Thames Tideway Tunnel
Thames Water Utilities Limited

Development Consent Order

Application Reference Number: WWO10001

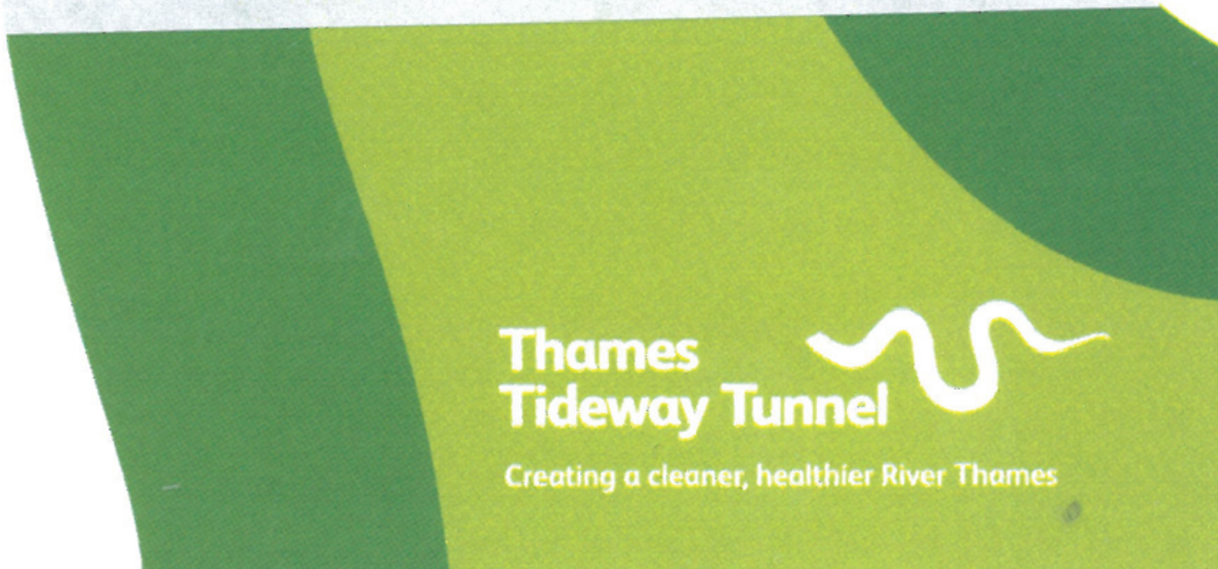
Documents for Certification
September 2014

We, Lindsay Speed and Sarah Fairbrother hereby certify that this is a true copy of the environmental statement referred to in Article 61 (1) (f) of the Thames Water Utilities Limited (Thames Tideway Tunnel) Order 2014.

Lindsay Speed

Sarah Fairbrother

September 2014



Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.10**

Volume 10: Carnwath Road Riverside appendices

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Thames Tideway Tunnel

Environmental Statement

List of contents

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Thames Tideway Tunnel

Environmental Statement

Volume 10 Carnwath Road Riverside site assessment

List of contents

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

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Volume 10: Carnwath Road Riverside appendices

Appendix A: Introduction

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This page is intentionally blank

Thames Tideway Tunnel

Environmental Statement

Volume 10 Carnwath Road Riverside appendices

Appendix A: Introduction

List of contents

Page number

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Appendix A: Introduction

A.1 Summary

A.1.1 This document presents the appendices that accompany the *Environmental Statement* Volume 10 Carnwath Road Riverside site assessment.

A.1.2 Figures associated with the appendices are provided within a separate volume of figures.

A.1.3 For consistency and ease of use Volumes 3 to 27 of the *Environmental Statement* all utilise the same appendices contents and labelling protocol. For these volumes the appendices are as follows:

a. Appendix A: Introduction
b. Appendix B: Air quality and odour
c. Appendix C: Ecology – aquatic
d. Appendix D: Ecology – terrestrial
e. Appendix E: Historic environment
f. Appendix F: Land quality
g. Appendix G: Noise and vibration
h. Appendix H: Socio-economics
i. Appendix I: Townscape and visual
j. Appendix J: Transport
k. Appendix K: Water resources – groundwater
l. Appendix L: Water resources – surface water
m. Appendix M: Water resources – flood risk
n. Appendix N: Development schedule.

A.1.4 Where a topic has not been assessed the associated appendix does not include any supporting information. Also, if a topic has been assessed but does not need to present any supporting information then the appendix is intentionally empty.

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.10**

Volume 10: Carnwath Road Riverside appendices

Appendix B: Air quality and odour

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This page is intentionally blank

Thames Tideway Tunnel

Environmental Statement

Volume 10 Carnwath Road Riverside appendices

Appendix B: Air quality and odour

List of contents

Page number

List of plates

Page number

List of tables

Page number

This page is intentionally blank

Appendix B: Air quality and odour

B.1 Model verification

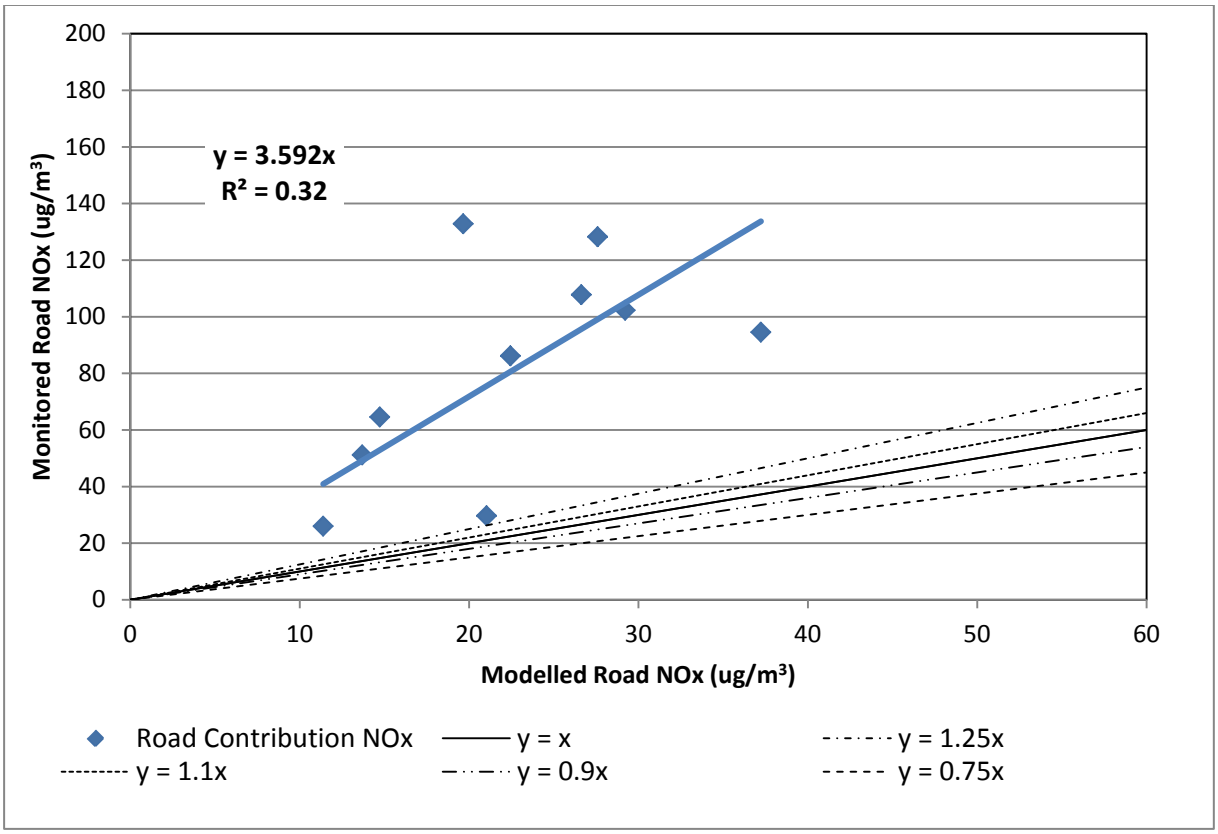
B.1.1 Modelled NO_2 concentrations have been plotted against monitored concentrations at eleven diffusion tube sites (CRRM1-CRRM6, DSTM5, DSTM7, DSTM8 and FPSM1) as shown in Vol 10 Figure 4.4.1 (see separate volume of figures).

B.1.2 This showed that the modelled results underestimated NO_2 concentrations by between 7% and 44%. As the model has been optimised and no further improvement of the model was considered feasible (such as reducing vehicle speeds or using different pollutant backgrounds, etc), a model adjustment factor was therefore deemed necessary.

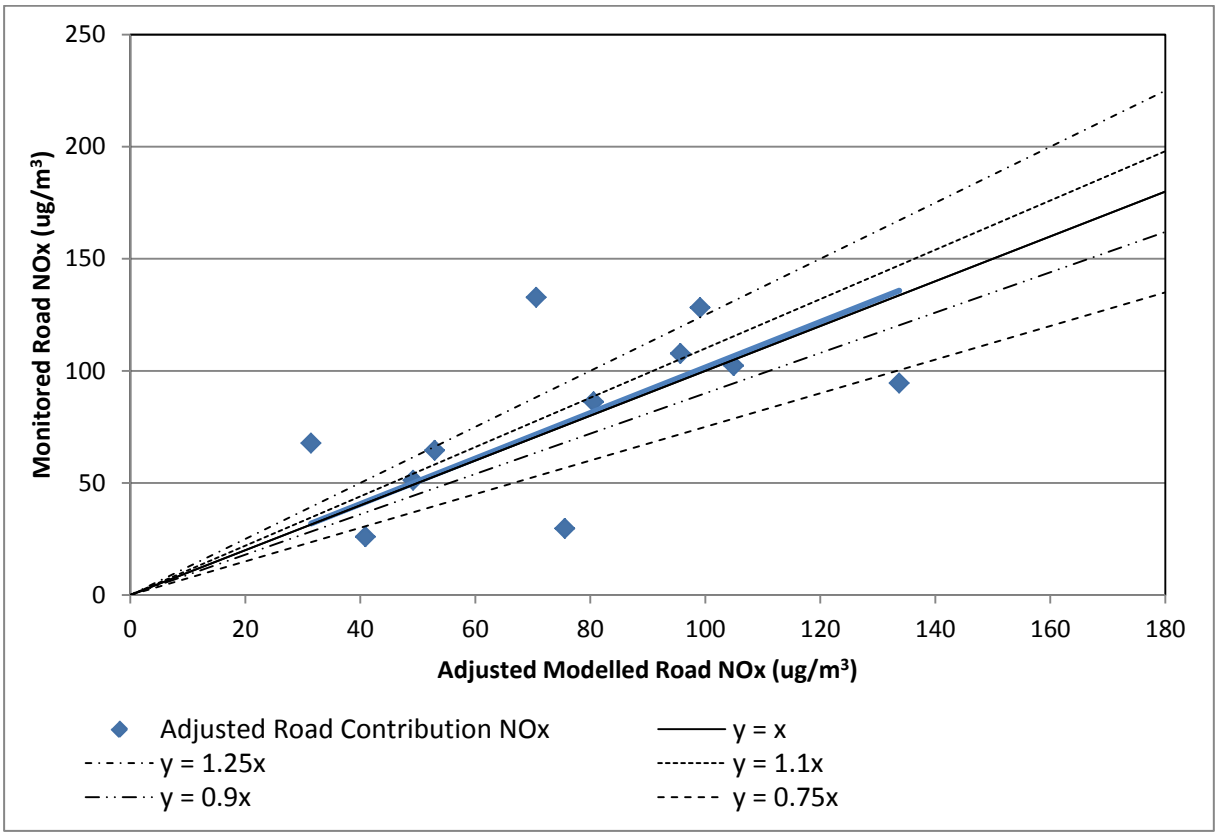
B.1.3 To derive the adjustment factor, modelled road NO_X concentrations were plotted against calculated monitored road NO_X concentrations (see Vol 10 Plate B.1 below). An adjustment factor of 3.59 was calculated for adjusting modelled roadside NO_X concentrations, in accordance with LAQM.TG(09)[1] and subsequently applied. This factor was also applied to the PM_{10} results as no local PM_{10} monitoring data were available for an area where traffic data were also available.

B.1.4 Applying the NO_X adjustment factor and then calculating NO_2 concentrations, as shown in Vol 10 Plate B.2, provides better overall agreement between actual and predicted data. The subsequent linear regression calculation for monitored versus modelled total NO_2, as shown in Vol 10 Plate B.3, indicated that six of the ten modelled concentrations were within 10% of the measured value and that nine of the ten were within 25% of the modelled value.

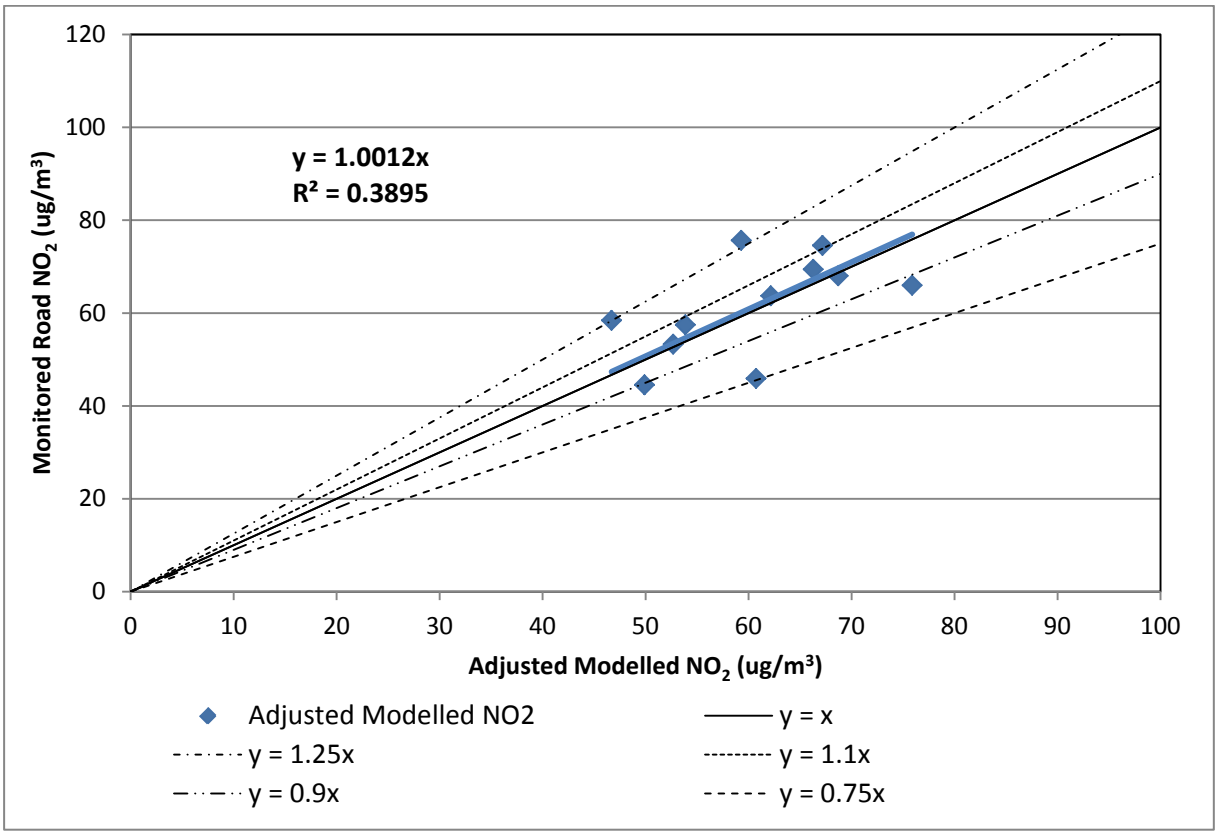
Vol 10 Plate B.1 Air quality - monitored road NO_X vs. modelled road NO_X



Vol 10 Plate B.2 Air quality – monitored road NO_X vs. adjusted modelled road NO_X



Vol 10 Plate B.3 Air quality – total monitored NO_2 vs. total adjusted modelled NO_2



B.2 Traffic Data

B.2.1 The traffic data used in the air quality modelling for the Carnwath Road Riverside site are shown in Vol 10 Table B.1.

Vol 10 Table B.1 Air quality - traffic data model inputs

Source	Road link	2010 baseline AADT*	Baseline % HGV >3.5t	Speed limit (mph)	Model input speed (mph)	Growth factor % (2009 - 2018)	Peak const-ruction year AADT	Peak construction year AADT scheme construction HGV (HGV >3.5t)	Peak construction year development case (total AADT)	Peak construct-ion year develop-ment case AADT % HGV (>3.5t)
ATC** 'direct'	Wandsworth Bridge	42403	11.3%	30	26.2	6.9%	45330	44	45425	11.4%
TfL Model	Carnwath Road	14382	4.8%	30	30	6.9%	15375	72	15449	5.3%
TfL Model	Townmead Road	16884	5.6%	30	30	6.9%	18049	16	18066	5.7%
ATC 'Indirect'	Wandsworth Bridge Road south	29554	8.4%	30	20.8	6.9%	31595	34	31630	8.5%
ATC 'direct'	Wandsworth Bridge Road north	21792	8.7%	30	20.8	6.9%	23296	34	23332	8.8%
TfL Model	Trinity Road	39023	3.3%	40	39.2	6.9%	41717	40	41959	3.4%

** AADT – annual average daily traffic. **ATC – automatic traffic counter.*

B.3 River tug emission factors

B.3.1 Emissions of NO_X and PM_{10} from tugs pulling the barges were calculated using the data shown in Vol 10 Table B.2 for the Carnwath Road Riverside site.

Vol 10 Table B.2 Air quality - tug assessment model inputs

Parameter	Value	Units
Total tugs	365	tugs/year
Time per tug*	20	minutes
NO_X base emission factor	10.2	g/kWhr
PM_{10} base emission factor	0.9	g/kWhr
Average tug engine size	984	kW
Manoeuvring and hotelling** load factor	0.2	No units
Total tug area***	18343	m^2
NO_X emissions per tug	3.0×10^{-05}	$g/s/m^2$
PM_{10} emissions per tug	2.7×10^{-06}	$g/s/m^2$

* Time that tug is at the site.
** Hotelling refers to when the tug is securely moored or anchored.
*** Area of the mooring and manoeuvring of tugs.

B.4 Construction plant emission factors

B.4.1 For the purpose of the assessment, the following listed equipment in Vol 10 Table B.3 has been modelled for the peak construction year at the Carnwath Road Riverside site.

Vol 10 Table B.3 Air quality - construction plant assessment model inputs

Construction activity	Typical location	Typical plant	Unit No(s)	% on-time	Power (kW)	NO_X emission rate ($g/s/m^2$)	PM_{10} emission rate ($g/s/m^2$)
Site set up and general site	Ground level behind hoarding	Compressor 250cfm*	1	50	104	7.6×10^{-7}	4.7×10^{-8}
	Ground level behind hoarding	Generator - 200kVA	1	100	160	2.3×10^{-6}	1.5×10^{-7}
	Ground level behind hoarding	JCB with hydraulic breaker	1	50	67	4.9×10^{-7}	3.0×10^{-8}
	Ground level behind hoarding	Cutting equipment (diamond saw)	2	10	2.3	1.7×10^{-8}	3.7×10^{-8}
	Ground level behind hoarding	Telescopic handler/FLT**	1	30	60	2.6×10^{-7}	1.6×10^{-8}
	Ground level behind hoarding	Hiab*** lorry/crane	1	5	56	4.1×10^{-8}	2.5×10^{-9}
	Ground level behind hoarding	Well drilling rig	1	50	403	6.6×10^{-7}	4.1×10^{-8}
Main Tunnel Drive - Carnwath to Acton	Ground level behind hoarding	150t crawler crane	1	50	240	3.9×10^{-7}	2.4×10^{-8}
	Ground level	Air compressor	2	50	129	4.2×10^{-7}	2.6×10^{-8}

Construction activity	Typical location	Typical plant	Unit No(s)	% on-time	Power (kW)	NO_X emission rate ($g/s/m^2$)	PM_{10} emission rate ($g/s/m^2$)
	behind hoarding	600cfm*					
	Ground level behind hoarding	Dumper	1	25	81	6.6×10^{-8}	4.1×10^{-9}
	Ground level behind hoarding	Emergency generator - 200kW	1	5	200	3.3×10^{-8}	2.0×10^{-9}
	Ground level behind hoarding	Flatbed trucks for materials haulage	1	20	56	3.7×10^{-8}	2.3×10^{-9}
	Ground level behind hoarding	Flatbed trucks for segment haulage	1	20	56	3.7×10^{-8}	2.3×10^{-9}
	Ground level behind hoarding	25T Loading shovel	2	30	325	6.4×10^{-7}	4.0×10^{-8}
	Ground level behind hoarding	Telehandler 5t	2	80	60	3.1×10^{-7}	2.0×10^{-8}
	Within tunnel	Locomotives	4	100	180	4.7×10^{-5}	2.9×10^{-6}

*Note: For the purposes of this assessment, the above listed equipment has been modelled for the peak construction year. The data assumes a 24-hour working day. This schedule provides an illustration of typical plant that could be used in the construction of the Thames Tideway Tunnel at this site. The appointed Contractor must comply with section 6 of the CoCP but may vary the method and plant to be used. This schedule therefore represents the most reasonable assumption for the assessment that can be made at this stage. * cfm - cubic feet per minute. ** FLT – fork lift truck. *** Hiab – loader crane.*

References

[1] Defra, *Local Air Quality Management - Technical Guidance*, LAQM.TG(09) (2009).

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.10**

Volume 10: Carnwath Road Riverside appendices

Appendix C: Ecology - aquatic

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Thames Tideway Tunnel

Environmental Statement

Volume 10 Carnwath Road Riverside appendices

Appendix C: Ecology - aquatic

List of contents

Page number

.

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Appendix C: Ecology - aquatic

C.1 Introduction

C.1.1 Construction and operational effects assessments at this site for this topic do not require the provision of any supporting information, so this appendix is intentionally empty.

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.10**

Volume 10: Carnwath Road Riverside appendices

Appendix D: Ecology - terrestrial

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Thames Tideway Tunnel

Creating a cleaner, healthier River Thames

This page is intentionally blank

Thames Tideway Tunnel

Environmental Statement

Volume 10 Carnwath Road Riverside appendices

Appendix D: Ecology – terrestrial

List of contents

Page number

List of plates

Page number

List of tables

Page number

This page is intentionally blank

Appendix D: Ecology – terrestrial

D.1 Notable species survey report

Introduction

D.1.1 A Phase 1 Habitat Survey was carried out on 17 May 2011 at the Carnwath Road Riverside site (Vol 10 Figure 6.4.2, see separate volume of figures). Based on this, surveys for the following species have been undertaken:

a. bats

b. wintering birds

c. black redstart (*Phoenicurus ochruros*); and

d. invasive plants.

D.1.2 The purpose of the surveys is to determine the presence or likely absence of these species at and around the site.

D.1.3 This report presents the survey findings. The survey area for each species is described with reference to the habitat types identified during the Phase 1 Habitat Survey as having potential for notable species (paras. D.1.5 to D.1.14). The results from the surveys are then presented (paras. D.1.15 to D.1.25). The final section provides an interpretation of the results (paras. D.1.26 to D.1.34). Figures referred to in this report are contained within Vol 10 Carnwath Road Riverside Figures.

D.1.4 Information on legislation, policy and methodology can be found in Volume 2 Environmental assessment methodology of the *Environmental Statement*. Information on site context can be found in Section 3 of this volume.

Survey area

Bats

D.1.5 Bats are associated with a diverse range of habitats, including woodland, scrub, riparian habitats and buildings. They roost in trees and buildings where suitable features are present, and they commute along linear features such as hedgerows, watercourses and tree lines, and forage around vegetation such as scrub, hedgerows, grassland, trees and river corridors.

D.1.6 A remote recording (bat triggering) survey using remote Anabat™ recording devices was undertaken. Based on the habitat types identified during the Phase 1 habitat survey and their potential to support foraging, commuting or roosting bats, one location was chosen for the installation of the remote recording device (shown on Vol 10 Figure 6.4.3, see separate volume of figures).

D.1.7 Location 1 was selected to record activity associated with commuting and foraging along the River Thames corridor and activity of bats entering and leaving the Carnwath Road Riverside site.

D.1.8 As high numbers of bats and a range of bat species were recorded, the remote recording surveys triggered the need for an additional survey at the Carnwath Road Riverside site (see Vol 2 for bat triggering criteria). However, access to the site was not available in order to undertake a dawn survey; therefore, a second remote recording survey was carried out as an alternative to the dawn survey.

Wintering birds

D.1.9 Wintering birds are mainly associated with aquatic habitats such as intertidal mudflats and marshes, marginal vegetation and wetlands, which they use for resting and foraging.

D.1.10 The survey area is shown in Vol 10 Figure 6.4.4 (see separate volume of figures), and comprises the intertidal foreshore of the River Thames, which consists of stones of various sizes and silt.

Black redstarts

D.1.11 Black redstart nest on and within buildings and structures (mostly those that are derelict), and forage on sparsely-vegetated open areas. The survey area is shown in Vol 10 Figure 6.4.5 (see separate volume of figures).

D.1.12 The survey area includes those buildings, areas of hard standing and other features which lie in the immediate vicinity of Carnwath Road Riverside site and includes the section of foreshore and river which lie adjacent to the proposed development site.

Invasive plants

D.1.13 Invasive plants that are listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) occur in a wide range of habitats, although they are more often associated with watercourses or wet areas, or within areas of disturbed ground, where material contaminated with seeds and rhizomes (sections of root that can re-grow), may have been imported into the area.

D.1.14 The invasive plants survey area, as shown on Vol 10 Figure 6.4.6 (see separate volume of figures), comprises the proposed development site, and an area within 10m of the proposed development site boundary. The 10m zone beyond the site boundary was surveyed to record any invasive plants present adjacent to the site that could potentially spread onto the site, or that could have roots that extend into the site below ground (e.g. Japanese knotweed).

Results

D.1.15 In this section, the results of the desk study, notable species surveys and the invasive plant survey are presented. The results are then interpreted in paras. D.1.26 to D.1.34.

Desk Study

D.1.16 Species data recorded within 500m of the site from 2001 to 2011, as supplied by Greenspace Information for Greater London (GIGL), are summarised in Vol 10 Table D.1.

Vol 10 Table D.1 Terrestrial ecology - Species recorded within 500m of the site from 2001 - 2011

Common name	Latin name	Record count
Mammals		
West European hedgehog	*Erinaceus europaeus*	3
Bat	*Vespertilionidae*	1
Soprano pipistrelle	*Pipistrellus pygmaeus*	2
Common pipistrelle	*Pipistrellus pipistrellus*	2
Lesser noctule	*Nyctalus leisleri*	1
Birds		
Northern pintail	*Anas acuta*	29
Little egret	*Egretta garzetta*	1
European honey-buzzard	*Pernis apivorus*	1
Peregrine falcon	*Falco peregrinus*	2
Little gull	*Larus minutus*	1
Caspian gull	*Larus cachinnans*	39
Herring gull	*Larus argentatus*	5
Mediterranean gull	*Larus melanocephalus*	2
Common tern	*Sterna hirundo*	3
Arctic tern	*Sterna paradisaea*	4
Common kingfisher	*Alcedo atthis*	10
Hedge accentor/ Dunnock	*Prunella modularis*	2
Black-tailed godwit	*Limosa limosa*	1
Common starling	*Sturnus vulgaris*	1
House sparrow	*Passer domesticus*	13
Common linnet	*Carduelis cannabina*	4
Common redpoll	*Carduelis flammea*	1
Reed bunting	*Emberiza schoeniclus*	4
Amphibians		
Common frog	*Rana temporaria*	4
Common toad	*Bufo bufo*	2
Invertebrates		
Stag beetle	*Lucanus cervus*	4
Cinnabar moth	*Tyria jacobaeae*	2

Common name	Latin name	Record count
Plants		
Cornflower	*Centaurea cyanus*	1
Tower mustard	*Arabis glabra*	1
Pasqueflower	*Pulsatilla vulgaris*	1

Bat surveys

Bat triggering (remote recording) surveys

D.1.17 The bat triggering (remote recording) surveys were undertaken over three nights from 1 July 2011 and 3 July 2011, and three nights from 4 October 2011 and 6 October 2011 in suitable weather conditions (Vol 10 Table D.2).

D.1.18 The remote recording surveys undertaken at Carnwath Road Riverside site recorded three species of bats using the site: common pipistrelle, (*Pipistrellus pipistrellus)*, soprano pipistrelle, (*Pipistrellus pygmaeus)*, and noctule*, (Nyctalus noctula)*.

