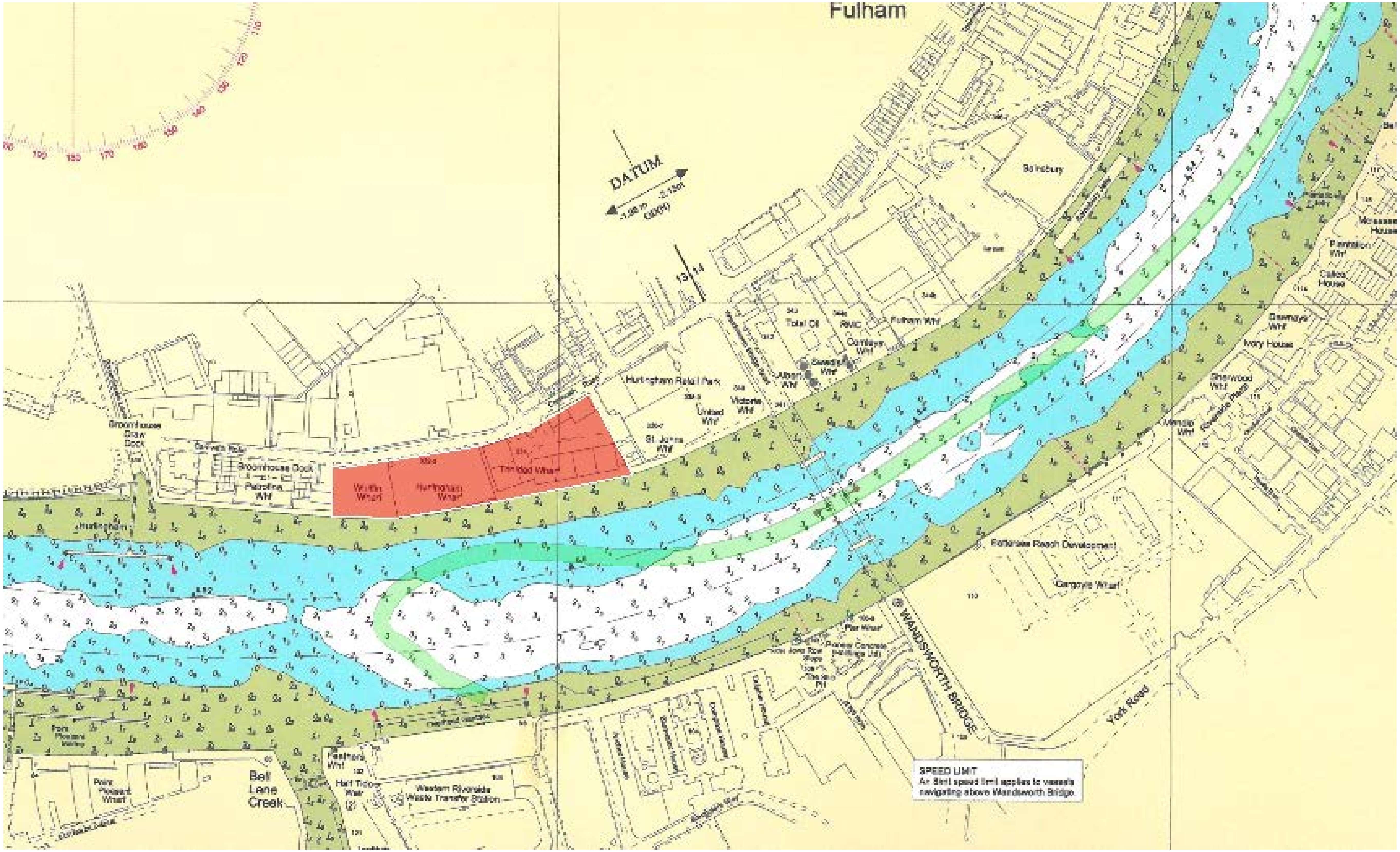
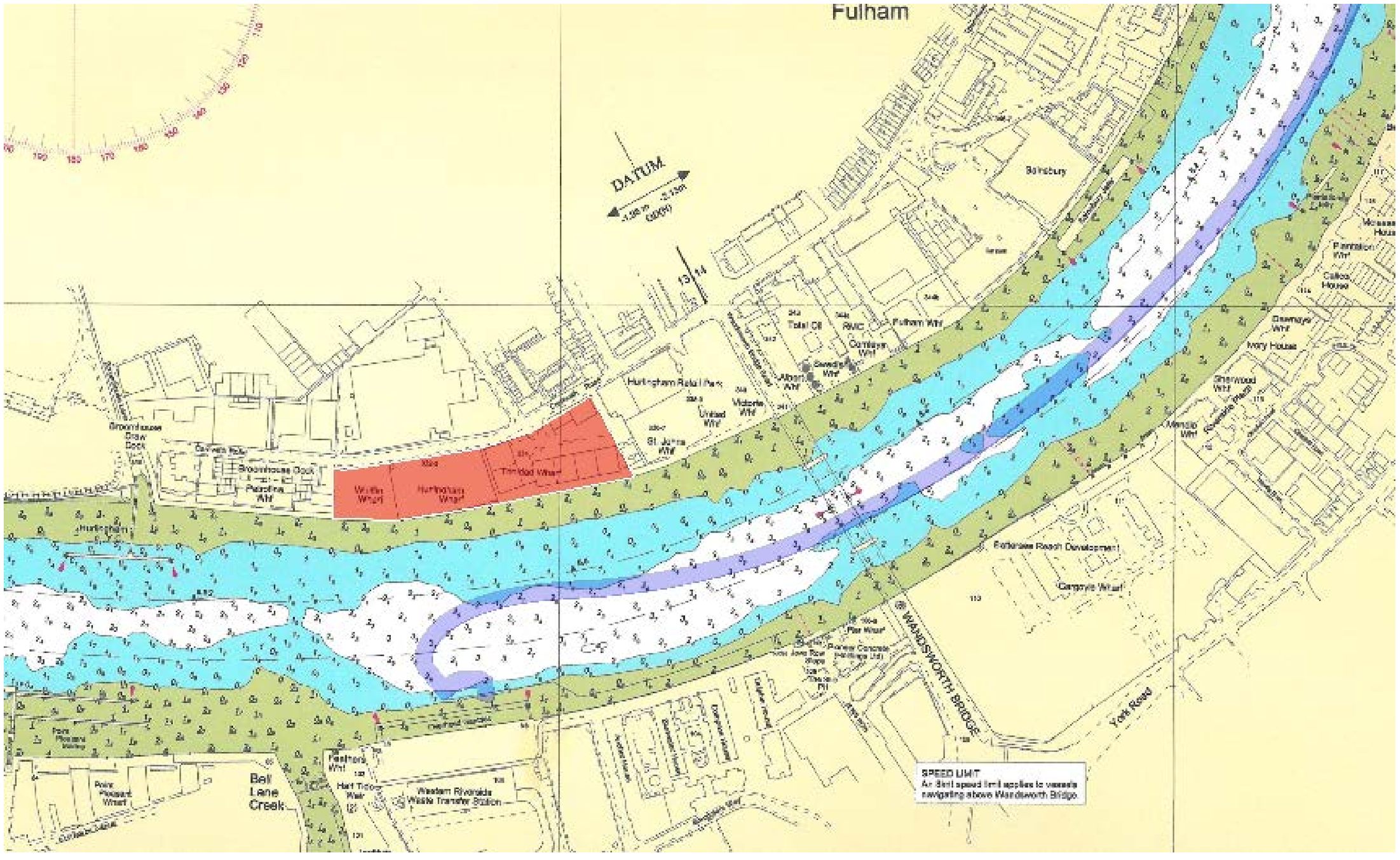


Figure B.13 25/11/2011 - Blue Track image



This page is intentionally blank

Copyright notice

Copyright © Thames Water Utilities Limited January 2013.
All rights reserved.

Any plans, drawings, designs and materials (materials) submitted by Thames Water Utilities Limited (Thames Water) as part of this application for Development Consent to the Planning Inspectorate are protected by copyright. You may only use this material (including making copies of it) in order to (a) inspect those plans, drawings, designs and materials at a more convenient time or place; or (b) to facilitate the exercise of a right to participate in the pre-examination or examination stages of the application which is available under the Planning Act 2008 and related regulations. Use for any other purpose is prohibited and further copies must not be made without the prior written consent of Thames Water.

Thames Water Utilities Limited
Clearwater Court, Vastern Road, Reading RG1 8DB

The Thames Water logo and Thames Tideway Tunnel logo are © Thames Water Utilities Limited. All rights reserved.

DCO-DT-000-ZZZZZ-072005