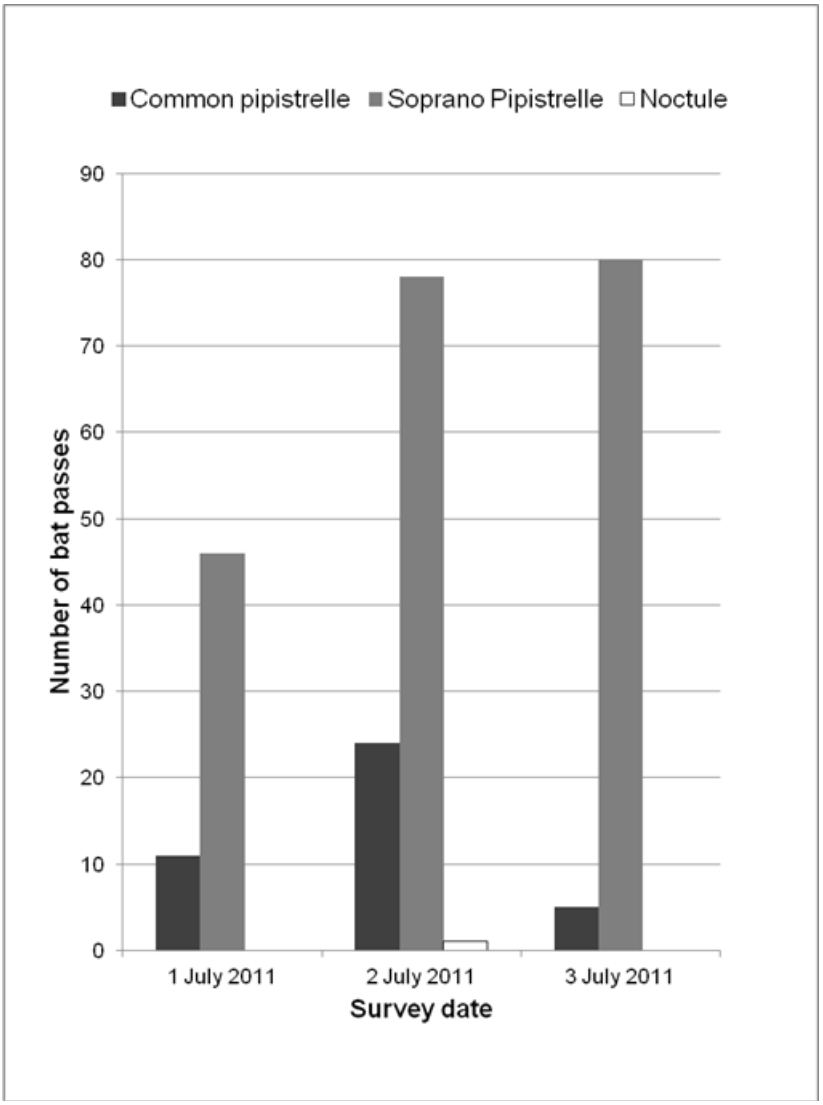
D.1.19 Common pipistrelle was recorded on each of the three surveys in July, with a maximum number of passes per night of 24. Higher levels of activity were recorded for soprano pipistrelle, which were recorded on each of the three survey nights in July with a maximum number of passes per night of 80. A single noctule bat pass was recorded on one night in July.

D.1.20 No bats were recorded during remote recording surveys undertaken in October.

Vol 10 Table D.2 Terrestrial ecology – bat survey weather conditions

Survey visit	Weather conditions
1 July 2011	15°C, moderate breeze, 0% cloud cover, dry
2 July 2011	16°C, light breeze, 0% cloud cover, dry
3 July 2011	16°C, light breeze, 20% cloud cover, dry
4 October 2011	16°C, moderate breeze, 60% cloud cover, dry
5 October 2011	16°C, moderate breeze, 20% cloud cover, dry
6 October 2011	17°C, moderate breeze, 80% cloud cover, dry

Vol 10 Plate D.1 Terrestrial ecology – bat passes recorded during remote recording surveys at Carnwath Road Riverside site



Wintering bird survey

D.1.21 A total of six survey visits were undertaken at monthly intervals during October 2011 to March 2012 by an experienced ornithologist (bird specialist). The survey visits were undertaken in suitable weather conditions (Vol 10 Table D.1). The main foraging and resting areas for wintering birds are indicated on Vol 10 Figure 6.4.4 (see separate volume of figures). The numbers of individuals of each species recorded in each month are provided in Vol 10 Table D.2.

D.1.22 A total of 15 waterbird[i] species were recorded foraging on the foreshore on and adjacent to the site. Of these, seven species are of nature conservation importance and are included on the Birds of Conservation

i A waterbird is a species which is listed in the Wetland Bird Survey (WeBS) methodology – British Trust for Ornithology, Royal Society for the Protection of Birds, Joint Nature Conservation Committee and Wildfowl and Wetlands Trust.

Concern 3 (Royal Society for the Protection Birds, 2009)[1] Red or Amber Listii and/or UK and London BAP as priority species.

a. Black-backed gull (*Larus ridibundus*), common gull (*Larus canus*), lesser black-backed gull (*Larus fuscus*), herring gull (*Larus argentatus*) and great black-backed gull (*Larus marinus*) were recorded foraging on the foreshore, both on, adjacent and opposite the site.

b. The confluence of the River Thames and the River Wandle on the opposite foreshore supported foraging bird species lesser black-backed gull (*Larus fuscus*), herring gull (*Larus argentatus*), great black-backed gull (*Larus marinus*), gadwall (*Anas strepera*) and mallard (*Anas platyrhynchos*), as well as the Green List species cormorant (*Phalacrocorax carbo*), great crested grebe (*Podiceps cristatus*).

Vol 10 Table D.1 Terrestrial ecology – wintering bird survey weather conditions

Survey visit	Weather conditions
26 October 2011	8°C, light breeze, 10% cloud cover, dry
28 November 2011	3°C, light breeze, 0% cloud cover, dry
12 December 2011	6°C, moderate breeze, 40% cloud cover, dry
10 January 2012	10°C, moderate breeze, 60% cloud cover, dry
8 February 2012	-3°C, moderate breeze, 60% cloud cover, dry
9 March 2012	7°C, moderate breeze, 0% cloud cover, dry

ii The conservation status of all regularly occurring British birds has been analysed in co-operation with the leading governmental and non-governmental conservation organisations, including the Royal Society for the Protection of Birds (RSPB), British Trust for Ornithology (BTO) and Birdlife International Birds of Conservation Concern 3 (RSPB, 2009). The basis of species ongoing population trends are assigned to one of three lists of Conservation Concern. These are the UK Red, Amber and Green lists. Although the lists confer no legal status in themselves, they are useful in evaluating the conservation significance of bird assemblages, and for assessing the potential significance of impacts and informing appropriate levels of mitigation with respect to bird populations.

Birds of Conservation Concern (BoCC) Red List criteria for breeding birds are those which have experienced a severe decline of more than 50% of population and / or range over the last 25 years, as measured by the number of 10km squares occupied by breeding birds of the species concerned. Species listed as globally threatened by Birdlife International and those with a historical decline in the UK between 1800 and 1995 (without evidence of recovery) are also included. BoCC Amber List criteria for breeding birds are those which have experienced a moderate decline of between 25% and 49% of population and / or range over the last 25 years. Species of European conservation concern and those with a historical decline but which are currently recovering are also included.

Vol 10 Table D.2 Terrestrial ecology – species and number of wintering waterbirds recorded during monthly wintering bird surveys

Species name	Latin name	Conservation designation[iii]	Monthly wintering waterbird counts					
			26 October 2011	28 November 2011	12 December 2011	10 January 2012	8 February 2012	9 March 2012
Great Crested Grebe	*Podiceps cristatus*	Green List	2	2	-	2	-	2
Cormorant	*Phalacrocorax carbo*	Green List	17	14	2	23	4	12
Grey Heron	*Ardea cinerea*	Green List	2	2	1	1	1	2
Mute Swan	*Cygnus olor*	Green List	-	-	-	1	2	-
Greylag Goose	*Anser anser*	Green List	-	-	-	1	-	-
Egyptian Goose	*Alopochen aegyptiacus*	Green List	-	-	-	2	-	-
Gadwall	*Anas strepera*	Amber List	-	-	-	-	10	5
Mallard	*Anas platyrhynchos*	Amber List	14	10	8	6	26	14
Moorhen	*Gallinula chloropus*	Green List	1	1	-	-	1	-
Coot	*Fulica atra*	Green List	-	-	-	-	2	-
Black-headed	*Larus ridibundus*	Amber List	98	147	27	88	76	134

[iii] A species that is listed in the following publications:

Batten, L.A., Bibby, C.J., Clement, P., Elliot, G.D. & Porter, R.F. (1990). *Red Data Birds in Britain*. T. & A.D. Poyser, London.

Commission of the European Communities (1979). Council Directive 79/409/EEC on the Conservation of Wild Birds. *Official Journal of European Communities, L103*.

Holliday, M & Rare Breeding Bird Panel (2011). Rare Breeding Birds in the United Kingdom in 2009. *British Birds*, 104, 9, 476-537.

Royal Society for the Protection Birds (2009). *Birds of Conservation Concern 3*. RSPB, Sandy.

United Kingdom Biodiversity Action Plan Steering Group (2011). *United Kingdom Biodiversity Action Plan* http://jncc.defra.gov.uk/page-5163 [10.11].

Species name	Latin name	Conservation designation[iii]	Monthly wintering waterbird counts					
			26 October 2011	28 November 2011	12 December 2011	10 January 2012	8 February 2012	9 March 2012
Gull								
Common Gull	*Larus canus*	Amber List	4	28	1	2	10	21
Lesser Black-backed Gull	*Larus fuscus*	Amber List	2	3	-	2	1	1
Herring Gull	*Larus argentatus*	Red List UK BAP Priority List	13	9	3	7	14	4
Great Black-backed Gull	*Larus marinus*	Amber List	-	1	-	-	1	2

Black redstart survey

D.1.23 A total of five back redstart survey visits were undertaken between 26 May and 19 July 2011 by an experienced ornithologist, for a minimum of three hours each during the early morning period and when weather conditions were suitable, as detailed below in Vol 10 Table D.1.

D.1.24 Black redstart was not recorded within the proposed works area during the five survey visits.

Vol 10 Table D.1 Terrestrial ecology - Weather conditions for black redstart surveys

Date	Weather conditions
26 May 2011	13°C, light breeze, 50% cloud cover, dry.
24 June 2011	13°C, moderate breeze, 60% cloud cover, dry.
1 July 2011	15°C, moderate breeze, 0% cloud cover, dry.
8 July 2011	14°C, moderate breeze, 75% cloud, dry.
19 July 2011	13°C, moderate breeze, 90% cloud cover, dry.

Invasive plants survey

D.1.25 The invasive plant survey was undertaken on the 1 July 2011 by an experienced ecologist. The results of the survey are shown on Vol 14 Figure 6.4.6 (see separate volume of figures). No invasive plant species listed on Schedule 9 of the Wildlife and Countryside Act 1981 were recorded during the survey.

Interpretation

Bats

D.1.26 The survey area is used by a soprano pipistrelle and common pipistrelle as a foraging and commuting site. Other bat species are also using the site although much more infrequently; the single record of a noctule bat suggests that this species passes through the site area occasionally.

D.1.27 Given the limited vegetation within the survey area, the common pipistrelle and soprano pipistrelle records are likely to be associated with foraging and commuting along the foreshore of the River Thames and foraging around vegetation on and adjacent to the site. The river corridor is of importance to both species, although the use of this corridor by soprano pipistrelles was considered likely to be higher.

D.1.28 As no bats were recorded close to sunset or sunrise when bats leave and return to their roosts, no bat roosts are likely to be present on or in close proximity to the site

D.1.29 The lack of records of bat activity from the surveys undertaken in October indicates that bat activity in the vicinity of the site at this time of year is limited. Whilst weather conditions were suitable for recording bats in October, the absence of records indicates that bats had moved away from their summer foraging and roosting sites, potentially to hibernation roosts.

Wintering birds

D.1.30 Of the 15 waterbird species that have been recorded within the survey area, nine are of nature conservation importance and are included in the Birds of Conservation Concern Red or Amber List and/or UK BAP Priority Species: gadwall, mallard, black-headed gull, common gull, lesser black-backed gull, herring gull, great black-backed gull.

D.1.31 Within the survey area the foreshore was used for foraging by the following species; lesser black-backed gull, common gull, lesser black-backed gull, herring gull and great black-backed gull.

D.1.32 Greylag goose (*Anser anser*) was recorded on site, which is an Islandic species of international importance listed on the Amber List of conservation importance. The Islandic greylag goose mainly winters in Scotland (particularly around the Moray Firth) and northern England. The UK also has a resident (breeding in the UK) feral population, mainly in southern England. The resident feral greylag goose population has established from birds that have escaped or been released from captivity. For this reason the resident greylag goose population at Cremorne Wharf Depot do not qualify for Amber List status and are therefore considered to be Green List species.

Black redstart

D.1.33 Black redstart was not recorded on site during the black redstart survey. Therefore, the Carnwath Road Riverside site is not considered to be used by black redstart for foraging or nesting purposes. The lack of black redstart observations indicates that the species does not currently utilise the proposed development site or immediate surrounds for foraging or breeding. While there are many opportunities for black redstart to nest and forage in London, not all these locations are occupied by this species. This is mainly due to the rarity of black redstart in the UK and in London (Holling and Rare Breeding Birds Panel, 2008)[2].

Invasive plants

D.1.34 No invasive plant species listed on Schedule 9 of the Wildlife and Countryside Act 1981 were present on or within 10m of the site boundary.

References

[1] Royal Society for the Protection Birds. *Birds of Conservation Concern 3*. RSPB, Sandy (2009).

[2] Holling and Rare Breeding Birds Panel. *Rare breeding birds in the United Kingdom in 2008*. Mark Holling and the Rare Breeding Birds Panel (2008).

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.10**

Volume 10: Carnwath Road Riverside appendices

Appendix E: Historic environment

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

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Creating a cleaner, healthier River Thames

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Thames Tideway Tunnel

Environmental Statement

Volume 10 Carnwath Road Riverside appendices

Appendix E: Historic environment

List of contents

Page number

List of plates

Page number

List of tables

Page number

Appendix E: Historic environment

E.1 Gazetteer of known heritage assets

E.1.1 Details of known heritage assets within the assessment area are provided in Table E.1 below, with their location shown on the historic environment features map (Vol 10 Figure 7.3.1, see separate volume of figures).

E.1.2 All known heritage assets within the assessment area are referred to by a historic environment assessment (HEA) number. Assets within the site are referred to (and labelled in the historic environment features map) with the prefix 1, eg, **HEA 1A**, **1B**, **1C**. References to assets outside the site but within the assessment area begin with 2 and continue onwards, eg, **HEA 3**, **4**, **5**.

Vol 10 Table E.1 Historic Environment – gazetteer of known heritage assets within the site and assessment area

HEA Ref no.	Description	Site code/ GLHER ref/ List Entry Number
1A	The site of a medieval meadow known as Elm Tree (or Lady Lonsdale's) Mead recorded on the GLHER.	MLO23079 050623
1B	An unknown obstruction in the River Thames recorded by the UK Hydrographic Office (UKHO) although the obstruction is thought to be no longer existent (dead).	6370000011 06498
1C	The site of post-medieval possible mooring features comprising a timber post and plank recorded by the Thames Archaeological Survey (TAS) on the foreshore in the 1990s. No longer visible.	FHM10 A104
1D	Post-medieval barge bed comprising a chalk dump recorded by TAS on the foreshore in the 1990s. Still visible on the foreshore, partly covered with concrete sandbags and extending out of the site to the west.	FHM10 A105
1E	The site of post-medieval wharf made of stone, timber and metal recorded by TAS on the foreshore in the 1990s. No longer visible.	FHM10 A106
1F	Metropolitan Asylums Board (MAB) open wharf named 'West Wharf', with a jetty and floating pier on the eastern site boundary. MAB was set up in 1867, to take over from London's workhouses the care of the sick poor. In 1883, MAB set up a new river ambulance service operated from the wharf (one of three) which was set up for the embarkation of patients with infectious diseases such as smallpox. The ambulance service began with a fleet of	---

HEA Ref no.	Description	Site code/ GLHER ref/ List Entry Number
	four paddle-steamers. The Board also operated its own Mechanical Transport Department at Carnwath Road which undertook a variety of work including the building of ambulance bodies, and the repair and maintenance of its fleet of vehicles. The OS revised edition 25":mile map of 1916 shows the eastern part of the site occupied by a number of buildings of the Ambulance Station and West Wharf. In 1930, the river ambulance service passed into the control of the London County Council but was disbanded in 1932.	
1G	River wall comprising sections of concrete and sheet piling. Noted on the site visit.	---
2	Petrofina Wharf, Carnwath Road, SW6. An archaeological evaluation by Museum of London Archaeology Service (MOLAS, now MOLA) in 1996. Two possible buried soil horizons survived above the natural gravels. A pit contained fire-cracked flint fragments, possibly suggesting prehistoric activity in the area. The soils were overlaid by alluvial and peaty deposits – having accumulated over a long period of time – and sealed by modern made ground.	CNR96
3	Broomhouse Dock, Broomhouse Lane, Hurlingham, SW6. An archaeological watching brief by Wandsworth Historical Society (WHS) in 2004. General debris, a tree and modern concrete ramp were removed as part of an environmental improvement site for the drawdock. Beneath the concrete ramp were the remains of its foundations: a hardcore base and timber framework. Beneath these were river deposits, with material dating to 19th to 20th century. As the earlier timber ramp (visible further out in the river at low tide) was not revealed above current river levels at the north end of the site, no further deposits were removed prior to reinstating access.	DBL04
4	Broomhouse Lane is noted on the GLHER as possibly of medieval date. This is also the site of the Town Meadows which date to the medieval period.	MLO13616 050628 MLO23079 050623
5	The site of the medieval village of Broomhouse. Recorded on the GLHER.	050629
6	Porcelanosa, Wandsworth Bridge Road, SW6. An archaeological watching brief by Pre-Construct Archaeology (PCA) in 2002. Natural alluvium was found below 19th century make-up deposits	WBD02

HEA Ref no.	Description	Site code/ GLHER ref/ List Entry Number
7	The chance find of an unspecified Neolithic artefact. Recorded on the GLHER.	050457
8	The site of the medieval meadow called Dock Mead. Recorded on the GLHER.	MLO40742 050623/03
9	A Mesolithic flint tranchet axe was found in the Thames at Fulham, approximately 120m west of Wandsworth Bridge. Recorded on the GLHER.	MLO25997 106087
10	A polished Neolithic flint axe recovered from the Thames at Wandsworth Bridge. Recorded on the GLHER.	MLO26780 106047
11	The possible site of a prehistoric or Roman ford crossing the Thames near modern Wandsworth Bridge. Recorded on the GLHER.	MLO156 031592
12	An ovate flint axe of Middle Acheulean type (Lower Palaeolithic) found in 1907. Recorded on the GLHER. A middle Bronze Age palstave axe was found near Wandsworth Bridge in the River Thames, as recorded on the GLHER. The axe was made from copper alloy and has a loop and was one of a number of items collected by the Reverend William Greenwell which were later bought by John Pierpont Morgan who donated them to the British Museum in 1908. . A Bronze Age to Iron Age Hallstatt sword found in 1907 under Wandsworth Bridge. Recorded on the GLHER.	MLO11936 100222 MLO14563 100003 MLO24660 100204
13	A Palaeolithic flint flake exposed in gravel in Mears Pit which was situated slightly west of Wandsworth Bridge. Recorded on the GLHER.	MLO11946 030886
14	Wandsworth Garage Bus Depot (London Transport Executive). Grade II listed.	1184233
15	An unknown obstruction in the River Thames recorded by the UKHO although the obstruction is thought to be no longer existent (dead).	6370000011 06497
16	The chance find of two Mesolithic flint blades/flakes which were 14cm and 15cm in length. Recorded on the GLHER.	MLO67 100055
17	A Neolithic to Bronze Age ‘boat shaped’ battle axe found in 1974 by the WHS. Recorded on the GLHER.	MLO11987 100223
18	A Mesolithic flint core was retrieved from the River Thames at the point where it merges with the River Wandle. Recorded on the GLHER.	MLO14598
19	A Mesolithic flint tranchet axe found in 1971 by the WHS.	MLO14596

HEA Ref no.	Description	Site code/ GLHER ref/ List Entry Number
	Recorded on the GLHER.	100053
20	A Neolithic flint core accessioned in 1936, found at the mouth of the Wandle. Recorded on the GLHER. Neolithic to Bronze Age axe, spearhead, sword and pin dredged together from around the mouth of the River Wandle. Recorded on the GLHER. A Bronze Age to Iron Age leaf shaped sword found in 1874. Recorded on the GLHER. A late Iron Age brooch found from the mouth of the River Wandle. Recorded on the GLHER.	MLO10164 100202 MLO14624 100100 MLO25144 100192 MLO26716 106033
21	The GLHER records the northern terminus of the Surrey Iron Railway, which opened in 1803 and connected the Thames with Croydon and Merstham, using horse-drawn carts on iron rails. It was the first railway run by a public company independent of a canal or other enterprise. From the Thames the line ran to the east of the Wandle and Ram Brewery, crossing the Wandle to the south of Wandsworth High Street to serve the Wandle mills. The line closed in 1846. A basin or dock was constructed at the mouth of the Wandle in 1802 and remained in use until the 1840s.	MLO11013 031593
22	Peterborough Road. Unspecified Neolithic finds recovered by chance. Recorded on the GLHER.	050186
23	A Mesolithic flint flake/blade recovered in 1981. Recorded on the GLHER.	MLO10457 031187
24	Post-medieval causeway made of timber and concrete recorded by TDP on the foreshore.	FHM10 A101
25	Aggradation layer deposited on the foreshore by riverine action, recorded by TDP.	FHM10 A102
26	Post-medieval dump deposit of bricks recorded by TDP on the foreshore.	FHM10 A103
27	The former Wandsworth Gasworks site. The GLHER includes the approximate location of the chance find of late Bronze Age artefacts, possibly part of a hoard of metal pieces, eight axes and a chisel found in 1923.	MLO10470 MLO13085 MLO11003 031257–9
28	Wandsworth Bridge, constructed in 1939 and designed by the London County Council Chief Engineer Mr T. Pierson Frank.	-
29	An area of 19th century residential streets comprising two-	-

HEA Ref no.	Description	Site code/ GLHER ref/ List Entry Number
	storey terrace housing.	
30	Scatter of timbers lying flat in various directions: possible shipyard waste or driftwood of post-medieval date recorded by TDP on the foreshore. Post-medieval timber fender lying flat on the foreshore recorded by TDP.	FWW08 A122 FWW08 A123
31	Modern rubble dump deposit recorded by TDP on the foreshore.	FHM10 A109
32	Possible prehistoric deposit of peat/organic clay shown on intermittent exposures that appears to go beneath **HEA 33** (below). Recorded by TDP on the foreshore.	FWW06 A110
33	Undated silt deposit comprising large tufa balls and wood in blue shelly silt that appears to go over **HEA 32** (above). Recorded by TDP on the foreshore.	FWW06 A111
34	Possible prehistoric deposit comprising a dark brown peat shown on intermittent exposures and recorded by TDP on the foreshore.	FWW06 A112
35	Post-medieval riverfront flood defences made of brick and located at the entrance to the River Wandle. Recorded by TDP on the foreshore.	FWW06 A114
36	Possible prehistoric deposit comprising peat/organic clay recorded by TDP on the foreshore.	FWW06 A121
37	Barge bed made of timber and metal recorded by TDP on the foreshore.	FWW07 A101
38	Post-medieval outfall drain comprising an apron made on concrete, recorded by TDP on the foreshore.	FWW07 A102
39	Scatter of timbers lying flat in various direction: possible shipyard waste or driftwood of post-medieval date recorded by TDP on the foreshore.	FWW07 A103
40	Scatter of timbers lying flat in various directions: possible shipyard waste or driftwood of post-medieval date recorded by TDP on the foreshore.	FWW07 A104
41	Post-medieval barge bed made of timber and metal recorded by TDP on the foreshore.	FWW07 A105
42	Post-medieval barge bed made of timber and metal recorded by TDP on the foreshore.	FWW07 A106
43	Aggradation layer deposited on the foreshore by riverine action, recorded by TDP. Deep in several places where it	FWW07

HEA Ref no.	Description	Site code/ GLHER ref/ List Entry Number
	was dredged.	A107
44	Moored barge recorded by TDP on the foreshore.	FWW07 A108
45	Aggradation layer deposited on the foreshore by riverine action, recorded by TDP.	FWW07 A109
46	Aggradation layer deposited on the foreshore by riverine action, recorded by TDP. Apparently due to dredging of lower foreshore.	FWW07 A110
47	Post-medieval timber fender lying flat on the foreshore recorded by TDP.	FWW08 A104
48	Post-medieval consolidation deposit of chalk recorded by TDP on the foreshore.	FWW08 A105
49	Possible post-medieval mooring post recorded by TDP on the foreshore.	FWW08 A120
50	Scatter of timbers lying flat in various directions: possible shipyard waste or driftwood of post-medieval date recorded by TDP on the foreshore.	FWW08 A121
51	Thames channel The approximate location of a post-medieval metal mount, recovered from the Thames channel and recorded by the Portable Antiquities Scheme (PAS).	LON-983246
52	Thames channel The approximate location of a Neolithic flint blade, recovered from the Thames channel and recorded by the PAS.	LON-4290F0
53	Thames channel The approximate location of a Roman token, recovered from the Thames channel and recorded by the PAS.	LON-E98F21
54	The murals on the Piper Building by the artist John Piper, are locally listed. The Piper Building is an industrial building dated to the 1950s and was converted to residential use in the 1990s by Lifschutz Davidson.	---

E.2 Site location, topography and geology

Site location

E.2.1 The site is located on the north bank of the River Thames and comprises two parts, the main site and the highway works site. The main site includes a vacant riverside plot of land known as Whiffin Wharf and Hurlingham Wharf in its western side, and the Carnwath Road industrial estate in its eastern side, and the river wall and foreshore in the southern part of the site. Carnwath Road runs outside the main site boundary to the northwest. The highway works site lies to the northeast of the main site on the corner of Wandsworth Bridge Road and Carnwath Road. The site falls within the historic parish of Fulham, and formerly lay within the county of Middlesex prior to being absorbed into the administration of the London Borough of Hammersmith and Fulham.

Topography

E.2.2 The area is fairly flat with a gentle slope down towards the northeast. Street level on Carnwath Road, immediately to the north of the site, is at approximately 105.5m ATD (above Tunnel Datum: the equivalent of 5.5m Ordnance Datum). In the southern part of the site the level of the foreshore beside the river wall ranges between 102.2m ATD and 103.3m ATD, and further south is exposed at low tide at levels between 100.2m ATD and 100.6m ATD. The Pelor Multibeam Bathymetry data held by Thames Tunnel suggests that the river bed falls from about 99.0m ATD just below the low tide mark to 96.0m ATD at the southern boundary of the site.

Geology

E.2.3 The site lies on the northern edge of the Thames floodplain, opposite its confluence with the River Wandle. According to British Geological Survey (BGS) digital data the floodplain deposits comprise alluvium overlying Shepperton sand and gravel. The northern boundary of the site follows the interface between the floodplain and the river terrace (Kempton Park Gravels[1]).

E.2.4 The northern part of the main site lies on the landwards side of the river wall, where the alluvium is buried by modern and historic made ground, wharves and buildings. The southern part of the main site includes the modern foreshore and the riverbed. Here alluvial deposits will have been eroded by the river in the past and are likely to be sealed by modern foreshore and riverbed gravels, sands and silts.

E.2.5 Although there is no geotechnical borehole data for the site itself (apart from two vibro cores on the foreshore), there is a cluster of BGS boreholes 400m to the northeast in a similar topographical environment[2], from which the levels of gravel and alluvium on the site might be inferred. All the boreholes in this cluster are antiquated and short in detail but they record the modern ground surface at 104.6m ATD, with the surface of alluvium at 101.5m ATD and the gravel surface at 100.9m ATD.

E.2.6 If the surfaces of the gravel and alluvium lie at a similar elevation at Carnwarth Road as recorded in the borehole cluster to the north east, then alluvial deposits might be found between c 100m and 102m ATD. Towards the southern boundary of the main site, however, the alluvium is likely to have been eroded by the river, as the riverbed lies at c 96m ATD. In this area the riverbed lies below the level of the top of the gravels that form the base of the archaeological sequence and it is likely that any deposits of archaeological interest would have been removed by river scour or historic dredging.

E.2.7 If the gravel surface on the site lies, as inferred, at c 100m ATD, it would have lain above the deeper parts of the valley floor, forming a step between the lower-lying parts of the floodplain, where wetland environments existed, and the adjacent river terrace. Thus it is likely that the site lay in a relatively dry location throughout prehistory, slightly above the deeper and wetter parts of the floodplain. Evidence for a dry prehistoric land surface is likely to exist below the alluvium on the main site, which probably became inundated by flooding during the historic period, when 1–2m of alluvial clay silts built up. These would have been deposited in brackish water from the late prehistoric/Roman period onward, when the maximum mean tidal head measurements, as taken from the study of Roman bankside revetments, indicate that only land over 101.0m ATD would lie above the tidal range[3]. Therefore, from the Iron Age or Roman period a slightly saline, seasonally flooded, wet meadowland/marsh environment would have existed on the site, which could have persisted for much of the historic period across the site area.

E.2.8 Soils are likely to have formed at the surface of the gravel on the site in prehistory. Such soils are unlikely to have good preservation of environmental remains, owing to their dry environment and mixing caused by exposure at a land surface for considerable time. The overlying alluvium might preserve organic remains, but this may have been derived from up or downstream and could also have been subject to episodic drying out. Apart from basic characterisation of the depositional environment and topographic / deposit modelling, the potential for past environment reconstruction from the alluvium on the site is likely to be low.

E.2.9 Two vibro cores on the foreshore within the site record a variable thickness of foreshore gravels. To the west (VC6007) c. 0.8m of foreshore gravels were recorded and to the east (VC6009) c. 1.6m were recorded. The London Clay was not reached in the eastern locations but was recorded at 96.12m ATD in VC6007.

E.2.10 Historic maps (Figure E.1 and E.2) show a stream and several creeks cutting through the main site in the eighteenth and nineteenth centuries. These are not recorded as ‘lost rivers’, but could have been descendants of earlier, natural watercourses. No indication of such streams exist in the BGS mapping and there is no geotechnical data or deposit modelling available for the site itself to draw on. If such watercourses exist, however, the alluvial sequence is likely to be deeper and its environmental potential greater than that set out above.

E.3 Past archaeological investigations within the assessment area

E.3.1 In the 1990s the Thames Archaeological Survey (TAS) carried out a survey of the foreshore in the area of the main site. This identified, extending into the western part of the main site, the remnants of a post-medieval chalk and timber barge bed (**HEA 1D**), in the southwestern part of the site, which is still visible, with its eastern end within the main site partly covered with concrete sandbags (Figure E.10). Other post-medieval features were recorded on the foreshore within the main site comprising a possible timber post and plank mooring (**HEA 1C**), and the remnants of a post-medieval wharf made of stone, timber and metal (**HEA 1E**) were also identified, but these are no longer visible.

E.3.2 Three archaeological investigations have been carried out within the assessment area. An evaluation carried out in 1996, 85m to the west of the main site (**HEA 2**), revealed a soil horizon with fire-cracked flint fragments suggesting prehistoric activity in the area, overlain by alluvial and peaty deposits. Alluvial deposits were also recorded during a watching brief undertaken in 2002, 185m to the northeast of the main site (**HEA 6**), overlain by 19th century made ground. In 2004, an archaeological watching brief (**HEA 3**) 200m to the west recorded post-medieval foundations timber associated with a wharf. The results of these investigations, along with other known sites and finds within the assessment area, are discussed by period, below.

E.4 Archaeological and historical background of the site

E.4.1 The following section provides a detailed archaeological and historical background for the site. It should be read alongside the research framework presented in Appendix C to Vol 2 Appendix E2, which sets the overall Thames Tunnel scheme, and the individual site-specific assessments, within a broader historic environment context (i.e. past landscapes and human activity within such landscapes). It identifies the main route-wide heritage themes, of which the built and buried heritage assets identified within this assessment form a part.

Prehistoric period (700,000 BC–AD 43)

E.4.2 The site is located on the northern margin of the floodplain on what is likely to have been a step or promontory of higher ground, intermediary between the wetlands of the floodplain and the drier ground of the river terrace.

E.4.3 Although there has been a limited amount of past archaeological investigation in the assessment area, there is evidence of prehistoric activity from numerous chance finds noted in the GLHER. For the Palaeolithic period (700,000 BC–10,000 BC), these comprise a Lower Palaeolithic handaxe near Wandsworth Bridge, 185m to the southeast of the main site (**HEA 12**), and an axe from Mears Pit, 275m to the southeast

of the main site (**HEA 13**). Both of these finds are likely to be redeposited and not in their original context or location.

E.4.4 In the later prehistoric, the river terrace would have been a focus for settlement, whilst the floodplain would have become increasingly wet and marshy as river levels rose and drainage became impeded. Islands and areas of higher ground within or marginal to the floodplain, such as the site location, would have been used by Mesolithic and later prehistoric people (from c. 10,000 BC onward) as bases from which to exploit the rich floodplain resources of food and raw materials such as reeds or willow. These areas of higher ground were subsequently buried beneath alluvium, which accumulated as river levels rose and the river regime changed as a result of human impact and variations in climate. The Greater London Historic Environment Record (GLHER) records the findspot of a Mesolithic tranchet axe on the Thames foreshore, 15m east of the main site (**HEA 9**), and a flint axe and a core retrieved from the Thames 90m and 125m to the southeast of the main site (**HEA 19** and **18**). From the foreshore on the south side of the river, two Mesolithic blades/flakes were found by chance 170m south of the main site (**HEA 16**), and a blade/flake was recovered from Wandsworth Waterside 300m to the south of the main site (**HEA 23**).

E.4.5 It has been suggested that a possible prehistoric ford was located in the area of the current Wandsworth Bridge, 160m east of the main site (**HEA 11**). Fords probably exploited islands of higher ground within the floodplain and sand or gravel bars within the multiple river channels that threaded along it. They would have avoided areas within the floodplain that were low-lying and marshy. These areas however would have been attractive for hunting, and gathering food and reeds.

E.4.6 In 1996, an archaeological evaluation at Carnwath Road, 85m to the west of the main site (**HEA 2**), recovered evidence of undated prehistoric activity comprising a small pit or hollow which contained fragments of fire-cracked flint. The pit was associated with a buried soil horizon, formed in the surface of the river terrace gravels and later sealed by alluvium.

E.4.7 This stretch of the river may have been a ritual focus, suggested by the number of Neolithic artefacts recovered from the river within the assessment area. These comprise a polished flint axe and a 'boat-shaped' battle axe recovered from the Thames 220m to the east of the main site (**HEA 10**) and 160m to the south (**HEA 17**). In addition, a flint core and an axe were recorded in the confluence of the River Wandle and the Thames, 220m and 230m to the southwest of the main site (**HEA 20**). North of the Thames, chance finds of Neolithic artefacts have also been made 240m north of the main site (**HEA 22**).

E.4.8 The area was exploited through the Bronze Age; the GLHER records a middle Bronze Age Palstave axe 185m to the southeast of the main site (**HEA 12**). A Bronze Age spearhead, sword and pin were dredged together from the mouth of the River Wandle 220m to the southwest of the main site (**HEA 20**). In addition a Bronze Age to Iron Age Hallstatt type sword and leaf shaped sword were recovered from the river within the assessment area, 185m to the southeast of the main site and 220m to the southwest (**HEA 12** and **20** respectively). Also recorded within the

assessment area is the chance find of a possible Bronze Age metal-worker's hoard (**HEA 27**), *c*. 310m to the south of the main site.

E.4.9 Prior to the Roman period, the site itself would have remained largely dry, although with the effects of rising sea levels the area would have become increasingly wet and marshy over time. As a consequence, there is potential within the site for recovering evidence of dry land activity from the Mesolithic to at least the early Iron Age.

Roman period (AD 43–410)

E.4.10 Within approximately a decade of the arrival of the Romans in AD 43, the town of *Londinium* had been established on the north bank of the Thames where the City of London now stands, 8km to the northeast of the site. With its development of as a trading port, river traffic along the Thames would have increased. *Londinium* quickly became a major commercial centre and the hub of the Roman road system in Britain.

E.4.11 Small settlements and farmsteads would have been located along the roads and on the dry gravel terraces overlooking the Thames. The site is, however, some distance from any known areas of Roman settlement, and lay 4.5km to the southeast of the road to Silchester and the west of Britain, which ran on the line of modern Holland Park Avenue[4]. The GLHER records a possible Roman or earlier ford crossing the Thames 160m to the east of the main site (**HEA 11**). The only archaeological evidence of Roman activity within the assessment area is a Roman token recorded by the PAS 350m to the west of the main site (**HEA 53)**. During this period it is likely that the site would have been on the alluvial floodplain, possibly used for fishing and rough grazing.

Early medieval (Saxon) period (AD 410–1066)

E.4.12 Following the withdrawal of the Roman army from England in the early 5th century AD the whole country fell into an extended period of socio-economic decline. In the 9th and 10th centuries, the Saxon Minster system began to be replaced by local parochial organisation, with formal areas of land centred on settlements served by a parish church.

E.4.13 The site lay within the extensive manor (estate) of Fulham. The place name has Saxon origins, meaning the 'homestead of an individual named *Fulla'*, or possibly 'foul town' if referring to marshy land. The manor was given to Erkenwald, Bishop of London in the 7th century, and remained in the possession of the bishops of London throughout this period[5]. The land occupied by the later medieval Fulham Palace, 1.3km to the northwest of the site, was originally acquired in the early 8th century although there is no record of building until the mid 11th century[6].

E.4.14 The Anglo-Saxon chronicle of AD 879 records that Danish invaders came up the Thames and camped at Fulham[7]. In AD 950, Bishop Theodred's will lists '*Fullenham'* as one of his properties[8]. There may have been a manor house on or near the site of the later Fulham Palace at the time[9]. It has been conjectured that the moat which encompasses the palace grounds may have been originally dug by this Danish army[10], although an earlier (Roman) provenance has also been suggested. It seems more

likely, however, that the moat and earthworks represent several phases of medieval construction[11]. The manor house and nearby parish church would have formed a focus for settlement.

E.4.15 Throughout this period, the site lay some distance from known settlements in marshland, prone to flooding, but possibly used for grazing.

Later medieval period (AD 1066–1485)

E.4.16 By the time Domesday Book was compiled in AD 1086, Fulham (*Fuleham*) was a prosperous community with ploughland, meadows, woodland, and a small weir or fish trap. The manor house and palace of Fulham, 1.3km to the northwest of the site, is first mentioned in the mid 11th century and was one of the Bishop of London's country seats. The palace and its grounds covered thirty-seven acres surrounded by a moat[12]. The moat is recorded in Court Rolls of Fulham Manor for 1392, when it is referred to as the great ditch (magna *fossa*), and in 1476 it is called the 'moat ditch of Fulham'[13]. The palace was substantially demolished and rebuilt from 1506 onwards. It survives as a Grade I listed building, owned by Church Commissioners and leased to Hammersmith and Fulham Council and the Fulham Palace Trust. Both palace and gardens are designated as a Scheduled Monument and Registered Park and Garden.

E.4.17 The medieval village grew up to the southeast of the palace precinct[14]. The parish church of All Saints is located on Putney Bridge Approach, 1.2km to the northwest of the site. The church was built in 1154, although only a 15th century tower remains today. The village had watermills and wharves by the river, and was probably served by a ferry. However the site lay well beyond this main settlement nucleus, where a number of subordinate manorial states and farms grew up, held by the Bishops of London[15]. Closest to the site, the GLHER records the small settlement of Broomhouse, 75m to the west of the main site (**HEA 5**). A ferry operated from the bottom of the medieval Broomhouse Lane (**HEA 4**).

E.4.18 Along the fringes of the river, on the floodplain, were meadows, a number of which were documented in the medieval period including Elm Tree (or Lady Lonsdale's) Mead which the GLHER places in the main site (**HEA 1A**), with others to the east and west (**HEA 4** and **8**). At this time meadow (grassland which was mown for hay) was very valuable; the hay fed the plough animals of the farms and could be sold. At certain times of the year, animals would also be turned onto the meadow for pasture. By the 13th century, most floodplains were managed as meadows, with periodic flooding both fertilising and irrigating the grass[16]. From the later medieval period onwards, drainage and reclamation was often undertaken, with the construction of ditches and banks to safeguard crops on the higher ground and manage the low-lying meadows by controlling flooding. Later cartographic evidence (Figures E.1 and E.2) show a man made river 'wall' (ie an embankment) running along the northern boundary of the site, along the line of Carnwath Road, which may have had medieval origins.

E.4.19 Throughout this period, the site probably lay in floodplain meadows, close to but outside the settlement of Broomhouse.

Post-medieval period (AD 1485–present)

E.4.20 With the growth of urban London to the northeast, rural areas such as Fulham became valuable as market gardens supplying the growing population. Rocque's map of 1746 (Figure E.1) shows the site within meadows or pasture alongside the Thames, with extensive market gardens on the drier ground to the north of the site further from the river. Water Lane leads from the small settlement of Broomhouse at the river's edge and may have followed the line of the current Carnwath and Townmead Roads. A natural water channel or drainage ditch is shown crossing the main site from north to south: its course still forms the line of a boundary on the main site.

E.4.21 Industrial development started to encroach on the area of Fulham in the later-18th century. From 1762, parts of the Sandford estate, 1.0km to the northeast of the site, were turned over to the manufacture of saltpetre (an ingredient of gunpowder) and various industries were carried out on the land from this time onwards. In 1824, the Imperial Gas Company purchased the entire estate and erected gas holders[17].

E.4.22 Despite this, the rural character of the area as shown on Rocque's map was maintained into the second half of the 19th century. The Ordnance Survey (OS) 1":mile map of 1822 (not reproduced) and the OS 1st edition 25":mile map of 1869 (Figure E.2) show the site within an area named 'The Town Meadows', with a clear distinction between the market gardens to the north and the meadows on the reclaimed former marshland alongside the riverfront. At this time most of the site fell within two fields, with tree-lined drainage ditches across and between them. The southern half of the main site comprised the Thames foreshore and partly extended out into the river. Hachures indicate an earthen bank along the northern boundary of the site, which is probably the river wall.

E.4.23 Towards the end of the 19th century the land was gradually developed and the river frontage turned into an industrial area. The OS 2nd edition 25":mile map of 1896 (Figure E.3) still shows the main site as open land with ditches and raised banks, but with streets of terraced houses laid out in the highway works site to the northeast and wharves to the east along the river, and Carnwath Road established along part of the northern boundary. The eastern half of the main site has become the Metropolitan Asylums Board's open wharf named 'West Wharf', (**HEA 1F**) with a jetty and floating pier on the eastern main site boundary.

E.4.24 The Metropolitan Asylums Board (MAB) was set up in 1867, to take over from London's workhouses the care of the sick poor. In 1879, a Poor Law Act empowered the Board 'to provide and maintain carriages suitable for the conveyance of persons suffering from any infectious disorder'[18]. It was decided that smallpox cases should be treated in isolated hospitals on the banks of the Thames or in floating hospitals on the river. In 1883, the MAB set up three hospital ships (The Atlas, the Endymion and the Castilia) moored at an isolated stretch of the river at Long Reach near Dartford. To provide a more efficient means of transporting smallpox patients to and from Long Reach, a new river ambulance service was created with three wharves set up for the embarkation of patients including

the West Wharf (**HEA 1F**), within the eastern part of the main site, which served West London. The other wharves were at Rotherhithe and Poplar. It opened in February 1885. The river walling along the frontage measured 600 ft in length. The land side was fenced and a pier constructed, together with a porter's lodge, receiving houses and ambulance house.

E.4.25 The ambulance service began with a fleet of four paddle-steamers. After the smallpox epidemics of 1892–5 and 1901–2 had subsided the Wharves underwent a period of maintenance and major repairs, e.g. to all the dolphins. The pontoon at West Wharf was removed for repair between 1903–11[19]. Following the decline in smallpox cases, the river service was reorganized in 1913. The North Wharf at Blackwall in east London became the sole departure point for the smallpox ships, with the South Wharf at Rotherhithe accepting only general fever cases.

E.4.26 The Board also operated its own Mechanical Transport Department at Carnwath Road which undertook a variety of work including the building, repair and maintenance of its fleet of ambulances[20]. The OS revised edition 25":mile map of 1916 (Figure E.4) shows the eastern part of the main site occupied by a number of buildings of the Ambulance Station and West Wharf. The western part of the main site is occupied by two small buildings of the X.Y.Z. Wharf, with parts of the main site still vacant.

E.4.27 In 1930, the river ambulance service passed into the control of the London County Council but was disbanded in 1932[21]. The OS revised edition 25":mile map of 1938 (not reproduced) shows no change within the site. The London County Council's bomb damage map (not reproduced) shows no bomb damage within the site or the immediate vicinity, although the highway works site is marked as a clearance area[22].

E.4.28 By the time of the OS 6":mile map of 1954−8 (Figure E.5) the former ambulance maintenance depot in the eastern part of the main site and floating pier had been demolished, and the area was now occupied by the Trinidad Wharf and the Hurlingham Wharf, including a travelling crane. The X.Y.Z. Wharf still occupied the western part of the main site, and one of its buildings had been enlarged.

E.4.29 The OS 1:2,500 scale map of 1962−8 (Figure E.6) shows more buildings at the edge of the river on Trinidad Wharf, and some enlargement of the buildings on West Wharf. Much of Hurlingham Wharf is now taken up by two large buildings identified on later maps as a cement works, and there are warehouses of Whiffin Wharf in the western part of the main site. There are no jetties.

E.4.30 The OS 1:1,250 scale map of 1985 (Figure E.7) shows no change on the western part of the main site, but on the eastern part the earlier wharf buildings have been removed and the current Carnwath Road industrial estate has been built.

E.4.31 Hurlingham Wharf was last owned by Blue Circle cement company which closed it in 1995 when all its operations were consolidated in Gravesend. The structures within it and the warehouses of Whiffin Wharf to the west were demolished soon afterwards.

The current site

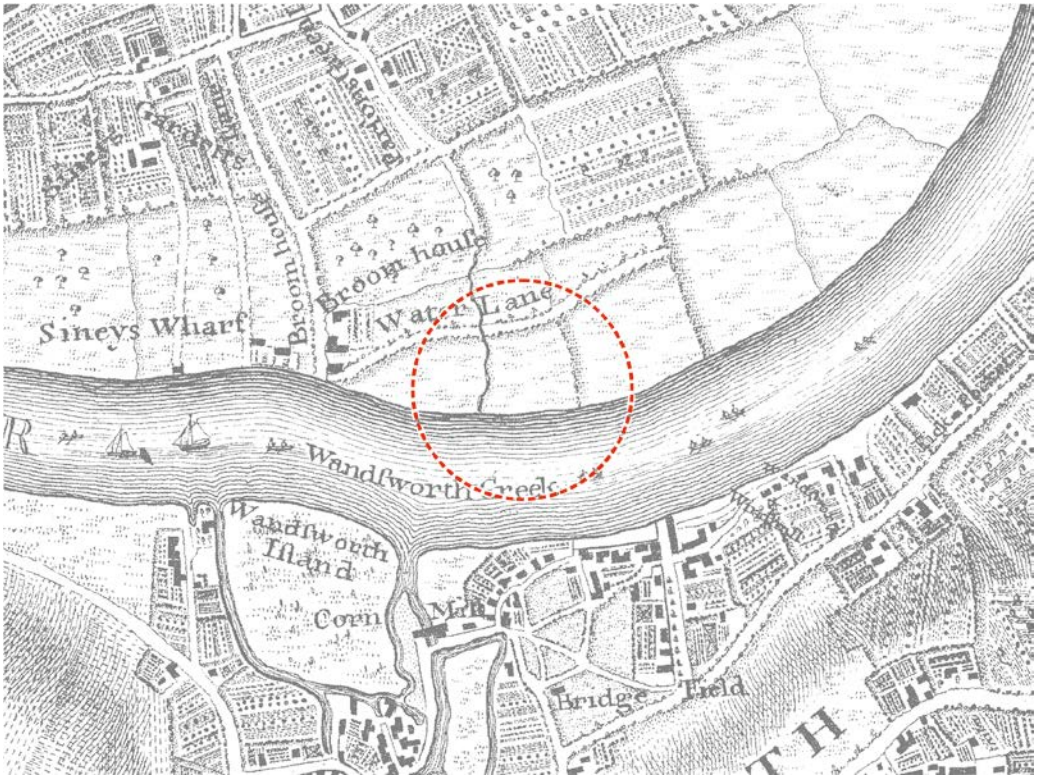
E.4.32 Carnwath Road Industrial Estate was not accessed during the site visit but there were adequate views from Carnwath Road and the public access along the riverfront (Figures E.8).

E.4.33 In the eastern section of the main site consists of small single storey yellow brick light industrial units ('portal buildings'), part of the Carnwath Road Industrial Estate. These date to the late 20th century and accommodate a number of small businesses (Figure E.8). The west of the main site consists of Whiffin Wharf and Hurlingham Wharf which at the time of the main site visit had a to-let sign displayed offering open storage yards, and was surrounded by a concrete slab boundary wall. Access is via a wide metal gateway in the northern wall. The area within this boundary wall is hardstanding with a mound of rubble to the east (Figure E.10, E.11).

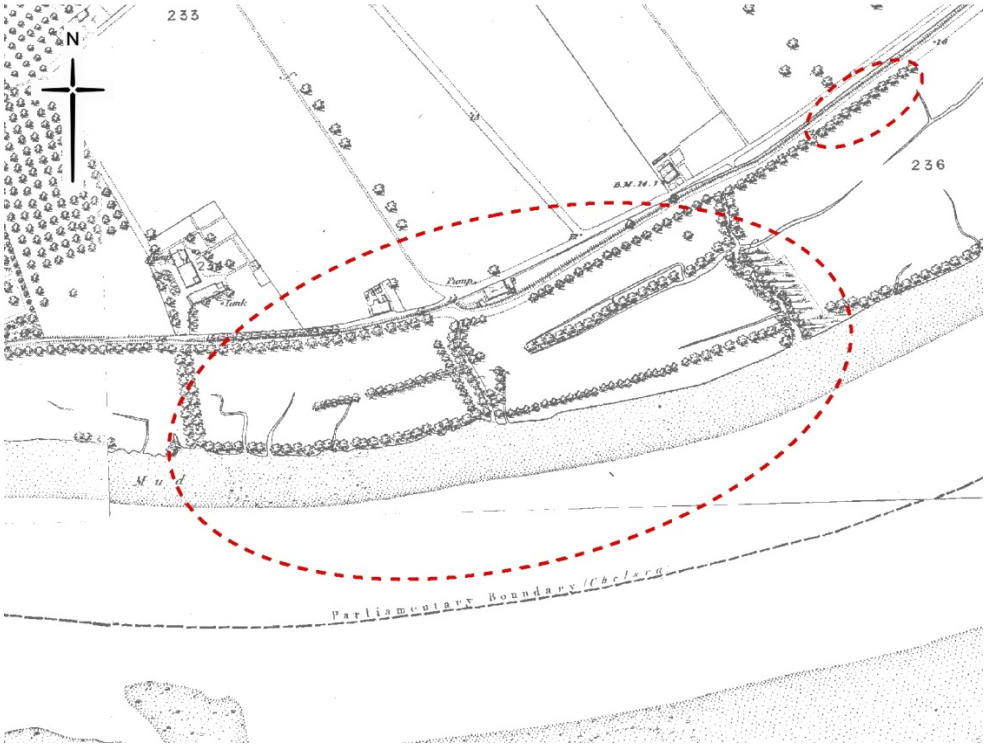
E.4.34 The MOLA site visit accessed most of the foreshore area, other than a soft spot in the central area (probably silted up area of dredging). The river wall within the main site (**HEA 1G**) comprises sections of concrete and sheet piling (Figure E.13). The eastern end of a chalk and timber barge bed is visible on the foreshore in the western part of the main site (**HEA 1D**), partly covered with concrete sandbags (Figure E.12).

E.5 Plates

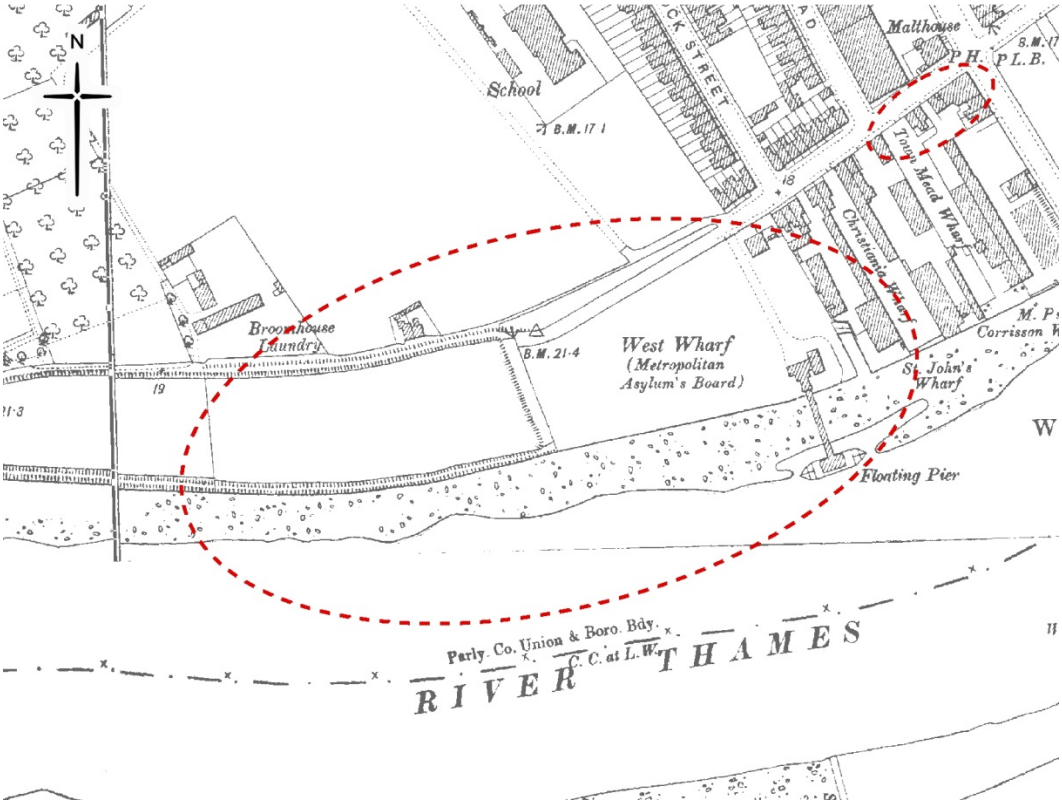
Vol 10 Plate E.1 Historic Environment – Rocque's map of 1746



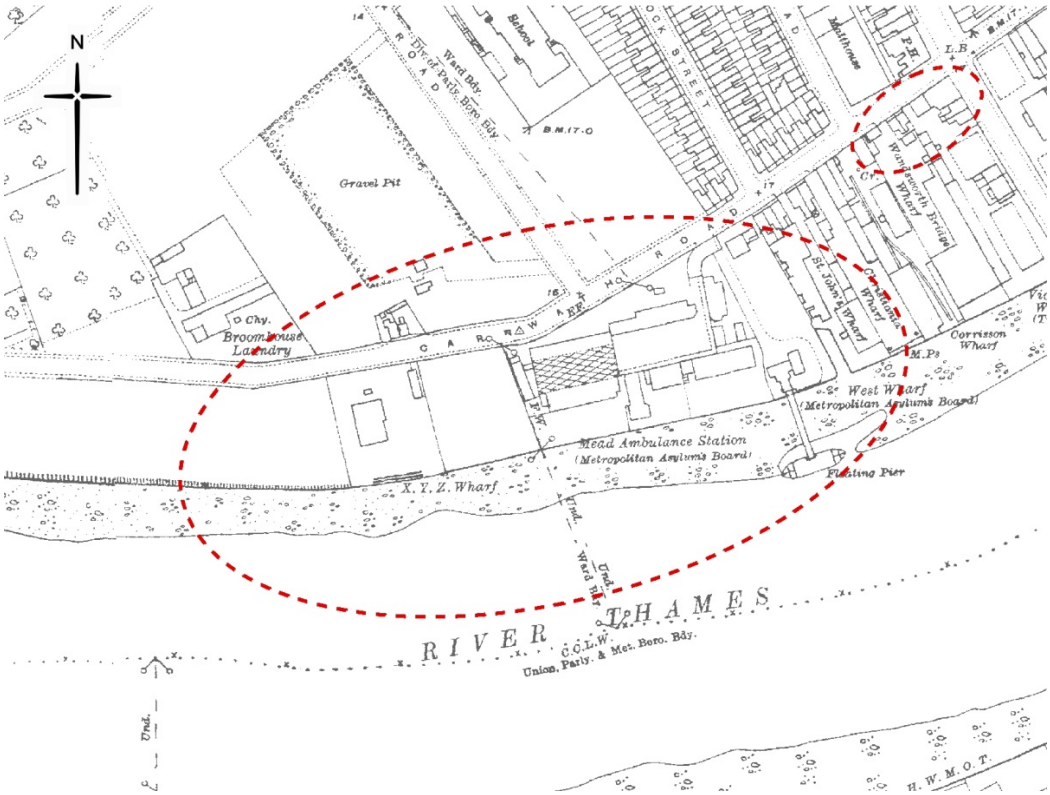
Vol 10 Plate E.2 Historic Environment – Ordnance Survey 1st edition 25":mile map of 1869 (not to scale)



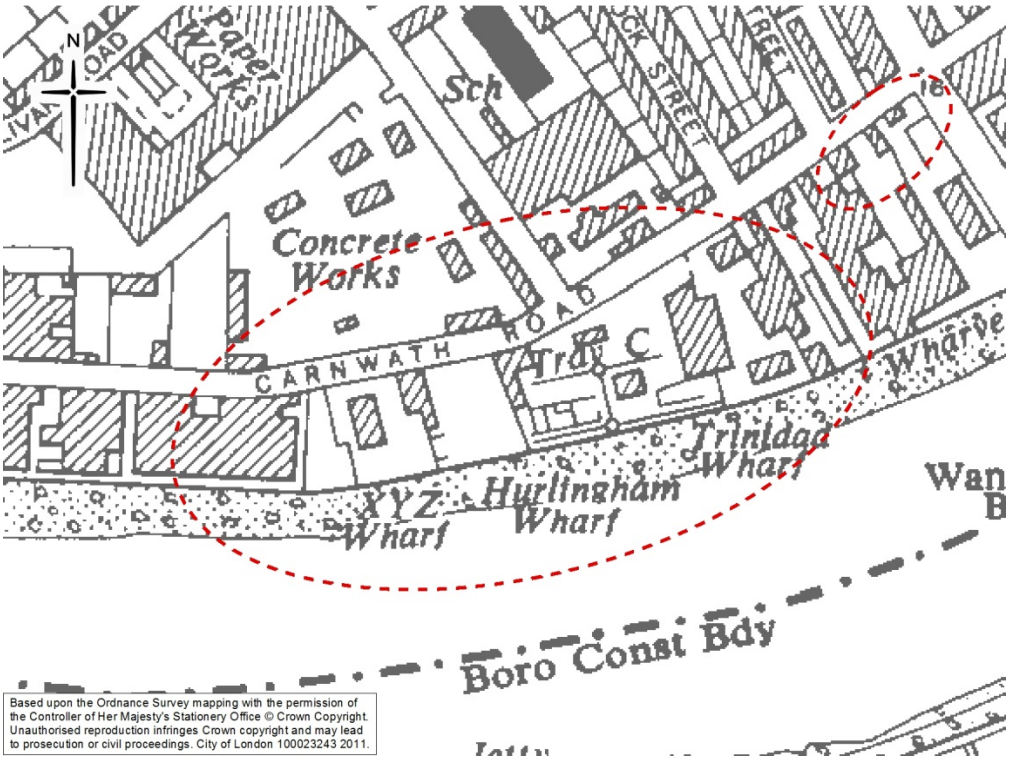
Vol 10 Plate E.3 Historic Environment – Ordnance Survey 2nd edition 25":mile map of 1896 (not to scale)



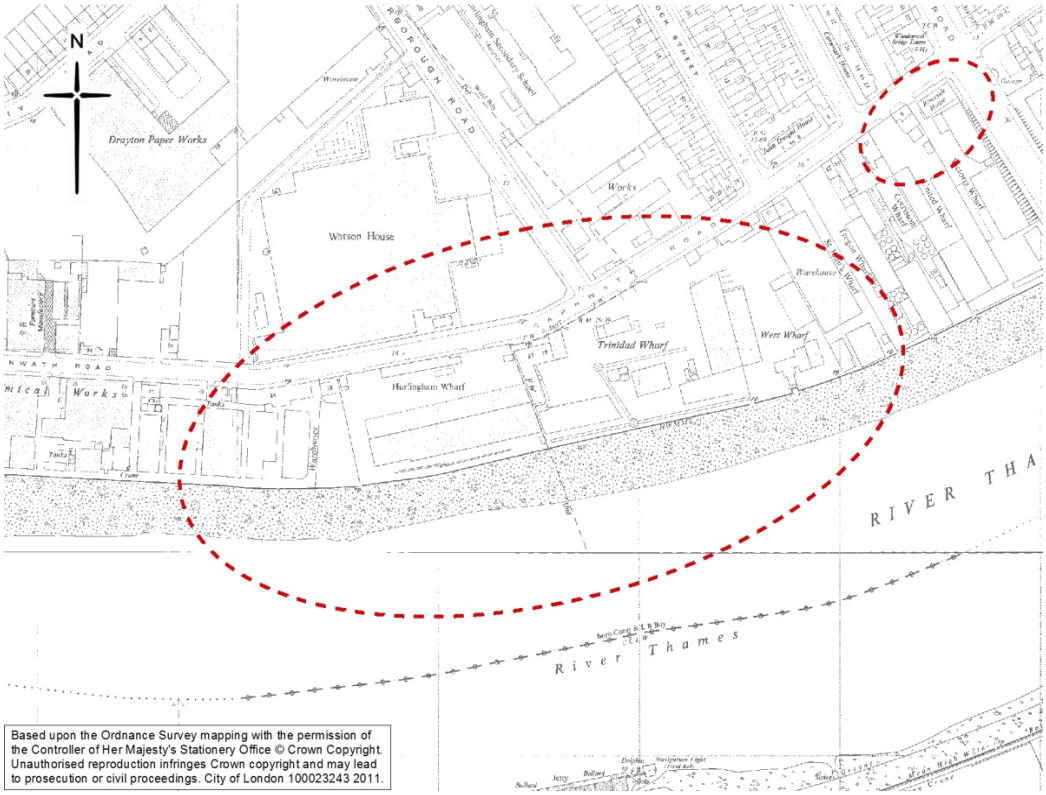
Vol 10 Plate E.4 Historic Environment – Ordnance Survey 3rd edition 25":mile map of 1916 (not to scale)



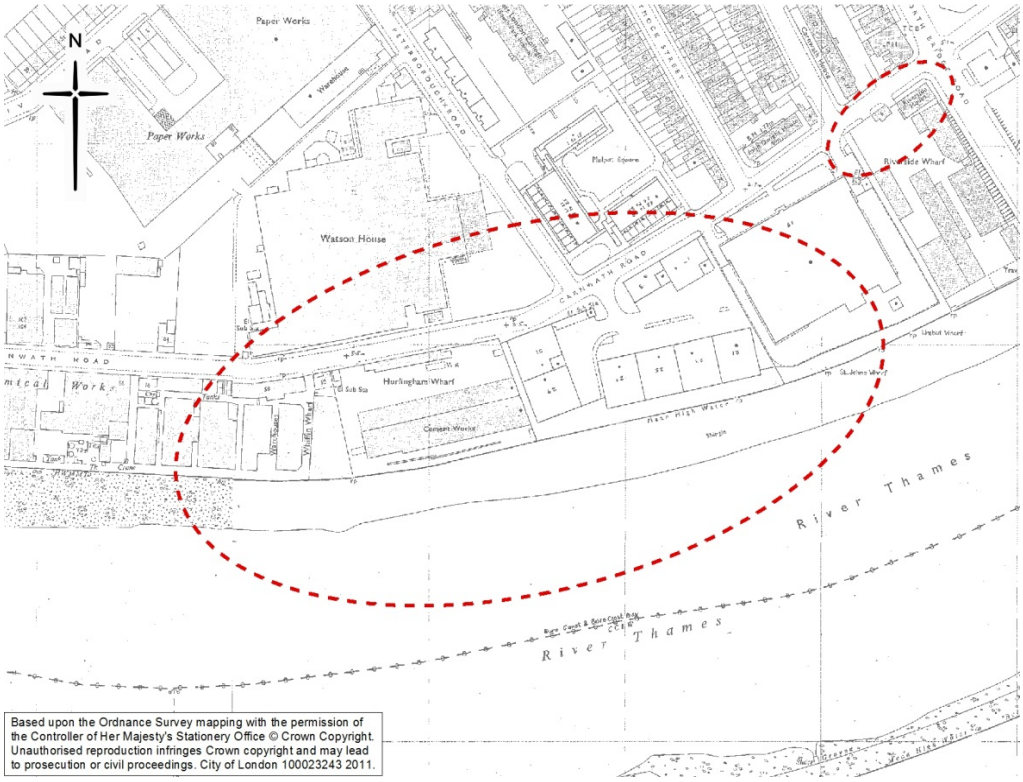
Vol 10 Plate E.5 Historic Environment – Ordnance Survey 6":mile map of 1954−8 (not to scale)



Vol 10 Plate E.6 Historic Environment – Ordnance Survey 1:2,500 scale map of 1962−8 (not to scale)



Vol 10 Plate E.7 Historic Environment – Ordnance Survey 1:1,250 scale map of c. 1985 (not to scale)



Vol 10 Plate E.8 Historic Environment – view along the riverfront within the main site, showing portal buildings in the eastern part of the main site on the left.

April 2011; standard lens, looking east (MOLA 2011)

Vol 10 Plate E.9 Historic Environment – Industrial estate at 17–31 Carnwath Road within the eastern part of the main site.

April 2011; standard lens, looking southeast (MOLA 2011)

Vol 10 Plate E.10 Historic Environment – Hurlingham Wharf in the western part of the main site.

April 2011; standard lens, looking southeast from Carnwath Road (MOLA 2011)

Vol 10 Plate E.11 Historic Environment – Hurlingham Wharf in the western part of the main site.

April 2011; standard lens, looking west (MOLA 2011)

Vol 10 Plate E.12 Historic Environment – Post-medieval barge bed on the foreshore in the western part of the main site (HEA 1D) and extending out of the main site to the west, partly covered with concrete sandbags.

October 2011; standard lens, looking northeast (MOLA 2011)

Vol 10 Plate E.13 Historic Environment – River wall within the main site comprising sections of concrete and sheet piling (HEA 1G).

October 2011; standard lens, looking northeast (MOLA 2011)

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[1] British Geological Survey solid and drift geology, sheet 270

[2] British Geological Survey borehole nos. TQ27NE80A, TQ27NE1756, TQ27NE1757 and TQ27NE524

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[14] Whitehouse K, 'Early Fulham' in *London Archaeologist* 1 (15), (1972), 347

[15] Lysons D, *The Environs of London*, volume 2, (1795), 344–424

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[21] http://www.workhouses.org.uk/index.html?/MAB-River/MAB-River.shtml, Accessed 01/03/2012

[22] *London County Council Bomb Damage Maps 1939–45*, reproduced by the London Topographical Society and London Metropolitan Archives. LTS Publication No 164. (2005), map 100

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.10**

Volume 10: Carnwath Road Riverside appendices

Appendix F: Land quality

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

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Thames Tideway Tunnel

Creating a cleaner, healthier River Thames

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Thames Tideway Tunnel

Environmental Statement

Volume 10 Carnwath Road Riverside appendices

Appendix F: Land quality

List of contents

Page number

List of tables

Page number

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Appendix F: Land quality

F.1 Baseline report

F.1.1 Baseline data is sourced from:

a. walkover survey

b. the Landmark Information Group database, which includes historic maps and environmental records

c. British Geological Survey (BGS) borehole[1]

d. stakeholder consultation.

F.1.2 The baseline report relates only to the main Carnwath Road Riverside site. The Highway site is referred to explicitly where relevant.

Site walkover

F.1.3 A site walkover survey of Carnwath Road Riverside was undertaken on 25th May 2011.

F.1.4 The aim of the walkover survey was to inspect the condition of the site and surrounding areas in order to identify evidence of historic or ongoing contamination sources, as well as any nearby sensitive receptors.

F.1.5 The site comprises former wharf areas, notably from a west to east direction these are Whiffin Wharf, Hurlingham Wharf and Trinidad Wharf. The former two are currently unoccupied derelict land and the latter is now the Carnwath Road Industrial Estate.

F.1.6 No access to Whiffin Wharf and Hurlingham Wharf was available during the walkover survey and all observations were made from publicly accessible areas. The entire derelict site could be viewed from the publicly accessible areas.

F.1.7 Access was available to the external parts of the retail park now located in Trinidad Wharf.

F.1.8 Detailed site walkover notes are provided in Vol 10 Table F.1 below.

Vol 10 Table F.1 Land quality – site walkover report

Item (Site ref: PHF3X, Carnwath Road Riverside)	Details	
Date of walkover	25th May 2011	
Site location and access	Carnwath Road Riverside site consists of the main construction site, located within a wharf area along Carnwath Road. Access to this area was restricted and observations were made from publicly accessible areas only. In addition, the Carnwath Road Riverside highway works site, located adjacent to the junction of Wandsworth Bridge Road and Carnwath Road.	
Size and	Record elevation in	The site is formed from three

Item (Site ref: PHF3X, Carnwath Road Riverside)		Details
topography of site and surroundings	relation to surroundings, any hummocks, breaks of slope etc	former wharves (Whiffin in the west, Hurlingham, centrally and Trinidad in the east). The site is flat and level with surrounding land.
Neighbouring site use (in particular note any potentially contaminative activities or sensitive receptors)	North	Carnwath Road and offices/apartments. Timber yard/builders merchants to the northwest
	South	The Thames Path and River Thames bound the site to the south
	East	New-build retail park. There appears to be a passive gas venting system in place on the site perimeter as indicated by the regularly spaced purple painted vents.
	West	Residential properties
Site buildings	Record extent, size, type and usage. Any boiler rooms / electrical switchgear	The eastern most portion of the site is formed by a small retail park which includes a tile merchant, a kitchen shop, coachworks (vehicle repair/spraying) and timber merchants all located in single storey buildings with associated car parking and access road. At the time of the visit, the western and central portions of the site were open and largely clear from structures. The foreshore principally comprises gravel deposits.
Surfacing	Record type and condition	Hard standing, roads, pavements
Vegetation	Any evidence of distress, unusual growth or invasive species such as Japanese Knotweed	None observed
Services	Evidence of buried services	None observed
Fuels or chemicals on- site	Types/ quantities	None observed
	Tanks (above ground or below ground)	None observed

Item (Site ref: PHF3X, Carnwath Road Riverside)		Details
	Containment systems (eg, bund, drainage interceptors). Record condition and standing liquids	None observed
	Refill points located inside bunds or on impermeable surfaces etc	None observed
Vehicle servicing or refuelling onsite	Record locations, tanks and inspection pits etc	The central section of the site was used for bus parking, however no evidence of servicing or refuelling was observed.*
Waste generated/stored onsite	Adequate storage and security. Evidence of fly tipping	The western most parts were covered by mounds of excavated material, possibly from some minor construction activities that appeared to be taking place. The site is surrounded by hoarding and is secure.
Surface water	Record on-site or nearby standing water	The River Thames forms the southern boundary of the site.
Site drainage	Is the site drained, if so to where? Evidence of flooding?	None observed
Evidence of previous site investigations	eg trial pits, borehole covers	None observed
Evidence of land contamination	Evidence of discoloured ground, seepage of liquids, strong odours?	None observed
Summary of potential contamination sources		Areas of excavated material present on- site.
Any other comments	eg access restrictions/ limitations	No access to the central and western part of the site; observation through the entrance gate and gaps in hoarding surrounding the site.

** Subsequent site visits have identified that part of the main site is being used by a vehicle rental company. It is not known if servicing or refuelling is undertaken on site as part of this operation.*

Review of historical contamination sources

F.1.9 Historical mapping (dating between 1869 and 1989) has been reviewed in order to identify potentially contaminating land-uses at the site and within the 250m assessment area.

F.1.10 Vol 10 Table F.2 tabulates the potentially contaminating land-uses, inferred dates of operation and typical contaminants associated with the land-uses in question. Potential contaminants are sourced from CLR8: *Potential contaminants for the assessment of land (*Defra and EA, 2002*)*[2] and former Department of the Environment industry profiles (Department of the Environment, 2011)[3].

F.1.11 All dates are approximate, where no other information is available the dates relate to when the items first appeared and disappeared from the mapping rather than actual dates of construction, operation or demolition.

F.1.12 Items listed in the table below are also shown on Vol 10 Figure F.1.1 (see separate volume of figures). In addition, figures illustrating the historical environment of the site and surrounding area are provided in Vol 10 Appendix E.

Vol 10 Table F.2 Land quality – potentially contaminating land-uses

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item[2,3]
On-site			
1	Wharves: Hurlingham Wharf (former cement operations) Whiffin Wharf and Trinidad Wharf (former asphalt wharf) (formerly known as Victoria Wharf, XYZ Wharf and Wandsworth Bridge Wharf)	c1896-recent	Heavy metals, arsenic, asbestos, phenols, oil/fuels, hydrocarbons, Polyaromatic Hydrocarbons (PAHs), Polychlorinated Biphenyls (PCBs), sulphide, sulphate, chlorinated aromatic hydrocarbons, chlorinated aliphatic hydrocarbons
1a	Ambulance Station	c1916-c1940s	Hydrocarbons (fuels)
2	Electrical substation	c1951	Oils, PCBs
3	Asphalt works	c1951-c1971	Heavy metals, arsenic, sulphides, asbestos, acetone, oil/fuel hydrocarbons, PAHs, PCBs
4	Cement works	c1971-c1987	Plasticisers, sodium nitrate, calcium oxide, calcium chloride, calcium oxide, fuels, sulphates
5	Timber yard	c1951	Heavy metals, arsenic, boron,

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item[2,3]
			sulphate, phenol, acetone, aromatic hydrocarbons, PAHs and cresols
6	Warehouses	c1964-c1987	Use unknown
7	Tanks (possibly associated with the asphalt works)	c1951-c1971	Content unknown
8	Wharves (occupy the river embankments east and south of the site) includes Comley Wharf (concrete works), Fulham Wharf and Swedish Wharf (petroleum depot and associated tanks)	c1896-recent	Heavy metals, arsenic, asbestos, phenols, oil/fuels, hydrocarbons, PAHs, PCBs, sulphide, sulphate, chlorinated aromatic hydrocarbons, chlorinated aliphatic hydrocarbons
Off-site*			
9	(a) Works (25m east)	c1951	Heavy metals, arsenic, boron, free cyanide, nitrate, sulphate, sulphide, asbestos, aromatic hydrocarbons, PAHs, PCBs, chlorinated aliphatic hydrocarbons
	(b) Warehouse (25m east)	c1964	Use unknown
10	Wharf (65m east)	c1964-c1971	Heavy metals, arsenic, asbestos, phenols, oil/fuels, hydrocarbons, PAHs, PCBs, sulphide, sulphate, chlorinated aromatic hydrocarbons, chlorinated aliphatic hydrocarbons
11	Tanks (adjacent west and 95m northeast)	c1954	Content unknown
12	Works (15m northwest)	c1964-c1976	Heavy metals, arsenic, boron, free cyanide, nitrate, sulphate, sulphide, asbestos, aromatic hydrocarbons, PAHs, PCBs, chlorinated aliphatic hydrocarbons
13	Dock & landing stage (185m west)	c1920-recent	Heavy metals, arsenic, asbestos, phenols, oil/fuels, hydrocarbons, PCBs, PAHs, sulphide, sulphate, chlorinated aromatic hydrocarbons,

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item[2,3]
			chlorinated aliphatic hydrocarbons
14	(a)Electrical substation (40m east)	c1971	Oils, PCBs
	(b)Electrical substation (adjacent west)	c1951-c1971	
	(c)Electrical substation (25m north)	c1976	
	(d)Electrical substation (170m north)	c1987	
	(e)Electrical substation (160m north)	c1971	
	(f)Electrical substation (25m north)	c1951	
	(g)Electrical substation (55m west)	c1971	
15	Engineering works (55m north)	c1951-c1964	Heavy metals, arsenic, boron, free cyanide, nitrate, sulphate, sulphide, asbestos, aromatic hydrocarbons, PAHs, PCBs, chlorinated aliphatic hydrocarbons
16	Concrete works (10m north)	c1951	Plasticisers, sodium nitrate, calcium oxide, calcium chloride, calcium oxide, fuels, sulphates.
17	Paper works (130m north)	c1951	Heavy metals, arsenic, selenium, free cyanide, acetone, asbestos, aromatic hydrocarbons, chlorinated aliphatic hydrocarbons, PCBs
18	Warehouse (115m north)	c1964-c1984	Use unknown
19	Dry cleaning works (140m north)	c1971	Heavy metals, arsenic, free cyanide, Volatile Organic Compound (VOCs) such as chloroform and Tetrachloroethane, various solvents; fluorocarbon 113, asbestos, PCBs, aromatic hydrocarbons, chlorinated aliphatic hydrocarbons, nitrates and sulphates
20	Works (245m north)	c1964-c1984	Heavy metals, arsenic, boron, free cyanide, nitrate, sulphate,

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item[2,3]
			sulphide, asbestos, aromatic hydrocarbons, PAHs, PCBs, chlorinated aliphatic hydrocarbons
21	Garage (10m east)	c1951-c1971	Oil/fuel hydrocarbons, aromatic hydrocarbons, PAHs, chlorinated aliphatic hydrocarbons, organolead compounds. heavy metals and asbestos
22	Petroleum depot (50m east)	c1971	Oil/fuel hydrocarbons, monoaromatic hydrocarbons, benzene, toluene, ethybenzene and xylenes, PAH, n-alkanes (C5-C20), lead
23	Disinfectants and polishers factory (100m northeast)	c1951	VOCs, Semi VOCs (SVOCs), chlorine, sodium, potassium, oils
24	Coal hopper (110m southeast)	c1951	Coal dust, heavy metals
25	Warehouse (40m northwest)	c1976	Use unknown
26	(a) Furniture manufacture (60m northwest)	c1954	Cresols, phenols, herbicides, SVOCs, VOCs
	(b) Works (60m northwest)	c1959	Heavy metals, arsenic, boron, free cyanide, nitrate, sulphate, sulphide, asbestos, aromatic hydrocarbons, PAHs, PCBs, chlorinated aliphatic hydrocarbons
	(c) Warehouse (60m northwest)	c1976	Use unknown
27	(a) Stone works (115m northwest)	c1951	Sulphates, oils, detergents
	(b)Timber yard (115m northwest)	c1954	Heavy metals, arsenic, boron, sulphate, phenol, acetone, aromatic hydrocarbons, PAHs and cresols
	(c)Depot (115m northwest)	c1959	Oil/fuel hydrocarbons, aromatic hydrocarbons, PAHs, chlorinated aliphatic hydrocarbons, organolead compounds, heavy

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item[2,3]
			metals and asbestos
28	(a) Works (130m northwest)	c1959	Heavy metals, arsenic, boron, free cyanide, nitrate, sulphate, sulphide, asbestos, aromatic hydrocarbons, PAHs, PCBs, chlorinated aliphatic hydrocarbons
	(b) Warehouse (130m northwest)	c1976	Use unknown
29	Metal works (140m northwest)	c1951-c1959	Heavy metals, solvents, hydrocarbons
30	(a) Builders yard (170m northwest)	c1959	Oil/fuel hydrocarbons, VOCs, BTEX; solvents, oil and greases, heavy metals, particulates
	(b) Works (170m northwest)	c1976	
31	(a) Chemical works and tanks (50m west)	c1951-c1959	Heavy metals, arsenic, boron, selenium, free cyanide, nitrates, sulphates, sulphides, asbestos, PAHs, phenols, acetones, aromatic hydrocarbons, PCBs, dioxins, furans
	(b) Petroleum storage depot (50m west)	c1976	Oil/fuel hydrocarbons, aromatic hydrocarbons, PAHs, chlorinated aliphatic hydrocarbons, organolead compounds, heavy metals and asbestos
32	Gas works and associated bunkers, tanks, compounds, retort houses and other infrastructure (140m south)	c1920-c1968	Oil/fuel hydrocarbons, aromatic hydrocarbons PAHs, chlorinated aliphatic hydrocarbons, organolead compounds, cyanides, ammonia, phenols, heavy metals and asbestos
33	Refuse tip (160m south)	c1986-recent	Heavy metals, arsenic, sulphur, asbestos, oil/fuel hydrocarbons, PAHs, chlorinated aliphatic hydrocarbons, chlorinated aromatic hydrocarbons, PCBs, dioxins and furans
34	(a) Kops Brewery (125m east)	c1896-c1916	Volatile organic compounds, total petroleum hydrocarbons, heavy metals, ethanol/methanol,

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item[2,3]
			ammonia, chlorinated alkalis, benzene, toluene, ethylbenzene and xylenes
	(b) Warehouses, industrial units, associated tanks and electrical substation (125m east)	c1951-c1984	Use of warehouses/industrial units/contents of tank unknown. Contaminants associated with electrical substations include oils/PCBs

** refers to the main site.*

On-site

F.1.13 The historic mapping shows the entire site to be essentially undeveloped between c1868-c1869 (these maps are reproduced in Vol 10 Appendix E).

F.1.14 By c1896 wharves had been constructed on the eastern most part of the site (initially labelled as the West Wharf) as well as on land further to the east. The Mead Ambulance station and a wharf labelled the "X,Y,Z wharf" subsequently occupied the eastern and western parts of the site respectively from c1916 until the late 1940s. After this time, the maps show the construction of Whiffin, Hurlingham and Trinidad Wharves.

F.1.15 The wharves were subsequently utilised by several industries from the 1950s through to the 1980s. These included cement works, a petroleum depot and asphalt works.

F.1.16 Anecdotal evidence suggests that part of the site was used for munitions or ordnance manufacture during the Second World War. Whilst this could not be confirmed, given the industrial nature of the area during the war it is considered to be possible.

F.1.17 The on-site Carnwath Road industrial estate was constructed by the 1980s and the former structures within the wharf sites were demolished by this time, although more specific dates could not be determined from the available mapping.

Off-site

F.1.18 Within the 250m assessment area, the historic mapping shows that the area surrounding the Carnwath Road Riverside site has been subject to a number of commercial and industrial land-uses throughout the twentieth century. These have included an infilled gravel pit, chemical works, concrete works, laundry, and many unspecified works and warehousing. Remnants of these uses still exist (notably to the northwest of the site).

Geology

F.1.19 Data from the British Geological Survey (BGS) indicates the anticipated geological succession, as summarised in the table below (this varies from the geology presented in the groundwater appendix as the groundwater

geology is derived from an overwater borehole, the principle difference is the inclusion of Made Ground).

Vol 10 Table F.3 Land quality – anticipated site geology

Geological unit/ strata	Description	Approximate depth below ground level (m)
Made Ground/ infilled land	Granular fill comprising sand and gravel of brick with some fragments of timber. Locally clay soils predominate.	0 – 2.0
River Terrace Deposits	Medium dense to dense sand and gravel (predominantly quartz sand and flint gravel).	2 .0– 7.0
London Clay Formation	Slightly silty and sandy clay with pockets of selenite (gypsum).	7.0 – 53.0

Unexploded ordnance

F.1.20 During both World War I and II, the London area was subject to bombing. In some cases bombs failed to detonate on impact. During construction works Unexploded Ordnance (UXO) are sometimes encountered and require safe disposal.

F.1.21 A desk based assessment for UXO threat was undertaken by 6 Alpha Associates Limited (Vol 10 Appendix F.3) at the Carnwath Road Riverside site.

F.1.22 The assessment covered three areas, two in the wharf area (Area A – land aspect of main work area, Area B - foreshore and river of main work area and Area C located in the highway, as described in Vol 10 Table F.1)[4].

F.1.23 The report reviews information sources such as the Ministry of Defence (MoD), Public Records Office and the Port of London Authority (PLA).

F.1.24 The report advises that one high explosive bomb strike occurred within Area A and another within the buffered site boundary and a further two recorded within 100m of the buffered site boundary. In addition, although no bomb damage was recorded within the three areas, damage was recorded within the buffered site boundary.

F.1.25 Since WWII, development has taken place within Area A and C and there is the possibility that development works could have removed buried UXO items

F.1.26 Taking into account the findings of this study and the known extent of the proposed works at the Carnwath Road Riverside site, it was considered that within Area A there is an overall low/medium threat from UXO, within

Area B there is a high threat and within Area C there is a low/medium threat from UXO.

F.1.27 Anecdotal information received during phase two public consultation suggests the site may have been used for munitions manufacture however this is unconfirmed.

Thames Tideway Tunnel ground investigation data

F.1.28 This section summarises the ground investigation undertaken by the Thames Tideway Tunnel project.

F.1.29 The nearest borehole drilled as part of the Thames Tideway Tunnel project ground investigation (borehole reference SR2082) was undertaken in the River Thames within the site boundary, as shown on Vol 10 Figure F.1.2 (see separate volume of figures). The borehole was drilled for geotechnical purposes and was not tested for the presence of contaminants in either soils or groundwater.

F.1.30 Vol 10 Figure F.1.2 (see separate volume of figures) also identifies a number of other boreholes excavated in vicinity of the site, these are not considered relevant to the contamination status of the site, either due to their distance from the proposed main tunnel shaft location or because certain boreholes were excavated purely for geotechnical purposes.

Soil contamination testing

F.1.31 No soil contamination testing has yet been undertaken for the Carnwath Road Riverside site due to access issues.

Soil gas testing

F.1.32 No soil gas testing has yet been undertaken for the Carnwath Road Riverside site due to access issues.

Sediment quality testing

F.1.33 An investigation into the sediment quality within the foreshore at the Carnwath Road Riverside site was undertaken by the Port of London Authority (PLA) hydrographic department in December 2011[5]. A report on the findings is presented in Mott MacDonald Limited *Thames tunnel foreshore sediment quality interpretative report*[6].

F.1.34 Three samples of sediment were taken from the foreshore of the River Thames at the site and sent for laboratory analysis. The testing showed relatively low levels of PAHs and metals within the foreshore sediments which are typical of the sediments along the tidal River Thames.

F.1.35 These contaminants reflect the former industrial nature of the river and are present as they tend to bind with soils. The results are not elevated in terms of risk to human health[7],[8] but slightly elevated over PLA approved sediment quality guideline. Refer to Volume 2 Environmental assessment methodology for full guidance on the benchmarks used.

Third party ground investigation data

F.1.36 No third party ground investigation data was available for review at the Carnwath Road Riverside site.

F.1.37 Information from the BGS database[1] identifies that a borehole drilled on-site at Carnwath Laundry (1925) for the purposes of assessing the shallow groundwater for supply recorded well water that was sampled to have a distinct paraffin odour and a green/turbid appearance.

F.1.38 It should be noted that the review of available historical mapping has not identified the presence of this laundry.

Other environmental records

F.1.39 Details of environmental records (hazard and waste sites) in the vicinity of the site held by the Environment Agency (EA) and other bodies have been obtained from the Landmark Information Group and are presented in Vol 10 Table F.4. Pertinent records are discussed in further detail below.

F.1.40 The location of these records is shown on Vol 10 Figure F.1.3 (see separate volume of figures).

Vol 10 Table F.4 Land quality – hazard and waste sites

Item	On-site	Within 250m of site boundary
Active integrated pollution prevention and control	0	0
Control of major accident hazard sites	0	0
Historical landfill site	0	1
LA pollution prevention and control	3	7
Licensed waste management facility	0	1
Notification of installations handling hazardous substances	0	0
Past potential contaminated industrial uses	Areas of past potential contaminated industrial uses are present on-site and within 250m.	
Pollution incident to controlled water*	0	6
Registered waste transfer site	0	4
Registered waste treatment or disposal site	0	0

**Does not include regular combined sewer overflow (CSO) discharges*

F.1.41 Inspection of the data has identified three on-site local authority pollution prevention and control records at the Carnwath Road Riverside site (two of them within the trading estate). One relates to the blending, packing, loading and use of bulk cement from the former cement works (reported as withdrawn) whilst the two remaining relate to vehicle spraying. A further seven pollution prevention and controls have been identified within the wider assessment area.

F.1.42 A number of past potential contaminated industrial uses have been identified on and around the site. From an analysis of the historical mapping data, the past industrial land-uses can be attributed to various industries as highlighted on Vol 10 Figure F.1.1 (see separate volume of figures). Common contaminants associated with these types of previous land-uses are identified in Vol 10 Table F.2.

F.1.43 Three pollution incidents to controlled waters have been recorded to the southwest of the site. These are classified as Category 3 (minor) incidents by the EA and are associated with sewage and oils within Bell Lane Creek with a further three located to the northeast. These are not considered to be relevant to the assessment owing to their distance from the site. A further three pollution incidents to controlled water are located northeast.

F.1.44 In addition, there are four registered waste transfer sites and one licensed waste management facility located to the south of the Carnwath Road Riverside site on the southern bank of the River Thames. These are within an area also classified as a former (historic) landfill site. This facility is not considered to pose any significant risk to the Carnwath Road Riverside site.

Land quality data from local authority

F.1.45 The London Borough of Hammersmith and Fulham (LBHF) have been consulted with respect to land quality information held in relation to the site and the wider assessment area. The information summarised below has been sourced from the Council's contaminated land database. Their response is given in full in Section F.2.

F.1.46 The Carnwath Road Chemical Works and Whiffin Wharf were first used together for chemical production in the early 1920s. Records indicate that approximately 336 individual chemicals were manufactured at the chemical works and these included bromides, iodides, alkaloids (quinine, emetine, strychnine, and atopine) dyeline chemicals, camphor, vermillion, essential oils, the salts of many acids and a wide variety of metals.

F.1.47 Planning permission to develop Whiffin Wharf (the western part of the site) as a fuel depot was granted in May 1958 which was the first of several applications for associated fuel storage tanks and vehicle maintenance at the site.

F.1.48 The area immediately to the west of the site was redeveloped for housing following planning permission that was granted in 1996. A condition pertaining to the investigation of potentially contaminated land and its potential to pollute the water environment was imposed on the recommendation of the National Rivers Authority (NRA). Records show

that the information submitted was considered satisfactory and the condition was discharged by the Council in January 1997.

F.1.49 A planning application was approved in April 2003 for the use of Whiffin Wharf for vehicle storage.

F.1.50 Council records indicate that Hurlingham Wharf was operated by Blue Circle Cement for the trans-shipment of cement from their main works in Northfleet, Gravesend. In 1994 the Wharf handled 356,000t of cement. Blue Circle ceased their operation in 1995. The site was demolished in 1996 and used as a car storage compound.

F.1.51 Council records indicate that an application was approved in 1980 for the construction of the existing Carnwath Road Industrial Estate (formerly Trinidad and Mead Wharves).

F.1.52 The land immediately to the north of the site was occupied by a gravel pit from circa 1916. Council records indicate that the pit was backfilled with mixed waste material prior to being developed with Hurlingham Concrete Works by the 1930s. Planning permission was granted in July 1958 for the redevelopment of the concrete works with the Central Research Facility for the North Thames Gas Board.

F.1.53 The facility was to be used for prototype production repair of gas appliances, a maintenance depot and lecture rooms. A planning application was received in March 1997 to convert this research facility to the present residential use with additional business floor space on the ground floor.

F.1.54 The Hurlingham Retail Park which forms the plot of land to the east of the site and is presently occupied by retail units was the subject of a limited site investigation (soil sampling only) in September 1993.

F.1.55 The investigation identified potentially significant hydrocarbon contamination in the centre and hydrocarbon free product in the northwest of the site. In addition, elevated concentrations of coal tar were encountered in the south/southeast of the site and lead in the central and southern parts of the site.

F.1.56 Remediation proposals, including the removal of contamination “hot spots” beneath storage tanks and active removal and disposal of groundwater, were agreed with the regulators. No records of validation of such remediation have been received by the council.

Summary of contamination sources

F.1.57 Following the review of the baseline data, the following sources of on-site contamination which may impact on the construction of the proposed development have been identified:

a. historic contamination of underlying soils and groundwater as a result of former industrial use (wharves, asphalt works, cement works, and timber yards) - the main potential contaminants of concern are likely to be, but not limited to: elevated levels of metals, PAHs, fuel and oil hydrocarbons, cyanide, sulphates, asbestos and VOCs

b. A cover of Made Ground is present across the site which also represents a potential source of contamination.

c. ongoing light industrial usage as trading estate (eg, vehicle spraying)

d. historic shallow low level contamination of foreshore sediments – elevated PAHs and heavy metals/metalloids potentially elevated land gas within the Alluvium/shallow organic rich sediments

e. potential for UXO.

F.1.58 Off-site sources of contamination which may impact on the construction of the proposed development could arise from shallow groundwater contamination from existing industries around the site including, petroleum depot and chemical works.

F.2 Local authority consultation

London Borough of Hammersmith & Fulham
Public protection and safety
5th Floor Hammersmith Town Hall Extension, King Street, Hammersmith W6 9JU.
Tel: 020 8753 1084 Direct Dial: 020 753 3378
Fax: 020 8753 3922
Email: environmental.quality@lbhf.gov.uk
Web: www.lbhf.gov.uk

h&f putting residents first

Environment Division
To | A | I | C | Sign | Date
13 April 2011
28 APR 2011
File no 276212
Return to

Dino Giordenelli
Mott MacDonald Ltd.
Mott MacDonald House
8-10 Sydenham Road
Croydon
CR0 2EE

Our reference: 2011-00116 (Thames_Tunnel_Hurl_Wharf_Apr11).doc

Dear Dino,

Thames Tunnel – Hurlingham Wharf

I refer to your e-mail dated 31 March 2011 concerning environmental information for the above site.

To assist in the identification of contaminated land (as required by Part IIA of the Environmental Protection Act 1990) the Council has completed a preliminary review of historical land use in the borough. The information gathered as part of this review has indicated potentially contaminative land uses having occurred at and near to the site. Present and historical plans are enclosed showing the site in relation to surrounding areas and are discussed below.

There are seventeen areas of potential concern located at the subject site, each of which have been prioritised for further investigation under Part IIA of the Environmental Protection Act 1990. For your reference, these individual sites are highlighted on the attached Potentially Contaminated Land OS Map. The larger sites are numbered whilst the smaller sites are referred to collectively as 'Miscellaneous' records; all highlighted sites are discussed in turn as follows:

Potentially Contaminated Land Sites

1. Sulivan Road Metal Works
A Joinery Works is indicated to be located at the site on the 1930s OS Map. The site has been redeveloped and is labelled as a Metal Works on the 1951 OS Map and a Works of unspecified use on the 1961 OS Map.

2. Sulivan Road Warehouse & Works
Council planning records indicate that application was approved in August 1955 (1955/00443/HIST) for the construction of a Works for Silk Screen Printing and the Production of Advertisement Media at the site. This Works is identified on the 1969 OS Map and is labelled as a Warehouse by 1976.

Further planning records show that approval was granted in April 1986 (1986/00573/FUL) to redevelop the majority of the site with twenty Light Industrial/Business units, latterly identified as Hurlingham Business Park.

3. Peterborough Road (Drayton) Paper Works
A Paper Works operated by G. W. Dray and Son is located at the site from at least the 1930s. This site is labelled as Drayton Paper Works on the 1930s OS Map, a Paperworks on the 1951 OS Map, a Works on the 1969 OS Map and, finally, the southwestern portion as a Works and northeastern portion as a Paperworks on the 1971 OS Map. Council planning records indicate that an application was approved in March 1986 (1985/02523/FUL) for the redevelopment of the site with mixed use

POSITIVE ABOUT DISABLED PEOPLE

Director of Environment
Nigel Pallace

EQSD64
15 October 2007

residential, communal and Workshop/Studio use. The site is presently partially occupied by the Hurlingham Business Park (more information in point 2).

A Timber Yard is located adjacent to the southeastern boundary of the site on the 1930s OS Map and has been redeveloped with a Warehouse on the 1969 OS Map.

4. Carnwath Road Gravel Pit, Concrete Works and Gas Board Laboratory
A Pump and Tank (unspecified contents and capacity) are labelled amongst buildings of unspecified use located within the southwestern boundary of the site and extending to the southwest of the subject area on the 1869-1871 OS Map. These buildings are labelled as Broomhouse Laundry on the 1896 and 1916 OS Maps and are discussed further in point 5 below.

The central and northern portion of the sites are occupied by a Gravel Pit from at least 1916, as shown on the OS Map of that year. Council records indicate that the Gravel Pit was backfilled with mixed waste material prior to being developed with Hurlingham Concrete Works by at least the 1930s. Council planning records show that planning permission was granted in July 1958 (1957/00020/HIST) for the redevelopment of the Concrete Works with a Central Research Facility for the North Thames Gas Board, latterly labelled as Watson House. This Facility was to be used for Prototype Production, repair of Gas Consuming Appliances, a Maintenance Depot, training/lecture rooms and offices. Further records indicate that a planning application was approved in March 1997 (1996/01796/FUL) to convert the use of this research facility to residential dwellings with additional business floorspace. Although not a condition of planning, it is understood that phase II intrusive site investigation was carried out prior to this conversion. Investigation for contaminated land was not a material consideration of the Council at this time and, as a consequence, this investigation has not been formally approved by the Environmental Quality Team.

5. Broomhouse Laundry and Carnwath Road Garage
Broomhouse Laundry occupies the eastern portion of the site on the 1869-1871 OS Map. A Chimney is labelled at this Laundry on the 1916 OS Map and the Laundry is no longer indicated as present on the 1930s OS Map. Council planning records show that permission was granted in November 1947 (1947/00012/HIST), at the site of the former Laundry, for the Manufacture of Mineral Water and a Bottling Store. Furthermore, the application allowed for the interim use of this site as a Warehouse, Garage and Workshop.

Industrial Type Buildings of unspecified use are indicated to be located in the western portion of the site on the 1951 OS Map. One of these buildings, located in the northwest of the site, is latterly labelled as a Garage on the 1976 OS Map. Council planning records show that application was approved in June 1968 (1968/00381/HIST) for the installation of four to five Storage Tanks at a Paraffin and Domestic Oil Distribution Depot located in this portion of the site. A Warehouse is indicated in the west of the site on the 1976 OS Map. A further planning permission was granted in November 1991 (1986/01155/FUL) for a change of use of this property from a Wholesale Warehouse to the Storage and Retailing of Timber.

Council planning records indicate that the eastern portion of the site was occupied by a Haulage Contractor from at least 1952 (1952/00015/HIST) and that a Warehouse for the storage of Scaffolding Materials was located in this area from at least 1953 (1953/00024/HIST). A Planning application was approved in September 1959 (1959/00028/HIST) for the erection of a Saw Mill at this location. A Works of unspecified use is labelled in this portion of the site on the 1969 OS Map.

6. Carnwath Road Warehouse and Works
A Box Works is indicated at the site on the 1930s OS Map. A planning application was approved in November 1955 (1955/00014/HIST) for use of land at the rear of the site for the Storage of Timber. The site is shown to have been redeveloped with a Works of unspecified use on the 1969 OS Map. A planning application was approved in June 1969 (1969/00360/HIST) for the erection of a single storey extension at the site, to provide additional storage space for material to be used in the Press Shop. Council records dating from 1988 indicate that the site comprised a substantial building comprising six Industrial/Warehouse Units. A further planning application was approved in October 2007 (2007/02782/FUL) for the use of one of these units as an Electrical Wholesaler.

7. Carnwath Road Stone Works

A Tank of unspecified contents or capacity is labelled in the northern portion of the area in 1916. Industrial Type Premises are located at the site from at least the 1930s. These premises are labelled as a Monumental Stone Works on the 1951 OS Map and includes a Tray Crane that is located in the north of the area. The site is labelled as a Depot on the 1969 OS Map. Council planning records indicate that a Saw Mill was located at the site from at least 1975 (1975/00933/HIST) and the area is labelled as a Timber Yard on the 1976 OS Map and as a Works of unspecified use on the OS Master Map.

8. Carnwath Road Chemical Works and Whiffin Wharf

The 1869-1871 OS Map indicated the site to have comprised undeveloped riparian land traversed by a number of rivulets. The rivulets are no longer shown and the site level has indicated to have been modified on the 1896 OS Map. The site is indicated to have been developed with Aldersgate Chemical Works on the 1930s OS Map.

Council records indicate that Chemical Production at this Works commenced in the early 1920s under Whiffen and Sons Ltd. Further records indicate that approximately 336 individual chemicals were manufactured at the site of the Chemical Works and that these included bromides, iodides, alkaloids (quinine, emetine, strychnine and atropine), dyeline chemicals, camphor, vermilion, essential oils, the salts of many acids and a wide variety of metals.

A number of Tanks (unspecified contents or capacity) and a Chimney associated with the Chemical Works are labelled on the 1951 OS Map and a Crane is located along the southern boundary of the site. Council records indicate that the Chemical Works closed in 1958 and planning permission to redevelop the site (then known as Whiffin Wharf) with a Fuel Depot was granted in May 1958 (1958/00033/HIST). Further records indicate that permission was granted in August 1959 (1959/00017/HIST) for the installation of Storage Tanks and the erection of Vehicle Maintenance and Loading Bays in association with the use of the site as a Petroleum and Oil Storage and Distribution Depot. Planning application was approved in March 1960 (1960/00015/HIST) for use of the eastern part of the site for the Preparation and Distribution of Ready Mixed Concrete.

The area is indicated to have undergone significant redevelopment on the 1969 OS Map. Planning application was approved in August 1969 (1969/00402/HIST) for the installation of an Oil Storage Tank and associated 8ft. high bund wall at the site. A number of Warehouses are now indicated to occupy the eastern portion of the site and three large circular structures, latterly identified as Tanks on the 1971-1976 OS Map, are located in the centre of the site.

The site is labelled as Petrofina Wharf Petroleum Storage Depot on the 1971-1976 OS Map with Whiffin Wharf now indicated in the far the east of the site. An additional large Tank is now present in the centre and an Electricity Sub-Station in the northern portion of the subject area.

Council records indicate that planning permission was granted in April 1996 (1994/01963/FUL) for redevelopment of Petrofina Wharf with residential properties. A condition pertaining to the investigation of potentially contaminated land and its potential to pollute the water environment was recommended by the National Rivers Authority (latterly the Environment Agency) and placed by the Local Authority. Whilst the condition required that measures to prevent pollution of groundwater and surface water, including provisions for monitoring, should be submitted for approval, the validation of any remediation works was not requisite. Records show that the information submitted was considered satisfactory and the condition was discharged by the Council in January 1997 (1996/00892/DET).

A planning application was approved in April 2003 (2002/03112/FUL) for the use of Whiffin Wharf, located in the far east of the site, for Vehicle Storage.

9. Hurlingham Wharf

The site is indicated to comprise undeveloped riparian land traversed by a number of rivulets on the 1869-1871 OS Map. The rivulets are no longer shown and the site level has indicated to have been

modified on the 1896 OS Map. X.Y.Z Wharf is indicated to occupy the western and Hurlingham Wharf the eastern portion of the site on the 1916 OS Map and on the 1930s OS Map respectively. Council records indicate that a Cement Marketing Company Depot was located at Hurlingham Wharf from at least the 1920's.

A Tray Crane in the south of X.Y.Z Wharf on the 1951 OS Map and a Timber Yard labelled at Hurlingham Wharf. Council planning records indicate that application was approved in September 1951 (1951/00016/HIST) for the erection of buildings at both of these Wharves in conjunction with their combined use as a Cement Depot. The site is labelled solely as Hurlingham Wharf on the OS Maps provided from 1969 onwards. Further planning records show that permission was granted in November 1962 (1962/00027/HIST) for the erection of a 45 ft. Silo at the Depot, for the Storage of approximately 100 tonnes of Cement. An Electricity Sub-Station is labelled in the northwestern portion of the site by 1976.

Council records indicate that the Wharf was operated by Blue Circle Cement for the trans shipment of Cement from their main works in Northfleet, Gravesend. In 1994 the Wharf handled 356,000 tonnes of Cement. Blue Circle ceased to operate from the site in 1995. The site was demolished in 1996 and is then known to have been used as a Car Compound.

10. Trinidad Wharf

The 1869-1871 OS Map indicates the site to have comprised undeveloped riparian land traversed by a number of rivulets. The rivulets are no longer indicated and the site labelled as West Wharf (Metropolitan Asylum Board) on the 1896 Map. Council records indicate that Limmer and Trinidad Asphalt Company Limited occupied the site from the 1890's to at least 1905. Mead Ambulance Station is indicated at the Wharf on the 1916 OS Map, however, the precise location of this Station is considered to be in the east of the site, with continuation of Asphalt production at the Industrial Type Buildings occupying the majority of the subject area. This becomes more apparent by the 1930s with West Wharf indicated in the eastern and Trinidad Wharf in the central and western portions of the site.

A number of Tanks (unspecified contents or capacity) are labelled in the east of Trinidad Wharf on the 1951 OS Map. An Electricity Sub-Station is also labelled in the north and a Travelling Crane in the south of the Wharf at this time. Council records indicate that the company specialised in Asphalt Pavements and produced Trinidad Asphaltic Concrete. It is also understood that Tar was enriched and stabilised at the site. West Wharf is indicated to have been re-named Mead Wharf on the 1971 OS Map with an unspecified number of Tanks (unspecified contents or capacity) now labelled in its northern portion.

Council planning records indicate that an application was approved in May 1980 (1980/00504/FUL) for the redevelopment of both Trinidad and Mead Wharves with eight Industrial Units and associated office premises.

11. Hurlingham Retail Park

The site is indicated to comprise undeveloped riparian land traversed by a numerous rivulets on the 1869-1871 OS Map. The subject area is shown on the 1896 OS Map to have been developed with a number of Wharves, namely, St. John's Wharf, Christiania Wharf, Corrisson Wharf, Town Mead Wharf, and Victoria Wharf (Timber). These Wharves are indicated to have been developed with numerous Industrial Type Buildings of unspecified use.

The former Town Mead Wharf has been re-named Wandsworth Bridge Wharf on the 1916 OS Map and a Crane is indicated in the north of Corrisson Wharf at this time.

Trogon Wharf is labelled at the site of the former Christiania Wharf on the 1930s OS Map. This map also shows a Chimney in the southern portion of Wandsworth Bridge Wharf and a Laundry and an Oil Works as operational at St. John's Wharf and Corrisson Wharf respectively.

Council planning records indicate that permission was granted in July 1949 (1949/00016/HIST) for the erection of temporary office and Warehouse Buildings at Victoria Wharf in the east of the site. The 1951 OS Map shows Clayton's Wharf to be present in the western portion of the site. This map also

indicates a number of Tanks (unspecified contents and capacity) at both Corrisson and Trogon Wharves and a further Crane indicated in the south of Victoria Wharf. The Laundry, previously identified at St. John's Wharf is labelled as a Table Water Works on the 1951 OS Map and a Warehouse on the 1969 OS Map. Council records indicate that Maxima Lubricants Ltd. were located at Wandsworth Bridge Wharf from at least 1952 and specialised in Lubricants and Greases. It is understood that this business was purchased by United Lubricant Ltd., which led to the re-naming of Wandsworth Bridge Wharf to United Wharf, as shown on the 1969 OS Map.

Council planning records show that an application was approved in February 1959 (1959/00024/HIST) for the use of Clayton's Wharf, located in the west of the site, for the Storage, Cutting and Shearing of Metals, Hardboard and Plastic Sheets and for the Storage of Machine Tools and Engineering Sundries. Further records indicate that permission was granted in October 1959 (1959/00023/HIST) for the erection of a Petroleum Store at St. John's Wharf, also located in the west of the site.

The 1969 OS Map indicates United Wharf to now occupy the former Trogon and Corrisson Wharves in the centre of the site and Riverside Wharf to comprise the former Victoria and United Wharves in the east of the site.

A planning application was approved in May 1983 (1983/00466/FUL) for the installation of a Pump Island and Underground Storage Tanks (unspecified contents or capacity) at United Wharf, located in the centre of the site, In association with use of premises for Vehicles (including Taxi-Cab) Servicing and Repair.

Council Planning records indicate that planning permission was granted in February 1994 (1993/00031/FUL) for redevelopment of the entire site with retail and residential land use (latterly known as the Hurlingham Retail Park) with associated car parking. A planning condition requiring investigation to determine the degree of contamination present and to determine its potential for pollution of the water environment was recommended by the National Rivers Authority (latterly the Environment Agency) and placed by the Local Authority.

A limited site investigation (soil sampling only) that was carried out at the subject property (Harrison and Company report ref: C2320a, dated September 1993) and associated correspondence was provided to the Council by the Environment Agency in May 2005. The investigation identified potentially significant hydrocarbon contamination in the centre and hydrocarbon free product in the northwest of the site. In addition, elevated concentrations of coal tar were encountered in the south/southeast of the site and lead in the central and southern portions of the subject area. Remediation proposals - including the removal of contamination "hot spots", beneath ground Storage Tanks and the active removal/disposal of contaminated groundwater - were agreed between the applicant and the National Rivers Authority. Although not a condition of planning, the correspondence provided by the Environment Agency indicates that they have no records regarding the validation of these remediation proposals. I am not aware of any other information submitted to the Council as part of this application or of whether this condition has been discharged.

12. Albert Wharf

Large Industrial Type Buildings of unspecified use are indicated as present at the Wharf on the 1916 OS Map and an Electricity Sub-Station on the 1951 OS Map. Council planning records indicate that an application was approved in July 1954 (1954/00480/HIST) for use of the Wharf for the Bailing of Paper. Planning permission was granted in December 1977 (1977/20324/HIST) for use of the site for the sale of Motor Vehicles. A further application was approved in July 1994 (1990/01697/FUL) for the development of a Car Auction Room and residential properties at the site.

13. Wandsworth Bridge Road Shell Garage

Council records indicate that the site has been a Petroleum Filling Station since at least 1950 and a Garage is labelled at the site on the 1951 OS Map. Council planning records indicate that permission was granted in July 1962 (1962/00660/HIST) for the installation of new Underground Petrol Storage Tanks at the site, in a different location to those existing. A further application was approved in August 1988 (1988/00629/FUL) for the installation of an additional 26,000 litre Underground Storage Tank and associated Pump Island/Dispenser.

An application to redevelop the site with a three storey (plus basement) building comprising a Showroom, office accommodation, Design Studio and Store was approved in November 2001 (2001/02040/OUT). Conditions pertaining to the investigation of potentially contaminated land were placed on this planning permission by the Council. It is understood that preliminary remedial works were carried out during the redevelopment with contaminated soil excavated and removed from site. Additional remedial measures including membrane installation, basement venting measures and continuing groundwater monitoring at the site were agreed with both the Council and the Environment Agency. Although verification of these additional measures was a requirement of the planning conditions, I am not aware of any validation report being submitted, nor of whether the conditions have been discharged.

14. Peterborough Road Works

A Portable Building Works (Hurlingham Bungalow Co) is indicated in the central and southern portion of the site on the 1930s OS Map. Council planning records show that an application was approved in September 1949 (1949/00295/HIST) for the erection of a temporary Workshop for a Welding/Grinding business located at the property. The site is labelled as a General Engineering Works on the 1951 OS Map with associated Tanks (unspecified contents or capacity) located in the southeast and the west of the subject area. An Electricity Sub-Station is also labelled in the southeast of the site at this time. Planning permission was granted in September 1964 (1964/00625/HIST) for retention of the Temporary Workshop, an extension to house Dust Extraction Plant and a Steel Chimney Shaft at the Works.

An application was approved in March 1972 (1972/00069/HIST) for the change in use of part of this property to retail premises with associated parking. A further planning permission was approved in February 1982 (1981/02018/FUL) for the development of residential dwellings in the southwest of the site.

15. Carnwath Road Malthouse

A Malthouse is located at the site from at least 1896 to at least 1916 as shown on the corresponding OS Maps provided. The site is shown to have been redeveloped in to Carnwath House on the 1930s OS Map, which remains on this site, as shown on the OS Master Map.

16. Townmead Estate

Industrial Type Buildings of unspecified use are indicated to be located at the site on the 1896 OS Map. Council records indicate that the De Morgan Pottery was operational at the site from at least 1888. The business is understood to have closed down in 1908 and been purchased by a Disinfectant and Metal Polish Manufacturer.

A Disinfectants and Polishes Factory is indicated in the east of the subject area on the 1951 OS Map. A Tank (unspecified contents or capacity) is labelled in the centre and a Weighing Machine in the northwest of the site at this time. The site is shown to have been redeveloped with mixed commercial and residential land use on the 1969 OS Map.

Council planning records show that permission was granted for the redevelopment of the site with residential, commercial and communal land use (2003/02322/FUL). Conditions pertaining to the investigation of potentially contaminated land were placed on this planning permission by the Council. It is understood that remedial works were carried out during the redevelopment with contaminated soil excavated and removed from site. A validation report for the residential blocks was submitted and approved by the Council enabling the partial discharge of the conditions in May 2007 (2007/01610/DET). A validation report for the remaining central courtyard area of the site has not been submitted.

17. Bridge Studios

Council records indicate that both a Garage and Laundry are operational at the site from at least 1928. These records also show an Underground Storage Tank (unspecified contents or capacity) to be installed at the property at this time. A Garage is labelled at the site on the 1930s OS Map. Council

planning records indicate that the site was in operation as a Dry Cleaners by at least 1952 (1952/00375/HIST), as indicated on the 1971-1976 OS Map provided. Planning permission was granted in September 1983 (1983/01350/FUL) for change of use of the ground and first floors of the property to Light Industrial/commercial. Further Council records dating from 1984 indicate the presence of two Oil/Water Interceptors at the subject property. The site is understood to be currently occupied by commercial premises.

Miscellaneous
There are four smaller potentially contaminated land sites that are located along Wandsworth Bridge Road in the northeast of the subject area. Council records indicate that a Cycle and Motor Works was located at 332 Wandsworth Bridge Road from at least 1924 and a Motor Cycle Repair/Servicing business was located at 328 Wandsworth Bridge Road from at least 1956. Further records also show that a Motor Cycle Dealer was operational at 336 and a Garage at 338 Wandsworth Bridge Road from at least 1956.

Other Information

The Council can confirm that none of the properties are presently incurring remedial action under Part IIA of the Environmental Protection Act 1990. I can confirm that none of the properties are on the Council's Contaminated Land Register. However, please note that the absence of an entry in our register at present does not guarantee that the land is free from contamination or risk from harm.

Further information about past land uses may be gained from the Archive and Local History Centre located at 191 Talgarth Road, Hammersmith, London W6 8BJ (tel: 020 8741 5159). If you would like to visit the Centre then you will need to arrange an appointment by phone.

Yours sincerely,

Jim Lightbown
Environmental Quality Officer

Enc: Site Plan
Historical Ordnance Survey Plans

EQSD64
15 October 2007

F.3 Detailed Unexploded Ordnance (UXO) risk assessment

References

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[2] Department for the Environment, Food and Rural Affairs and The Environment Agency, *CLR8: Potential Contaminants for the assessment of land,* Environment Agency (2002).

[3] Department of the Environment, Industry Profiles (various), available from http://www.environment-agency.gov.uk/research/planning/33708.aspx, accessed 25th March 2011.

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6 Alpha Associates Limited
Quatro House, Frimley Road
Camberley, Surrey
GU16 7ER

T: +44(0) 203 371 3904
F: +44(0) 1276 804 676
W: www.6alpha.com

Detailed Unexploded Ordnance (UXO) Risk Assessment

Study Site: Work Area PHF3X – Carnwath Road Riverside
Document Number: 336-RG-TPI-PHF3X-000001
Client Name: Thames Water
6 Alpha Project Number: P2853_R1_V2.0
Date: 3rd May 2012

Originator: Max Chainey (3rd May 2012)
Quality Review: Lisa Askham (11th May 2012)
Released by: Lee Gooderham (11th May 2012)

Contents

Figures

EXECUTIVE SUMMARY

Study Site	The Client has specified the Study Site as Work Area PHF3X, located at National Grid Reference "525646, 175550". For the purposes of this report, the Site has been divided into **AREA A** (Land aspect of main Work Area), **AREA B** (Foreshore and river of main Work Area), and **AREA C** (Secondary Work Area).		
Key Findings	In light of the research for this report, 6 Alpha has assessed the threat on this Site based on these pertinent facts: • **AREA A and C** are situated on what was predominantly developed land during World War Two (WWII). **AREA B** overlaps the foreshore of the *River Thames*. • Numerous WWII bombing targets have been identified on and around **AREA A, B and C**, including various "works", a "power station", "gas suppliers", railway infrastructure and the *River Thames*. • *Fulham Metropolitan Borough*, where the Study Site is located, experienced a bombing density of 239 High Explosive (HE) bombs per 1,000 acres. This is a relatively medium to high bombing density for *London*. • One HE bomb strike occurred on the boundary of **AREA A**, and another occurred within the buffered Site boundary. Two more bomb strikes were recorded within 100m of the buffered Site boundary. • Bomb damage was not recorded within **AREA A, B or C**, however there was "total destruction" of a structure within the buffered Site boundary. • Some development has occurred within **AREA A and C**, involving the demolition of a number of structures, as well as the construction of others. Therefore, there is a possibility, albeit small, that previous works may have removed UXO items. The risk assessment and risk mitigation outlined below are based on the indicative engineering drawings and proposed works provided by *Thames Water*, and therefore it should be noted that any changes to the engineering drawings or proposed works may affect the risk assessment.		
Potential Threat Source	The threat is predominately posed primarily by WWII *German* HE bombs, with a secondary threat from Incendiary Bombs and *British* Anti-Aircraft Artillery (AAA) projectiles.		
Risk Pathway	Given the type of munitions that might be present on Site, all types of aggressive intrusive engineering activities may generate a significant risk pathway.		
Risk Level	**AREA A** **LOW/MEDIUM**	**AREA B** **HIGH**	**AREA C** **LOW/MEDIUM**
Recommended Risk Mitigation	**The following actions are recommended before undertaking any activity on the Study Site:** **ALL AREAS** **1. Operational UXO Risk Management Plan;** appropriate site management documentation should be held on site to plan for and guide upon the actions to be carried out in the event of a suspected or real UXO discovery. **2. UXO Safety & Awareness Briefings;** the briefings are essential when there is a possibility of explosive ordnance encounter and are a vital part of the general safety requirement. **3. On-Site Banksman;** all open excavation works should be accompanied by an UXO Specialist to monitor works down to the maximum bomb penetration depth. **AREA B** **4. Non-intrusive Magnetometer Survey**; Prior to any dredging of the foreshore, 6 Alpha recommend a non-intrusive magnetometer survey. Any magnetic contacts that model as UXO should either be investigated or avoided.		

ASSESSMENT METHODOLOGY	
Approach	6 Alpha Associates are independent, specialist risk management consultants and the UXO related risk on the Site has been assessed using the process advocated by both the *Construction Industry Research & Information Association* (CIRIA) best practice guide (C681) and by the *Health & Safety Executive* (HSE). Therefore, any risk levels identified in the assessments are objective, quantifiable and not simply designed to generate "follow on survey or contracting work"; any mitigation solution is recommended *only* because it delivers the Client a risk reduced to As Low As Reasonably Practicable (ALARP) at best value. Potential UXO hazards have been identified through investigation of Local and National archives covering the Site, *Ministry of Defence* (MoD) archives, local historical sources, historical mapping as well as contemporaneous aerial photography (as and if, it is available). Potential hazards have only been recorded if there is specific information that could reasonably place them within the boundaries of the Site. Key source material is referenced within this document, whilst data of lesser relevance (which may have been properly considered and discounted by 6 Alpha), is available upon request. The assessment of UXO risk is a measure of ***probability*** *of encounter* and ***consequence*** *of encounter*; the former being a function of the identified hazard and proposed development methodology; the latter being a function of the type of hazard and the proximity of personnel (and/or other "sensitive receptors"), to the hazard at the moment of encounter. Should a measurable UXO risk be identified, the methods of mitigation recommended are reasonably and sufficiently robust to reduce these to As Low As Reasonably Practicable (ALARP). We believe that the adoption of the legal ALARP principle is a key factor in efficiently and effectively ameliorating UXO risks. It also provides a ready means for assessing the Client's tolerability of UXO risk. In essence the principle states that if the cost of reducing a risk significantly outweighs the benefit, then the risk may be considered tolerable. Clearly this does not mean that there is no requirement for UXO risk mitigation, but any mitigation must demonstrate that it is beneficial. Any additional mitigation that delivers diminishing benefits **and** that consume disproportionate time, money and effort are considered *de minimis* and thus unnecessary. Because of this principle unexploded bomb (UXB) risks will rarely be reduced to zero (nor need they be).
Important Notes	Although this report is up to date and accurate, our databases are continually being populated as and when additional information becomes available. Nonetheless, 6 Alpha have exercised all reasonable care, skill and due diligence in providing this service and producing this report. The assessment levels are based upon our professional opinion and have been supported by our interpretation of historical records and third party data sources. Wherever possible, 6 Alpha has sought to corroborate and to verify the accuracy of all data we have employed, but we are not accountable for any inherent errors that may be contained in third party data sets (e.g. National Archive or other library sources), and over which 6 Alpha can exercise no control. The intention of this report is to provide the Client with a concise summary of the risks posed to the site investigation and construction works. The background risk has been established in a Threat & Preliminary Risk Assessment Report that will be provided separately. Whilst this document may be used in isolation, an overarching report is available that outlines the procedures, details and methodologies used to assess the UXO risk to this project.

STAGE ONE – SITE LOCATION AND DESCRIPTION

Study Site	The Client has specified the Study Site as Work Area PHF3X. The Site is located at National Grid Reference 525646, 175550. For the purposes of this study, a 50m assessment radius will be applied to the work area to provide flexibility should it need to be relocated. Additionally, the Site has been divided into **AREA A, B, and C** for the purpose of this report. See *Figures 1* and *2* for the Site location and area divisions.
Location Description ***(Figure 3)***	The Work Area is situated to the southwest of the *City of London* within the *Fulham Metropolitan Borough*. Current aerial photography has identified the following within each area: **AREA A:** "Waste ground" and *Carnwath Road Industrial Estate.* **AREA B:** *River Thames* and foreshore. **AREA C:** *Hurlingham Retail* car park.
Proposed Engineering Works	*Thames Water* have specified a summary of the proposed engineering works. including working draft plans with drawing no. 100-DA-CNS-PHF3X-238105_AI; 100-DA-CNS-PHF3X-238106_AH; 100-DA-CNS-PHF3X-238107_AG; and 100-DA-CVL-PHF3X-338020_AI. These works have been divided between **AREAS A, B, and C**, however where not explicitly stated, 6 Alpha has made an assumption of which area the work will be carried out. **Areas A & C** • Rerouting of the Thames Path around the rear of the Carnwath Road Industrial Estate. • Demolition of existing buildings within the Carnwath Road Industrial Estate. • Creation of a main tunnel drive construction site comprising Wiffin Wharf, Hurlingham Wharf and Carnwath Road Industrial Estate. • Construction of a 25m internal diameter shaft, approximately 40m deep. It is anticipated the shaft will be constructed using a sprayed concrete primary lining with a cast in-situ concrete lining. A pre-cast segmental lining could also be used as an alternative to the sprayed concrete. • Drive and line a 6.5 m internal diameter main tunnel to Acton. • Construction of an above ground ventilation building approximately 20m by 13m on plan and 9m high, also containing the site equipment kiosk. • Build two smaller above ground ventilation structures, 1.5m by 1.5m and 3m by 3m on plan respectively and both approximately 3m high. • Construct a ventilation column approximately 15m high. **Area B** • Refurbishment of the existing wharves to permit temporary river handling of both incoming materials and outgoing spoil in support of tunnel construction. May include dredging of the foreshore to recreate campsheds. • Construction a temporary pier to support earth moving via barges if dredging is to be avoided. • Drive and line a 6.5 m internal diameter main tunnel to Acton.
Ground Conditions	Thames Water have indicated the following ground conditions for the Work Areas as:

Site Geology	Depth Below Ground Level (m)	Thickness (m)
Made Ground	0.00	2.00
Alluvium	2.00	4.00
River Terrace Deposits	6.00	5.00
London Clay	11.00	Proven 30

It is important to establish the ground conditions within this report to determine both the maximum bomb penetration depth (BPD) and the potential for other types of munitions to be buried on this Site.

STAGE TWO – REVIEW OF HISTORICAL DATASETS	
Sources of Information Consulted	The following primary information sources have been used in order to establish the background UXO threat: 1. Home Office WWII Bomb Census Maps; 2. WWII & post-WWII Aerial Photography; 3. Official Abandoned Bomb Register; 4. National Archives in Kew; 5. Internet based research; 6. Historic UXO information provided by 33 Engineer Regiment (Explosive Ordnance Disposal) at Carver Barracks, Wimbish.
Site History and Use	According to the County Series (CS) & Ordnance Survey (OS) historical mapping, the following site history can be recorded immediately prior to and post-WWII: **1938 CS mapping** **AREA A** is located on predominantly developed land consisting of *Broom House Dock*, and an "ambulance station". **AREA B** contains no development. **AREA C** is located on developed land consisting of an unidentified structure and *Wandsworth Bridge Wharf*. **1948 OS mapping** No noticeable or significant changes have been observed within the areas.
1945 Aerial Photography ***(Figure 4)***	**AREA A and C:** The 1945 aerial photography confirms structural development on Site, and despite the lack of clarity in the aerial photography, we can infer that much of the Site is intact, given the buildings present on the photograph are concomitant with mapping from 1938.
WWII Luftwaffe Bombing Targets ***(Figure 5)***	**AREA A:** Several "works" factories were located within this area. **ALL AREAS:** Primary targets have been identified as "*Fulham Power Station"* 370m to the northeast, "*Wandsworth, Wimbledon and Epsom Gas Works"* 100m to the south, and a "generating station" 280m to the south. "Opportunistic" targets include "petroleum depots", "works", "coal bunkers", *Wandsworth Town Station* and railway infrastructure all within 600m of the Site.
WWII HE Bomb Strikes ***(Figure 6)***	Air Raid Precaution (ARP) reports indicate the following: **AREA A:** One HE bomb strike on the northwestern boundary. **AREA B:** No bomb strikes. **AREA C:** No bomb strikes. Additionally, one HE bomb strike occurred within the northeast of the buffered boundary. A further two HE bomb strikes were recorded within 100m of the buffered boundary.
WWII Bomb Damage ***(Figure 7)***	*London County Council* (LCC) bomb damage maps indicate the following: **AREA A:** No bomb damage. **AREA B:** No bomb damage. **AREA C:** No bomb damage. However, "total destruction" of a structure due to bomb damage was recorded 30m to the east of **AREA A** and within the buffered Site boundary.
WWII HE Bomb Density ***(Figure 8)***	The Study Site is located within the *Fulham Metropolitan Borough,* which recorded 239 HE bombs per 1,000 acres. This figure does not include incendiary devices, as they were often released in such large numbers that they were seldom recorded.
Abandoned Bombs	The Official Abandoned Register recorded one 250kg incendiary bomb located approximately 1.2km to the northwest of the buffered Site boundary.

STAGE THREE – DATA ANALYSIS	
Was the ground undeveloped during WWII?	**AREA A:** No; the ground was predominantly developed. **AREA B:** Yes; this area overlaps the *River Thames* and was undeveloped. **AREA C:** No; the ground was fully developed.
Is there a reason to suspect that the immediate area was a bombing target during WWII?	**ALL AREAS:** Yes; there are also numerous bombing targets within and around the buffered Site boundary, including many industrial areas, gas and power suppliers, and railway infrastructure. Furthermore, this area of *Wandsworth* where the Study Site is situated was subjected to high levels of bombing throughout WWII.
Is there firm evidence that ordnance landed on Site?	**AREA A:** Yes; there was one bomb strike on the boundary. **AREA B:** No; but unlikely to have been recorded given the environment. **AREA C:** No.
Is there evidence of damage sustained on Site?	**ALL AREAS:** No; although *LCC* bomb damage maps indicate "total destruction" of a structure within the buffered Site boundary.
Is there any reason to suspect that military training may have occurred at this location?	**ALL AREAS:** No; there is no evidence to suggest that military training occurred within any of the areas.
Would an UXB entry hole have been observed and reported during WWII?	**AREA A:** Yes; the land was mostly developed and a UXB entry hole would be witnessed. **AREA B:** Unlikely; UXBs falling in the *River Thames* are unlikely to have been observed and reported. Additionally, any impact craters of UXBs falling on the foreshore during low tide would have been masked and covered by the high tide. **AREA C:** Yes; the land was fully developed and a UXB entry hole would be witnessed.
What is the expected UXO contamination?	**ALL AREAS:** The most likely source of UXO contamination is from *German* aerial delivered ordnance, which ranges from small incendiary bombs through to large HE bombs (of which the latter forms the principal threat).
Would previous earthworks have removed the potential for UXO to be present?	**AREA A:** Possibly; changes within the central aspect of this area consist mostly of demolition activity, however new construction has occurred within the eastern portion of this area that may have removed the potential for UXO. **AREA B:** No; no significant earthworks have occurred. **AREA C:** Unlikely; demolition has occurred within this Site, but this activity is unlikely to have involved removing earthwork to the depths required for potential UXO.

STAGE FOUR – RISK ASSESSMENT		
Threat Items	The threat is predominately posed by WWII *German* HE bombs and Incendiary Bombs. Additionally, *British* Anti Aircraft Artillery (AAA) projectiles may also be present. However, AAA does not have the potential for deep burial, and thus is unlikely to be encountered at depths greater than 1m bgl.	
Maximum Penetration	Considering the general ground conditions (highlighted in Stage 1) including the potential depth of made ground and the hard surface geology within **AREA A and C**, the most likely Bomb Penetration Depth (BPD) for a 250kg bomb is assessed to be a maximum of 6m bgl, dependant on the depth of rock. As the boundary of **AREA B** overlaps with the foreshore of the *River Thames* and the river itself, the BPD will vary due to the softer ground conditions and the water causing a deceleration of the impacting bomb. Whilst the *Luftwaffe* used larger bombs, their deployment was so few and only used against notable targets, to use them within this risk assessment would not be justified. Additionally, smaller items such as *German* incendiary bombs and *British* AAA projectiles would have a significantly reduced penetration capability and would not be expected to be encountered at depths greater than 1m.	
Risk Pathway	Intrusive engineering activities are likely to be in the form of excavations. Although for the purposes of this report 6 Alpha will use a range of generic construction activities for the risk assessment.	
Consequence	**Potential consequences of UXO initiation**	1. Kill and/or critically injure personnel 2. Severe damage to plant and equipment 3. Blast damage to nearby buildings 4. Rupture and damage underground services
	Potential consequences of UXO discovery	1. Delay the project 2. Disruption to local community/infrastructure 3. Incurring of additional costs
Site Activities	A number of construction methodologies have been identified for analysis on this Site. There is a large amount of variation in the probability of encountering, or initiating items of UXO when conducting different activities on Site. Additionally the consequences of initiating UXO vary greatly depending on how the item of UXO was initiated on Site.	

STAGE FOUR – RISK ASSESSMENT (…continued)

UXO RISK CALCULATION TABLE

Risk Rating Calculation	6 Alpha's Semi-Quantitative Risk Assessment identifies the Risk Rating posed by the most probable threat items when conducting a number of different construction activities on the Site. Risk Rating is determined by calculating the probability of encountering UXO and the consequences of initiating it.

Activity	AREA A		
	Probability (SHxEM=P)	**Consequence** (DxPSR=C)	**Risk Rating** (PxC=RR)
Enabling Works	1x1=1	3x2=6	1x6=6
Tunnelling	1x2=2	1x1=1	2x1=2
Shaft Installation	1x2=2	1x2=2	2x2=4
Open Excavations	1x2=2	2x2=4	2x4=8

Activity	AREA B		
	Probability (SHxEM=P)	**Consequence** (DxPSR=C)	**Risk Rating** (PxC=RR)
Tunnelling	3x2=6	1x1=1	6x1=6
Dredging	3x3=9	3x2=6	9x6=54
Piling	3x3=9	2x2=4	9x4=36

Activity	AREA C		
	Probability (SHxEM=P)	**Consequence** (DxPSR=C)	**Risk Rating** (PxC=RR)
Enabling Works	1x1=1	3x2=6	1x6=6
Open Excavations	1x2=2	2x2=4	2x4=8

Abbreviations – Site History (SH), Engineering Methodology (EM), Probability (P), Depth (D), Consequence (C), Proximity to Sensitive Receptors (PSR) and Risk Rating (RR).

STAGE FIVE – RECOMMENDED RISK MITIGATION MEASURES WITH RESULTING RISK RATING	
If a geophysical survey is required are the ground conditions an issue?	**Non-Intrusive Methods of Mitigation –** The suitability for an effective non-intrusive method of mitigation is largely dependent on the depth (2m for this Site) and composition of made ground, as any magnetometer results are highly likely to be affected by ferro-magnetic contamination due to previous construction activities within the Study Site location. This method may be more effective on the foreshore, as this is area is undeveloped. **Intrusive Methods of Mitigation –** Intrusive magnetometry is expected to be possible on this Site, however deep excavation of made ground is required prior to the use of this methodology. It should be noted that ferro-contamination of any made ground/fill material, particularly at the fill layer, is likely to adversely affect detection capability of the equipment.

MITIGATION MEASURES TO REDUCE RISK TO 'ALARP'		
Activity	**Risk Mitigation Measures**	**Final Risk Rating**
ALL AREAS	**The following actions are recommended before undertaking any activity on the Study Site:** 1. **Operational UXO Risk Management Plan;** appropriate site management documentation should be held on site to plan for and guide upon the actions to be carried out in the event of a suspected or real UXO discovery. 2. **UXO Safety & Awareness Briefings;** the briefings are essential when there is a possibility of explosive ordnance encounter and are a vital part of the general safety requirement. All personnel working on the site should receive a general briefing on the identification of UXB, what actions they should take to keep people and equipment away from the hazard and to alert site management. 3. **On-Site Banksman;** all open excavation works should be accompanied by an UXO Specialist to monitor works down to the maximum bomb penetration depth.	ALARP
AREA B	**4. Non-intrusive Magnetometer Survey**; Prior to any dredging of the foreshore, 6 Alpha recommend a non-intrusive magnetometer survey. Any magnetic contacts that model as UXO should either be investigated or avoided.	
This assessment has been conducted based on the information provide by the Client, should the proposed works change then 6 Alpha should be re-engaged to refine this risk assessment.		

Report Figures

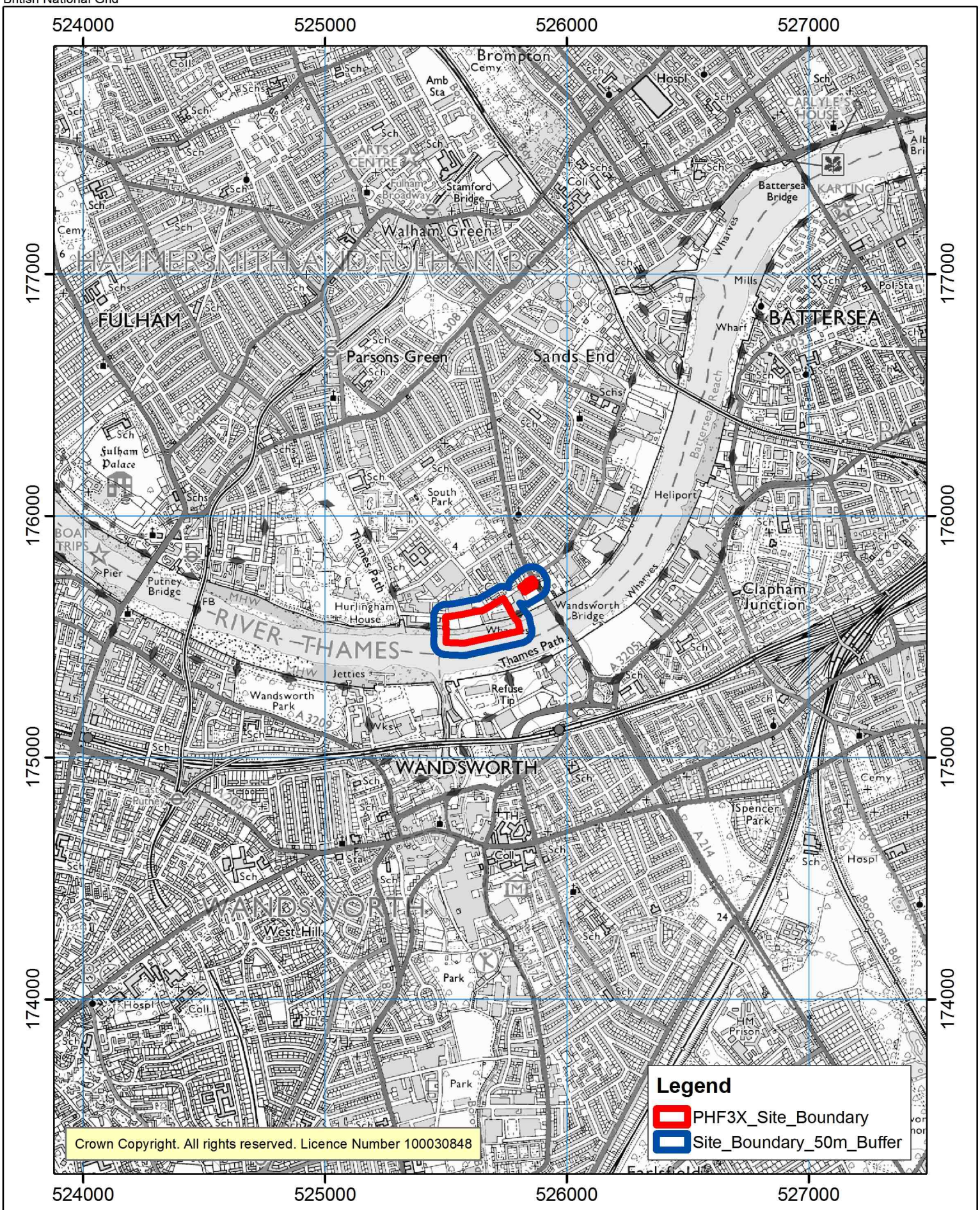
Figure One

Site Location

Thames Tideway Tunnel - Work Area PHF3X
Site Location

Figure 1

British National Grid



BOMB SEARCH

6 Alpha Associates Ltd.
Quatro House
Frimley Road
Camberley
Surrey GU16 7ER
United Kingdom
www.6alpha.com
0203 371 3900

0 100 200 400 600 800 1,000 Meters

N

Project Number: P2853_PHF3X
Drawn By: Dominique René
Checked by: Lee Gooderham
Date: 30th April 2012

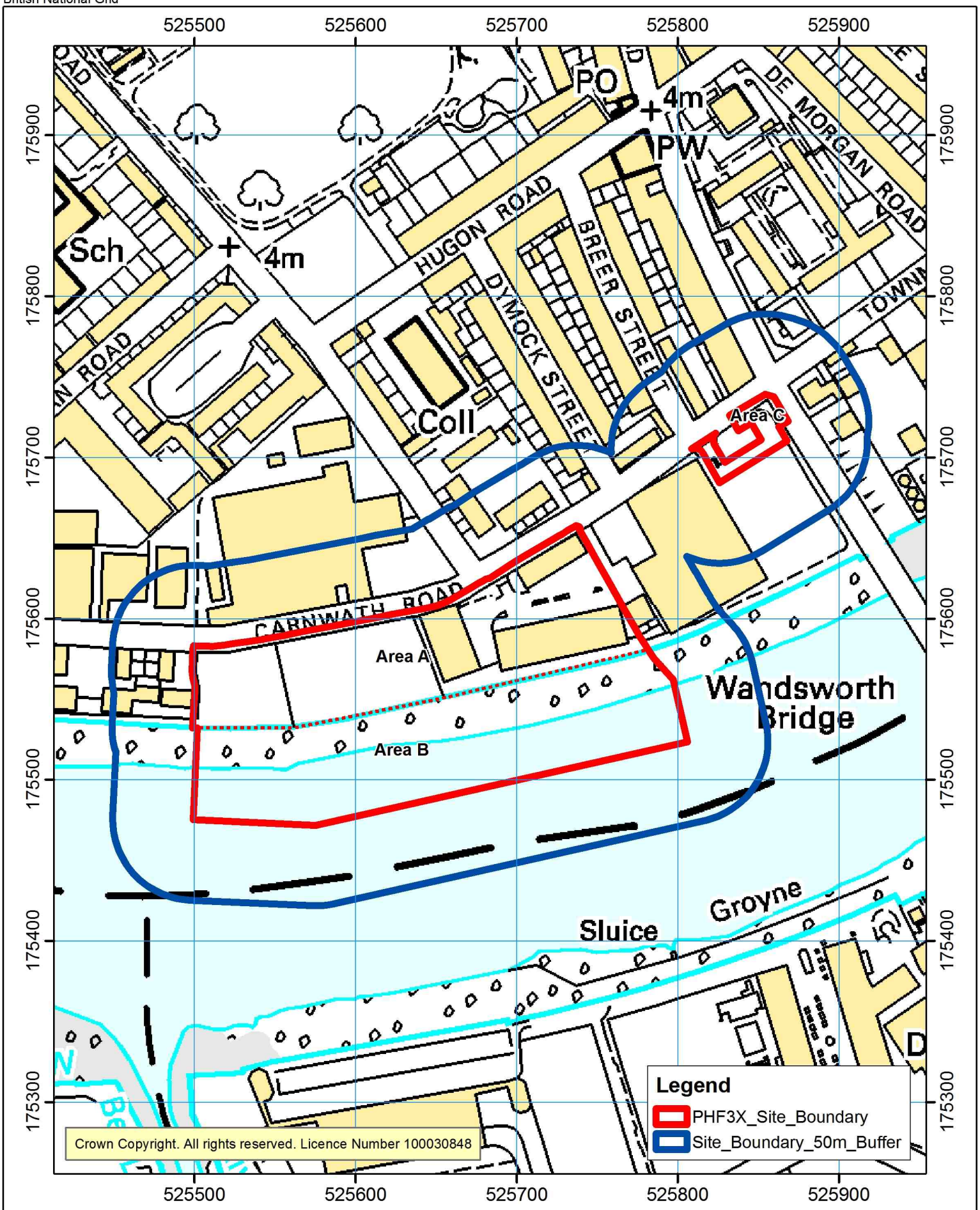
Figure Two

Site Plan

Thames Tideway Tunnel - Work Area PHF3X Site Boundary

Figure 2

British National Grid



6 Alpha Associates Ltd.
Quatro House
Frimley Road
Camberley
Surrey GU16 7ER
United Kingdom
www.6alpha.com
0203 371 3900

0 25 50 100 150 Meters

N

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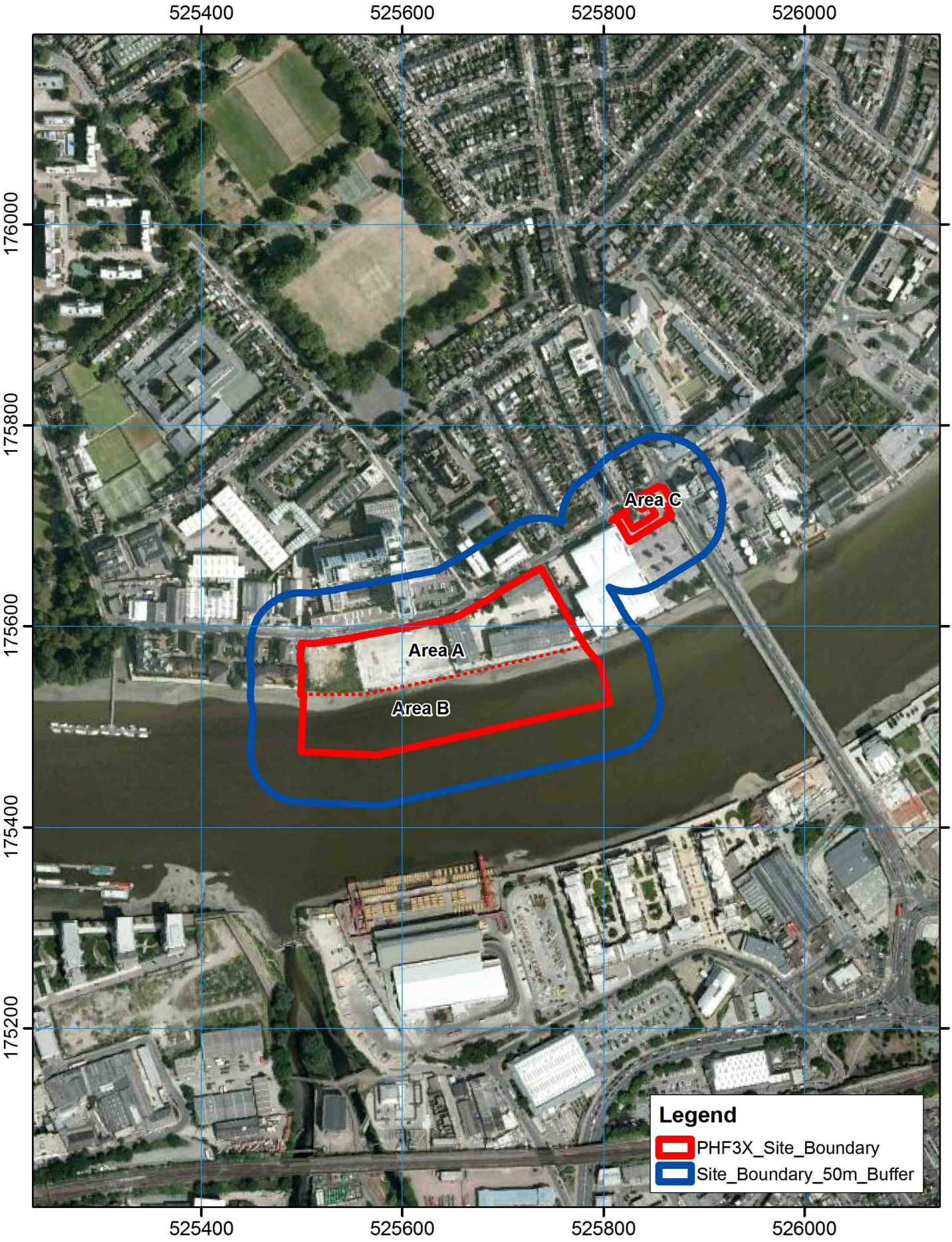
Figure Three

Current Aerial Photography

Thames Tideway Tunnel - Work Area PHF3X
Current Aerial Photography

Figure 3

British National Grid



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6 Alpha Associates Ltd.
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Camberley
Surrey GU16 7ER
United Kingdom
www.6alpha.com
0203 371 3900

0 25 50 100 150 200 250 Meters

N

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Checked by: Lee Gooderham
Date: 30th April 2012

Figure Four

1945 Aerial Photography

Thames Tideway Tunnel - Work Area PHF3X
1945 Aerial Photography

Figure 4

British National Grid

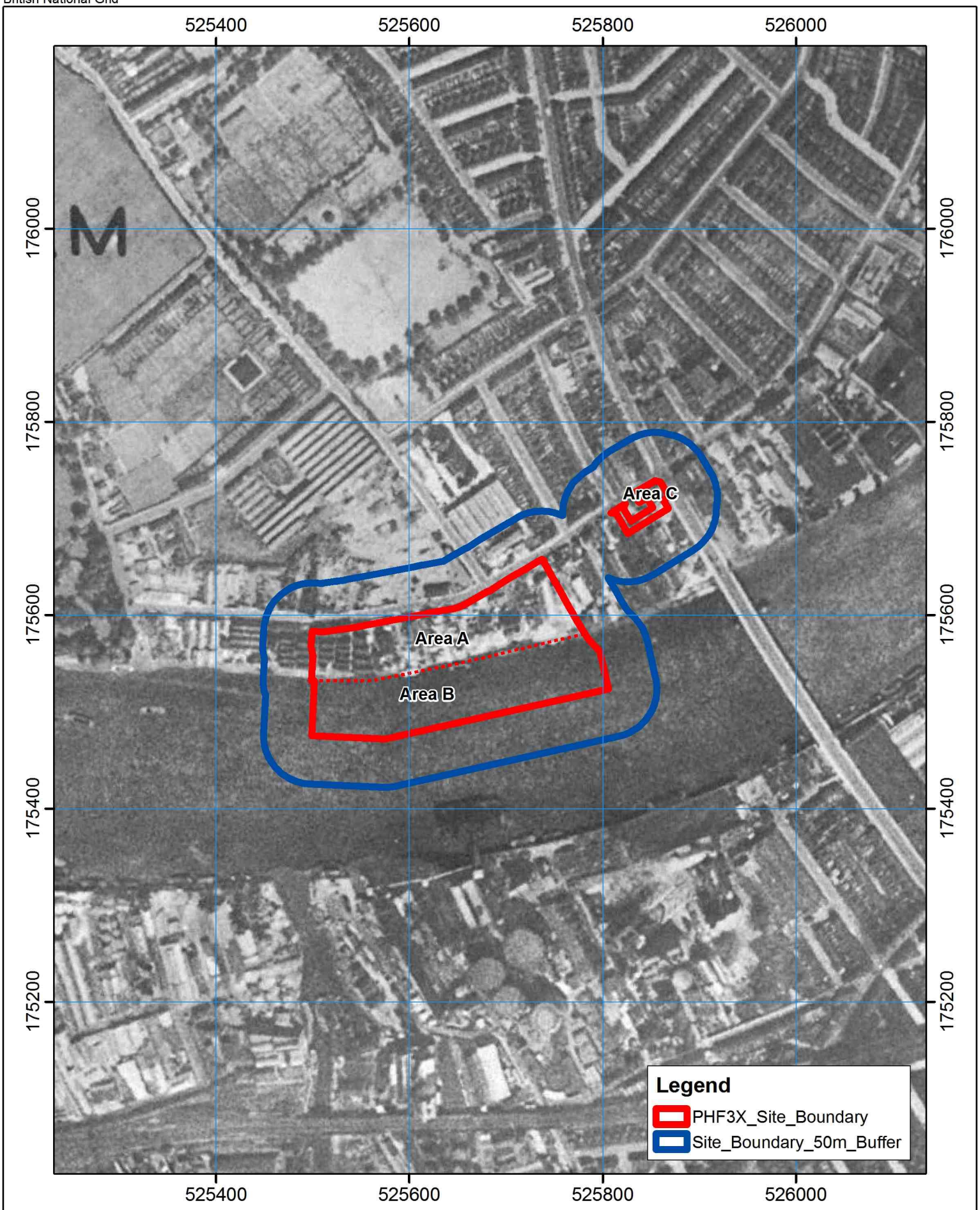

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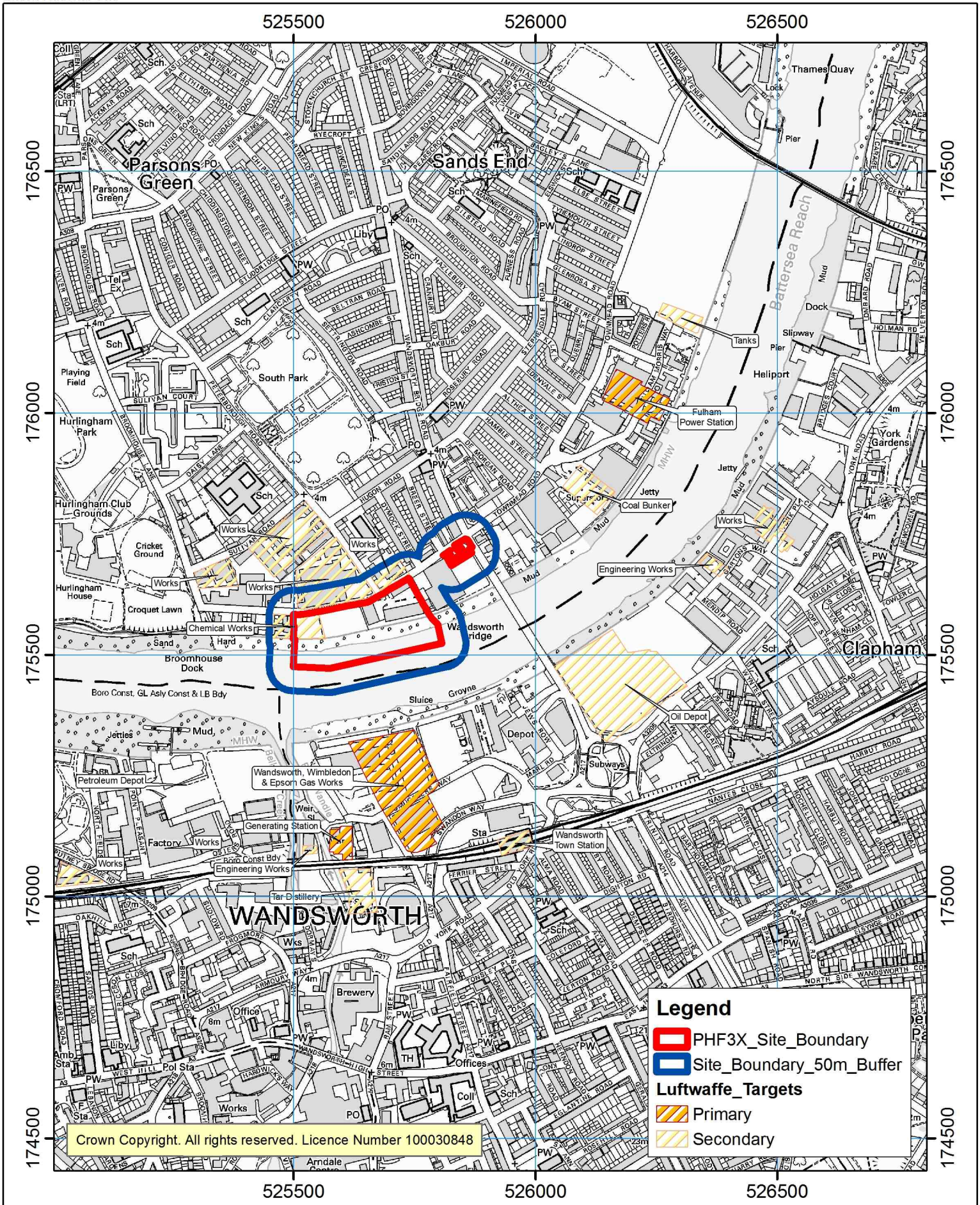
Figure Five

WWII *Luftwaffe* Bombing Targets

Thames Tideway Tunnel - Work Area PHF3X
WWII Luftwaffe Bombing Targets

Figure 5

British National Grid



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0 50 100 200 300 400 500 Meters

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Figure Six

WWII High Explosive Bomb Strikes

Thames Tideway Tunnel - Work Area PHF3X
WWII High Explosive Bomb Strikes

Figure 6

British National Grid

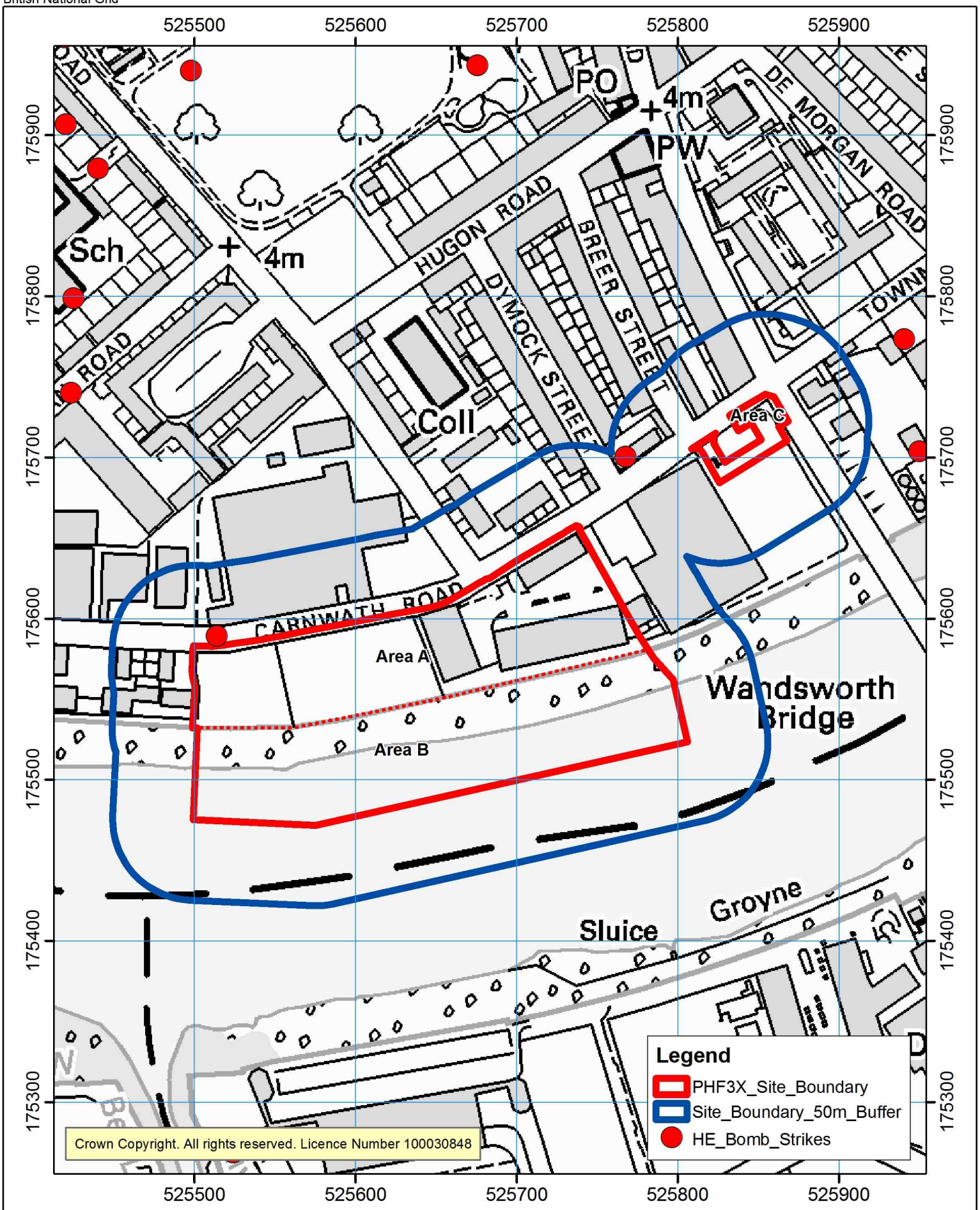

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Figure Seven

London County Council Bomb Damage Mapping

Thames Tideway Tunnel - Work Area PHF3X
London County Council Bomb Damage Map

Figure 7

British National Grid

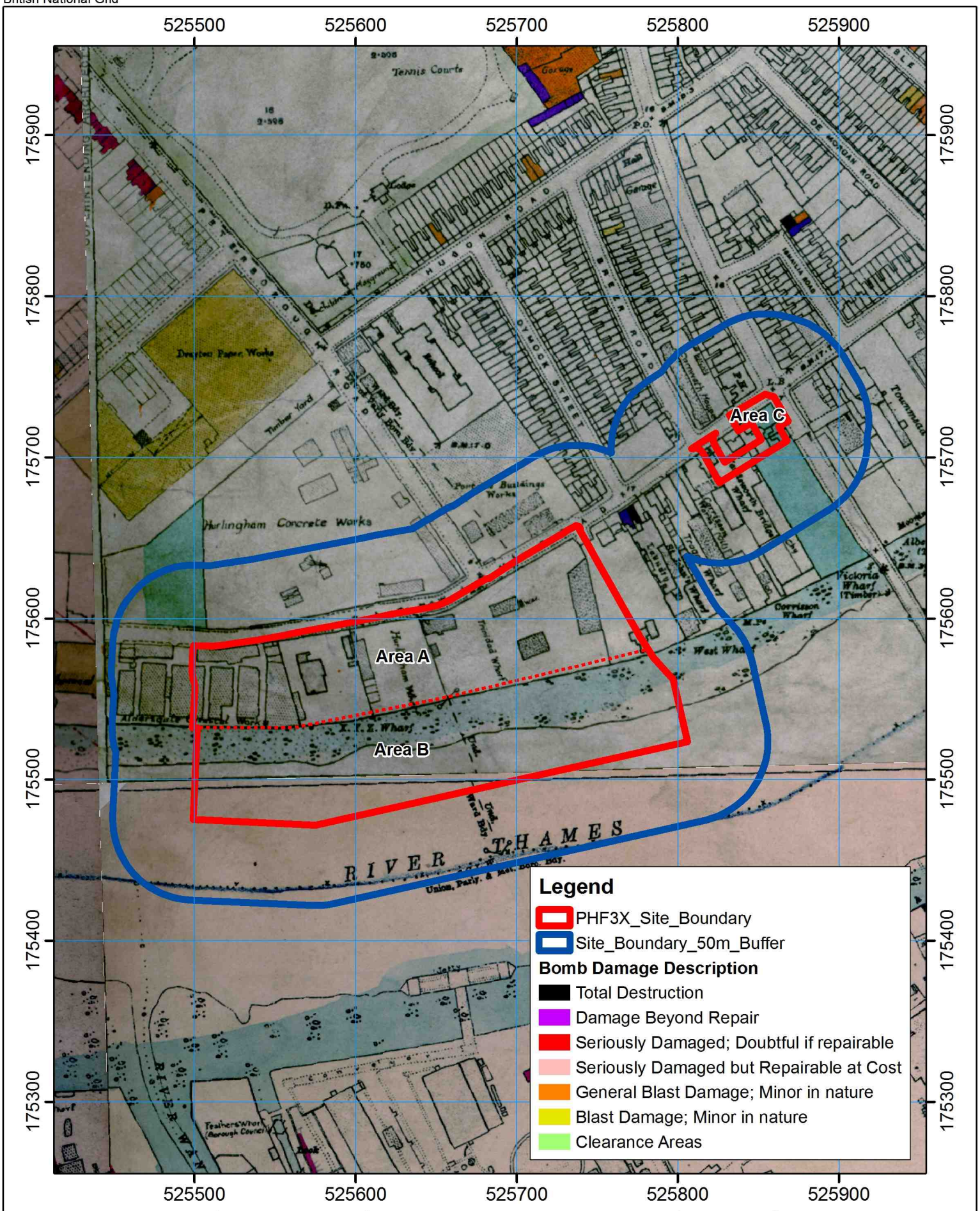

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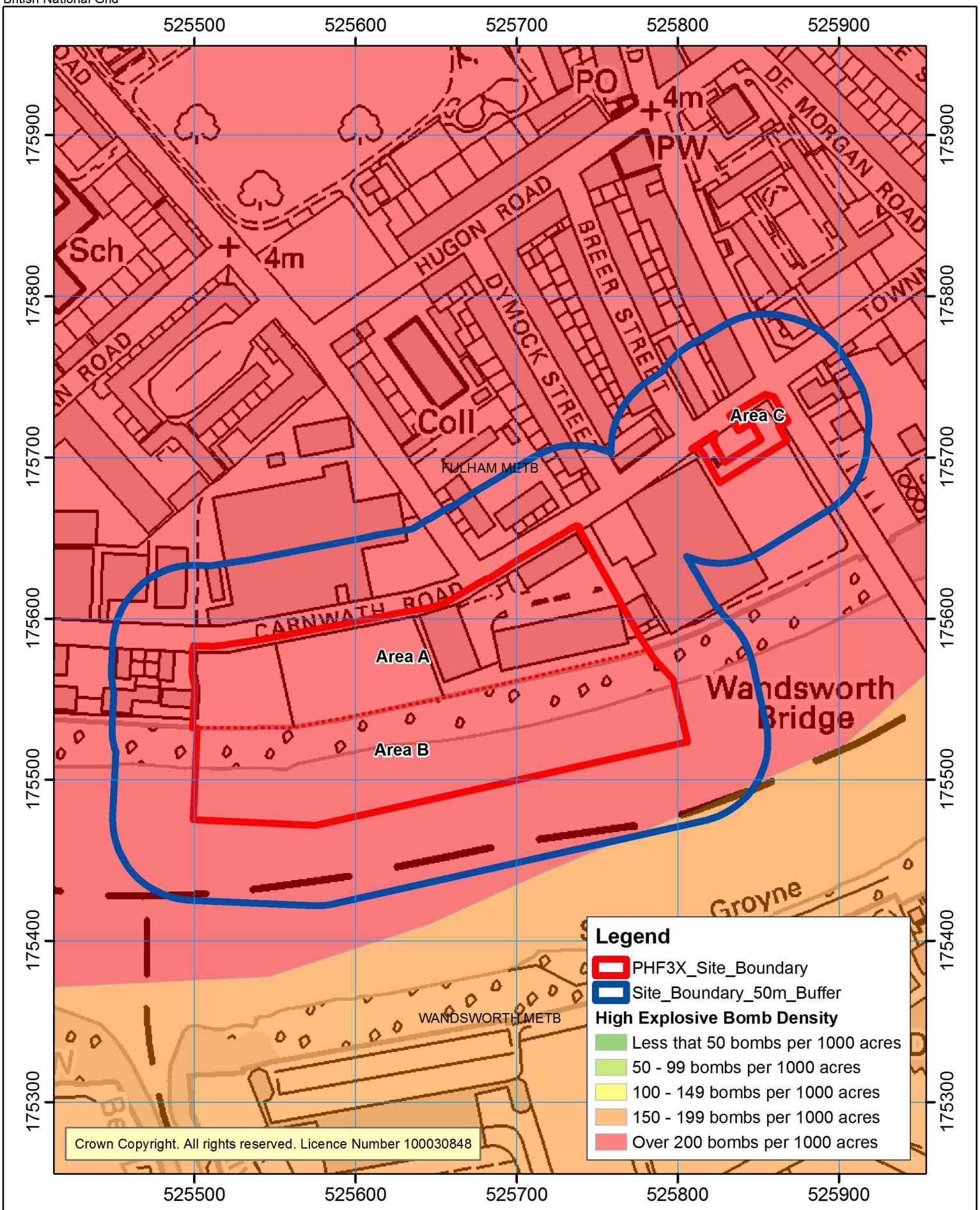
Figure Eight

WWII High Explosive Bomb Density

Thames Tideway Tunnel - Work Area PHF3X
WWII High Explosive Bomb Density

Figure 8

British National Grid



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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.10**

Volume 10: Carnwath Road Riverside appendices

Appendix G: Noise and vibration

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

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Thames Tideway Tunnel

Creating a cleaner, healthier River Thames

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Thames Tideway Tunnel

Environmental Statement

Volume 10 Carnwath Road Riverside appendices

Appendix G: Noise and vibration

List of contents

Page number

List of plates

Page number

List of tables

Page number

Appendix G: Noise and vibration

G.1 Baseline noise survey

Introduction

G.1.1 As described in Volume 2 Environmental assessment methodology, the main purpose of the noise survey has been to determine representative ambient and background noise levels at a number of different types of noise sensitive receptor.

G.1.2 The nearest identified noise sensitive receptors to Carnwath Road Riverside are the three storey residential premises (85 and 89 to 101 Carnwath Road) located west of the site and 5 Carnwath Road, a four storey residential property to the east. Residences in the Piper Building, Philpot Square and Dymock Street to the north of the site and at Riverside Quarter to the south of the site across the river have also been included in the assessment. The offices at 50 Carnwath Road are assessed as non-residential receptors.

Survey methodology

G.1.3 The London Borough of Hammersmith and Fulham has been consulted regarding the noise assessment and monitoring locations, prior to completing the surveys. A response has not been received (see Vol 10 Section 9.3).

G.1.4 An initial baseline noise survey was completed on 11th-12th December 2011 and additional data was collected on 8th to 10th January 2012. The baseline surveys comprised short term attended measurements taken during the daytime, evening and night time. Continuous unattended monitoring was also completed at one location.

G.1.5 Short term attended noise monitoring was completed at four locations. Measurements were undertaken during the interpeak periods of 10:00-12:00, 14:00-16:00 and 20:00-22:00 on a typical weekday, and 14:00-18:00 and 00:00-04:00 on a typical weekend day, so that the baseline data is representative of the quieter periods where any disturbance from construction would be most noticeable.

G.1.6 Vol 10 Table G.1 describes the survey equipment that was used to collect the baseline data at the site.

Vol 10 Table G.1 Noise – survey equipment

Item	Type	Manufacturer	Serial number(s)	Laboratory calibration date
Initial baseline survey: 11th-12th December, 2011				
Hand-held analyser(s)	2250	Brüel & Kjær	2626232 2626233	15/02/2010*
½ " microphone(s)	4189	Brüel & Kjær	2621211 2621212	15/02/2010*
B&K sound calibrator(s)	4231	Brüel & Kjær	2619374 2619375	21/02/2011* 12/01/2011*
Additional baseline survey: 8th - 10th January, 2012				
Hand-held analyser(s)	2250	Brüel & Kjær	2626230 2638881	19/01/2010* 14/09/2011
½ " microphone(s)	4189 4950	Brüel & Kjær Brüel & Kjær	2621209 2626990	20/01/2010* 14/09/2011
B&K sound calibrator(s)	4231	Brüel & Kjær	2619375	12/01/2011*

**Hand-held analyser(s) and ½ inch microphone(s) valid for two years from the date listed, calibrator(s) valid for one year from the date listed*

G.1.7 Prior to and on completion of the surveys, the sound level meters and microphone calibration was checked using a Brüel and Kjær sound level meter calibrator. On-site calibration checks were performed before and after all measurements with no significant deviation being observed. The sound level meters and calibrators have valid laboratory calibration certificates.

G.1.8 For the attended measurements, the sound level meters were tripod-mounted with the microphone approximately 1.3m above ground level. A windshield was fitted over the microphone at all times during the survey period to minimise the effects of any wind induced noise.

G.1.9 For the unattended measurement, the environmental case used for the continuous data logging was locked to avoid any potential tampering. The microphone was tripod-mounted approximately 1.3m above ground level. A windshield with bird spikes was fitted over the microphone at all times during the survey period to minimise the effects of any wind induced noise, and also to prevent birds from perching on the equipment.

G.1.10 The prevailing weather conditions observed during the baseline surveys are described in Vol 10 Table G.2.

Vol 10 Table G.2 Noise – weather conditions during baseline noise surveys

Wind Speed (ms^{-1})	Wind Direction	Temperature (°C)	Precipitation	Description
Initial baseline survey – 11th December, 2011 (daytime, 14:00-18:00)				
Maximum: 3.0-6.8 Average: 0.5-3.4	Southerly	8-9	Yes (drizzle observed early PM briefly)	Overcast, breezy and predominantly dry
Initial baseline survey – 12th December, 2011 (night-time, 00:00-04:00)				
Maximum: 1.2-2.5 Average: 0.3-0.7	Westerly	5-7	Yes - brief drizzle observed)	Overcast, calm and predominantly dry
Initial baseline survey – 12th December, 2011 (daytime, 10:00-12:00)				
Maximum: 1.9-5.7 Average: 0.4-1.4	SW	7-10	No	Sunny, clear, dry and breezey
Initial baseline survey – 12th December, 2011 (daytime, 14:00-16:00)				
Maximum: 2.4-6.1 Average: 0.7-2.7	S;SW	8-9	No	Dry, cloudy, breezy
Additional baseline survey – 9th January, 2012 (evening, 20:00-22:00)				
Maximum: 0.8-1.9 Average: 0.3-0.6	SW	12-13	No	Cloudy, dry, calm
Additional baseline survey – 10th January, 2012 (night-time, 00:00-04:00)				
Maximum: 0.7-3.2 Average: 0.3-1.7	Westerly	10-11	Yes (drizzle observed early AM)	Overcast, calm and predominantly dry

Measurement locations

G.1.11 Vol 10 Table G.3 details the measurement locations which are also presented in Vol 10 Figure G.1 Noise – measurement locations (see separate volume of figures), and shown in Plates G.1 to G.4.

Vol 10 Table G.3 Noise – measurement locations

Measurement location number	Description	Co-ordinates	
		X	Y
CRR01	Within private car park of Piper Building, adjacent to Carnwath Road	525610* 525619**	175627* 175616**
CRR02	On public footpath leading to Thames Path, between residential dwellings on Carnwath Road and Whiffin Wharf	525500	175563
CRR03	On public footpath outside residential dwelling on Dymock Street, by the junction between Dymock Street and Carnwath Road	525753	175680
CRR04	On public footpath adjacent to Carnwath Road, in front of residential dwellings	525767	175606

**Attended measurement location*

***Unattended measurement location*

Results

G.1.12 The range of values for each of the parameters collected during the baseline surveys are summarised in Vol 10 Table G.4 to Table G.9.

Vol 10 Table G.4 Noise – sampled noise survey results - CRR01

Location Detail: CRR01*, within private car park of Piper Building, adjacent to Carnwath Road						
Measurement period	**Noise level (dB(A) free-field)**			**Averaged ambient noise level, $dBL_{Aeq,15min}$**		**$dBL_{Aeq,15min}$ (rounded to nearest 5dB)**
	L_{AFmax}	**$L_{A90,15min}$**	**$L_{Aeq,15min}$**	**Free field**	**Façade**	**Façade**
Night (00.00-04.00)	69	46	46-50	45*	48	50

**Attended measurement data*

*** An approximation of the averaged ambient free-field level has been obtained by subtracting 3dB from the calculated averaged ambient façade noise level*

Vol 10 Table G.5 Noise – continuously logged noise survey results - CRR01

Location Detail: CRR01*, within private car park of Piper Building, adjacent to Carnwath Road						
Measurement period	**Noise level (dB(A) free-field)**			**Averaged ambient noise level, $dBL_{Aeq,15min}$**		**$dBL_{Aeq,15min}$ (rounded to nearest 5dB)**
	L_{AFmax}	**$L_{A90,15min}$**	**$L_{Aeq,15min}$**	**Free field**	**Façade**	**Façade**
Daytime (10.00-12.00, 14.00-16.00)	91	55	66	66	69**	70
Evening (20.00-22.00)	94	49	63	63	66**	70
Weekend day (14.00-18.00)	91	54	65	65	68**	70
Weekend night (00.00-04.00)	77	44	51	51	54**	55

**Unattended measurement data*

*** An approximation of the averaged ambient façade noise level has been obtained by adding 3dB to the calculated averaged ambient free-field level*

Vol 10 Table G.6 Noise – sampled noise survey results - CRR02

Location Detail: CRR02, on public footpath leading to Thames Path, between residential dwellings on Carnwath Road and Whiffin Wharf						
Measurement period	**Noise level (dB(A) free-field)**			**Averaged ambient noise level, $dBL_{Aeq,15min}$**		**$dBL_{Aeq,15min}$ (rounded to nearest 5dB)**
	L_{AFmax}	**$L_{A90,15min}$**	**$L_{Aeq,15min}$**	**Free field**	**Façade**	**Façade**
Daytime (10.00-12.00, 14.00-16.00)	93	53	59-62	58*	61	60
Evening (20.00-22.00)	85	34	42-61	55*	58	60
Night (00.00-04.00)	59	36	36-42	37*	40	40
Weekend day (14.00-18.00)	80	51	59-63	59*	62	60
Weekend night (00.00-04.00)	73	35	38-51	44*	47	45

** An approximation of the averaged ambient free-field level has been obtained by subtracting 3dB from the calculated averaged ambient façade noise level*

Vol 10 Table G.7 Noise – sampled noise survey results - CRR03

Location Detail: CRR03, on public footpath outside residential dwelling on Dymock Street, by the intersection between Dymock Street and Carnwath Road						
Measurement period	**Noise level (dB(A) free-field)**			**Averaged ambient noise level, $dBL_{Aeq,15min}$**		**$dBL_{Aeq,15min}$ (rounded to nearest 5dB)**
	L_{AFmax}	**$L_{A90,15min}$**	**$L_{Aeq,15min}$**	**Free field**	**Façade**	**Façade**
Daytime (10.00-12.00, 14.00-16.00)	85	60	68-70	66*	69	70
Evening (20.00-22.00)	78	41	54-57	53*	56	55
Night (00.00-04.00)	86	38	50-57	52*	55	55
Weekend day (14.00-18.00)	90	59	67-69	65*	68	70
Weekend night (00.00-04.00)	83	40	52-59	53*	56	55

** An approximation of the averaged ambient free-field level has been obtained by subtracting 3dB from the calculated averaged ambient façade noise level*

Vol 10 Table G.8 Noise – sampled noise survey results - CRR04

Location Detail: CRR04, on public footpath adjacent to Carnwath Road, in front of residential dwellings						
Measurement period	**Noise level (dB(A) free-field)**			**Averaged ambient noise level, $dBL_{Aeq,15min}$**		**$dBL_{Aeq,15min}$ (rounded to nearest 5dB)**
	L_{AFmax}	**$L_{A90,15min}$**	**$L_{Aeq,15min}$**	**Free field**	**Façade**	**Façade**
Daytime (10.00-12.00, 14.00-16.00)	78	52	59-61	57*	60	60
Evening (20.00-22.00)	76	41	46-55	50*	53	55
Night (00.00-04.00)	56	38	40-41	38*	41	40
Weekend day (14.00-18.00)	80	50	56-62	58*	61	60
Weekend night (00.00-04.00)	65	40	41-47	41*	44	45

** An approximation of the averaged ambient free-field level has been obtained by subtracting 3dB from the calculated averaged ambient façade noise level*

Vol 10 Table G.9 Noise measurements near embankment (for river-based traffic assessment

Sensitive receptor locations	**Measurement location**	**Measurement period**	**Noise level (dBL_{Aeq}, facade)**
Carnwath Road (east of site)	CRR02	Day/evening (07.00-23.00)	60
		Night (23.00-07.00)	41
Carnwath Road (west of site)	CRR04	Day/evening(07.00-23.00)	60
		Night (23.00-07.00)	40

Plates of noise measurement locations

G.1.13 The following plates (Vol 10 Plate G.1Plates G.1 to Vol 10 Plate G.5) illustrate the noise measurement locations.

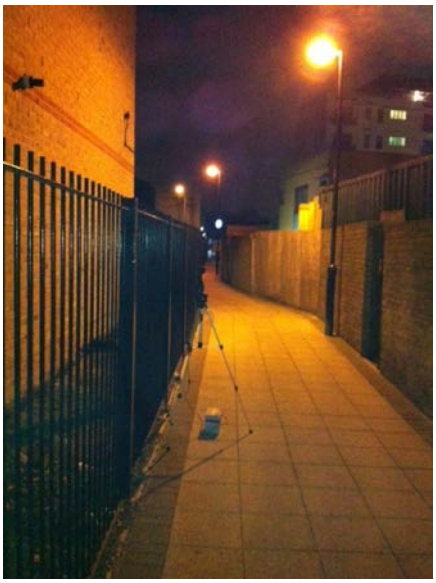
Vol 10 Plate G.1 Noise measurement location CRR01 (unattended)

Note: Within private grounds of Piper Building car park, looking south towards Carnwath Road

Vol 10 Plate G.2 Noise measurement location CRR01 (attended)

Note: Within private grounds of Piper Building car park, looking north (façade measurement)

Vol 10 Plate G.3 Noise measurement location CRR02



Note: On public footpath leading to Thames Path, between residential dwellings on Carnwath Road and Whiffin Wharf (façade measurement)

Vol 10 Plate G.4 Noise measurement location CRR03

Note: On public footpath alongside Dymock Street, looking northeast towards intersection between Dymock Street and Carnwath Road (façade measurement)

Vol 10 Plate G.5 Noise measurement location CRR04

Note: On public footpath adjacent to Carnwath Road, in front of residential dwellings looking southeast (façade measurement)

G.2 Construction noise prediction results

G.2.1 The construction noise prediction methodology follows the methodology provided in Volume 2 Environmental assessment methodology.

G.2.2 The assessment has been carried out based on a typical construction programme which has been used to calculate the average monthly noise levels.

G.2.3 Construction plant assumptions used in the assessment are presented in Vol 10 Table G.10.

G.2.4 Time histories of the predicted daytime construction noise levels across the programme of construction works are shown in Vol 10 Plate G.6 to Vol 10 Plate G.14.

Vol 10 Table G.10 Noise – typical construction plant schedule

Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
Hoarding General site equipment NOT applicable during this phase	Excavator digging post holes for hoarding	1	98	15	BS5228-1[i]: Table C.2, Item 7	Tracked excavator
	Nail guns for erection of hoarding	2	101	10	BS5228-1: Table C.4, Item 95	Handheld cordless nail gun, 15 to 50 mm nails
	Hand-held percussive breaker	1	111	30	BS5228-1: Table C.1, Item 6	Hand-held pneumatic breaker
	Compressor 250cfm	1	102	15	BS5228-1: Table C.1, Item 8	Hydraulic breaker power pack, 63 kg/ 138 bar
	Generator 35kVA	1	94	100	BS5228-1: Table C.4, Item 78	Diesel generator
	Circular saw cutting timber	1	110	10	BS5228-1: Table D.7, Item 77	Hand-held electric circular saw
	Cutting equipment (diamond saw)	1	108	10	BS5228-1: Table C.4, Item 93	Angle grinder (grinding steel), 4.7 kg
	Waste collection via skip or tipper lorry	1	106	10	BS5228-1: Table C.8, Item 21	Skip wagon
	Oxyaceteline cutting equipment	1	93	10	BS5228-1: Table C.3, Item 35	Hand-held gas cutter, 230 bar
Site set up and general site	Oxyaceteline cutting equipment	1	93	10	BS5228-1: Table C.3, Item 35	Hand-held gas cutter, 230 bar
	Compressor 250cfm	1	93	50	BS5228-1: Table D.5, Item 5	Compressor for hand-held pneumatic breaker

Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
	Generator - 200 kVA	1	94	100	BS5228-1: Table C.4, Item 78	Diesel generator
	Cutting equipment (diamond saw)	2	108	10	BS5228-1: Table C.4, Item 93	Angle grinder (grinding steel), 4.7 kg
	Telescopic Handler/FLT	1	99	30	BS5228-1: Table C.2, Item 35	Telescopic handler, 10 t
	Wheel wash	1	91	20	BS5228-1: Table C.3, Item 13	Water jet pump
	Hiab lorry/crane	1	105	5	BS5228-1: Table C.4, Item 53	Lorry with lifting boom, 6 t
	Water settling/treatment	1	104	100	Measured	Dirty water plant
	Dewatering Pump	1	96	100	BS5228-1: Table C.4, Item 88	Water pump
	Scissor lift	2	106	20	BS5228-1: Table C.4, Item 59	Diesel, scissor lift, 6 t
	JCB with hydraulic breaker	1	116	25	BS5228-1: Table C.5, Item 1	Backhoe mounted hydraulic breaker
	Fuel delivery vehicle	1	104	5	BS5228-1: Table C.4, Item 15	Fuel tanker lorry
	Well drilling Rig	1	107	50	Manufacturer	BauerBBA well drilling rig
Demolition General site	Service Crane 25T mobile Crane	1	98	30	BS5228-1: Table C.4, Item 43	Wheeled mobile crane, 35 t

Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
equipment above also applicable during this phase	22T Excavator c/w hydraulic hammer	1	118	30	BS5228-1: Table C.1, Item 9	Breaker mounted on excavator, 15 t, 1650 kg breaker
	Site dumper	1	104	30	BS5228-1: Table C.4, Item 3	Dumper, 7 t
	Pneumatic breaker	1	111	20	BS5228-1: Table C.1, Item 6	Hand-held pneumatic breaker
	Concrete crusher	1	110	80	BS5228-1: Table C.1, Item 14	Tracked crusher
	Vibrating rollers	2	101	50	BS5228-1: Table C.2, Item 38	Roller, 18 t
Piling for shaft/culvert support	80t crawler crane	1	103	50	BS5228-1: Table C.4, Item 52	Tracked mobile crane, 105 t
	25 tonne mobile crane	1	98	50	BS5228-1: Table C.4, Item 43	Wheeled mobile crane, 35 t
	Vibratory piling rig	1	116	80	BS5228-1: Table C.3, Item 8	Vibratory piling rig, 52 t
Shaft sinking General site equipment also applicable during this	Concrete deliveries (aggitating)	1	99	80	BS5228-1: Table C.4, Item 19	Cement mixer truck (idling)
	Concrete deliveries (discharging)	1	103	20	BS5228-1: Table C.4, Item 18	Cement mixer truck (discharging)
	Waste collection via skip or tipper lorry	1	106	10	BS5228-1: Table C.8, Item 21	Skip wagon

Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
phase	100t crawler crane	1	103	80	BS5228-1: Table C.4, Item 52	Tracked mobile crane, 105 t
	25t mobile crane	1	98	20	BS5228-1: Table C.4, Item 43	Wheeled mobile crane, 35 t
	Pneumatic breakers	4	111	20	BS5228-1: Table C.1, Item 6	Hand-held pneumatic breaker
	Vent fans	1	100	100	Measured	Ventilation fans
	25t excavator	1	96	100	BS5228-1: Table C.4, Item 88	Water pump (diesel), 100 kg
	400 cfm compressor	1	93	50	BS5228-1: Table C.5, Item 5	Compressor for hand-held pneumatic breaker
	12t excavator	1	97	80	BS5228-1: Table C.2, Item 25	Tracked excavator, 15 t
Connection tunnel (TBM assembly)	250t mobile (TBM assembly only)	1	106	25	BS5228-1: Table C.4, Item 38	Wheeled mobile telescopic crane, 400 t
	500t mobile (TBM assembly only)	1	106	25	BS5228-1: Table C.4, Item 38	Wheeled mobile telescopic crane, 400 t
Main tunnel construction General site equipment also applicable	150t crawler crane	1	103	50	BS5228-1: Table C.4, Item 52	Tracked mobile crane, 105 t
	Air compressor 600cfm	2	98	50	BS5228-1: Table D.6, Item 41	Compressor,
	Alimak service hoist	1	96	10	BS5228-1: Table C.4, Item 61	Caged material hoist, 500 kg

Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
during this phase	Gantry cranes 30t, 25m span with cantilever one end	2	105	80	Measured	Gantry crane
	Stockpiler conveyor	1	90	50	Measured	Conveyor
	Shaft HAC conveyor	1	90	50	Measured	Conveyor
	Flatbed trucks for materials haulage	1	105	20	BS5228-1: Table C.4, Item 53	Lorry with lifting boom, 6 t
	Flatbed trucks for segment haulage	1	105	20	BS5228-1: Table C.4, Item 53	Lorry with lifting boom, 6 t
	Sump pumps 150mm	4	96	100	BS5228-1: Table C.4, Item 88	Water pump (diesel), 100 kg
	Ventilation fans - set	2	90	100	Measured	Ventilation plant
	Land conveyor to stockpile	1	90	100	Measured	Conveyor
	25T loading shovel	2	105	30	BS5228-1: Table C.10, Item 7	Loading sand to lorry, 29 t
	Dumper	1	104	25	BS5228-1: Table C.4, Item 3	Dumper, 7 t
	Waste water treatment plant	1	104	100	Measured	Dirty water plant
	Telehandler 5t	2	99	80	BS5228-1: Table C.2, Item 35	Telescopic handler, 10 t
	Grout mixer including silos and feeders	1	108	50	BS5228-1: Table D.6, Item 13	Grout and mixer

Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
	Barge conveyor	1	90	90	Measured	Conveyor
	Mains substation	1	100	100	Measured	Diesel generator, 800kVA
Main tunnel secondary lining General site equipment also applicable during this phase	Concrete pump	1	103	20	BS5228-1: Table C.4, Item 18	Cement mixer truck (discharging)
	Waste water treatment plant	1	104	100	Measured	Dirty water plant
	Sump pumps 150mm	4	96	100	BS5228-1: Table C.4, Item 88	Water pump (diesel), 100 kg
	25T loading shovel	2	105	50	BS5228-1: Table C.10, Item 7	Loading sand to lorry, 29 t
	Air compressor 600cfm	2	98	80	BS5228-1: Table D.6, Item 41	Compressor, 7m^3/min
	Concrete batching plant 40m3/hr	1	95	100	Measured data	Batching
	Mains substation	1	100	100	Measured	Diesel generator, 800kVA
	Alimak service hoist	1	96	10	BS5228-1: Table C.4, Item 61	Caged material hoist, 500 kg
Shaft secondary lining General site equipment also applicable	150t crawler crane	1	103	50	BS5228-1: Table C.4, Item 52	Tracked mobile crane, 105 t
	Service Crane 40T mobile Crane	1	98	25	BS5228-1: Table C.4, Item 43	Wheeled mobile crane, 35 t
	Concrete deliveries	1	103	20	BS5228-1: Table C.4,	Cement mixer truck

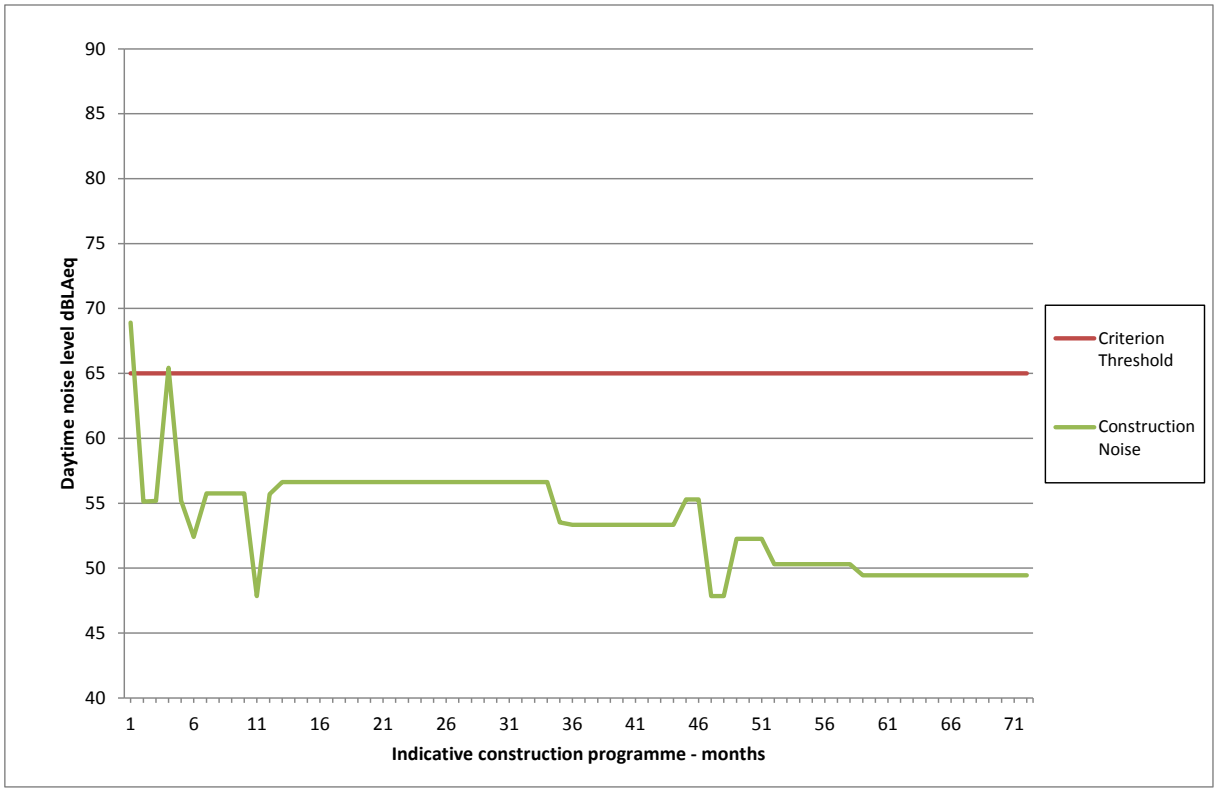
Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
during this phase	(discharging)				Item 18	(discharging)
	Concrete pump	2	95	20	BS5228-1: Table C.4, Item 24	Concrete pump + cement mixer truck (discharging), 8 t / 350 bar
	Hand tools (e.g. drills and wrenches)	4	95	80	Estimated	Impact wrench and compressor
Culvert and chamber works General site equipment also applicable during this phase	Service crane - 100T mobile crane	1	103	50	BS5228-1: Table C.4, Item 52	Tracked mobile crane, 105 t
	25t excavator	1	105	50	BS5228-1: Table C.2, Item 19	Tracked excavator, 25 t
	Fixed and portable concrete vibrators	4	106	20	BS5228-1: Table C.4, Item 33	Poker vibrator
	Concrete deliveries (discharging)	1	103	20	BS5228-1: Table C.4, Item 18	Cement mixer truck (discharging)
	Concrete boom pump	1	108	20	BS5228-1: Table C.4, Item 29	Truck mounted concrete pump + boom arm, 26 t
	Dumper	1	104	50	BS5228-1: Table C.4, Item 3	Dumper, 7 t
	Hand tools (e.g. drills and wrenches)	4	95	80	Estimated	Impact wrench and compressor
Landscaping	25t excavator	1	105	50	BS5228-1: Table C.2, Item 19	Tracked excavator, 25 t

Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
General site equipment NOT applicable during this phase	Dumper	1	104	70	BS5228-1: Table C.4, Item 3	Dumper, 7 t
	Telescopic Handler/FLT	1	99	30	BS5228-1: Table C.2, Item 35	Telescopic handler, 10 t
	Hiab lorry/crane	1	105	5	BS5228-1: Table C.4, Item 53	Lorry with lifting boom, 6 t
	Compressor for hand-held breaker	1	102	10	BS5228-1: Table C.1, Item 8	Hydraulic breaker power pack, 63 kg/ 138 bar
	Hand-held percussive breaker	1	111	10	BS5228-1: Table C.1, Item 6	Hand-held pneumatic breaker
	Plate compactors	2	108	10	BS5228-1: Table C.2, Item 41	Vibratory plate (petrol)
	Vibrating rollers	1	101	20	BS5228-1: Table C.2, Item 38	Roller, 18 t

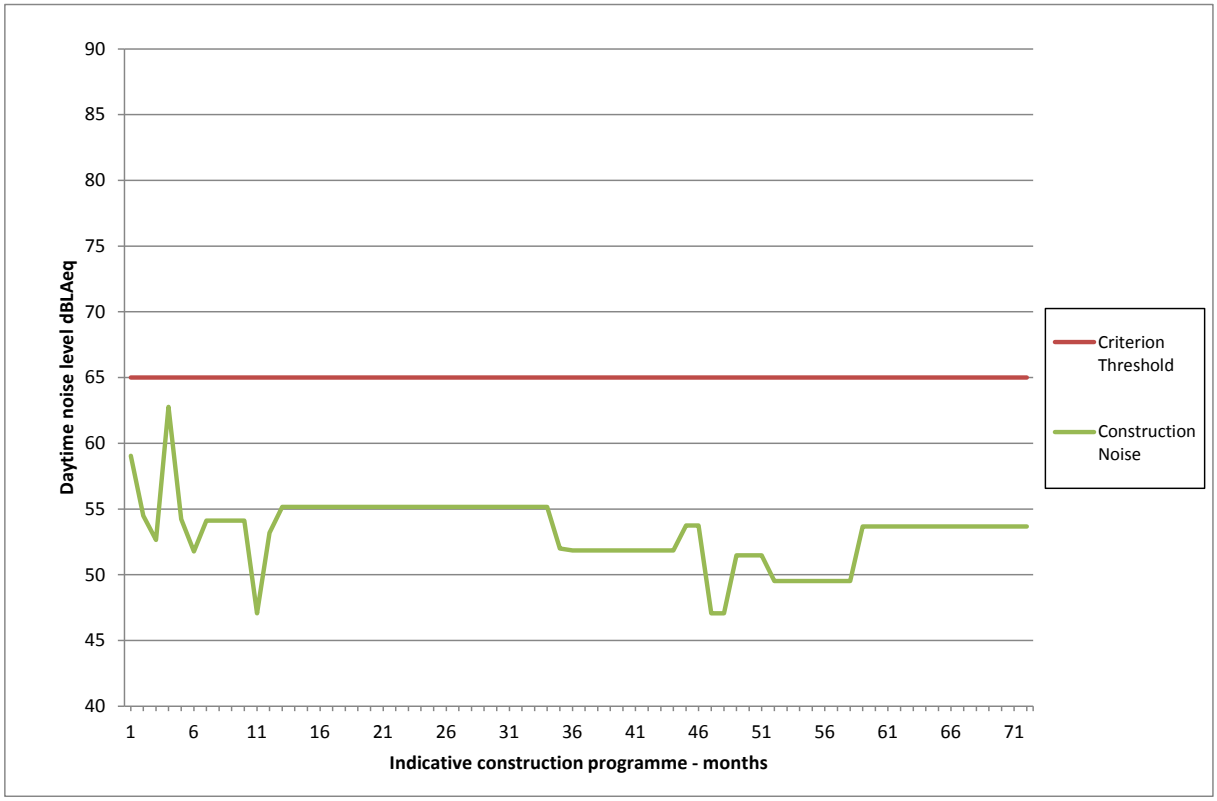
Note: This schedule provides an illustration of typical plant that could be used in the construction of the Thames Tideway Tunnel at this site. The appointed Contractor must comply with section 6 of the CoCP but may vary the method and plant to be used. This schedule therefore represents the most reasonable assumption for the assessment that can be made at this stage.

G.2.5 The predicted construction noise over time at each receptor is shown in the figures below. It should be noted that these represent the worst-case scenarios for noise exposure at the upper floors. For comparison with the construction noise, the figures also show either the potential significance criterion threshold for residential receptors, or the ambient noise level. This comparison is discussed in the main assessment text. The night-time noise levels have also been assessed and these results are described in the main assessment text and not presented here.

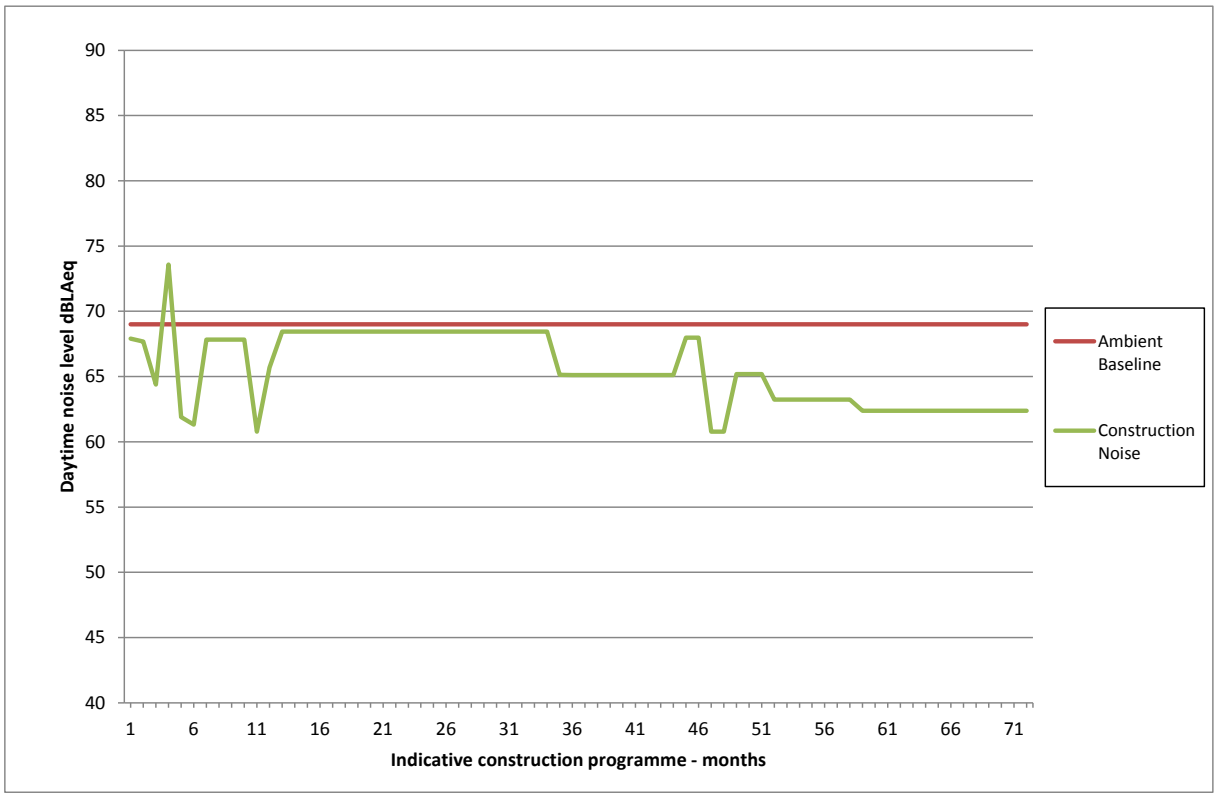
Vol 10 Plate G.6 Average monthly daytime noise level over duration of construction -89-101 Carnwath Road (Residential) (CR1)



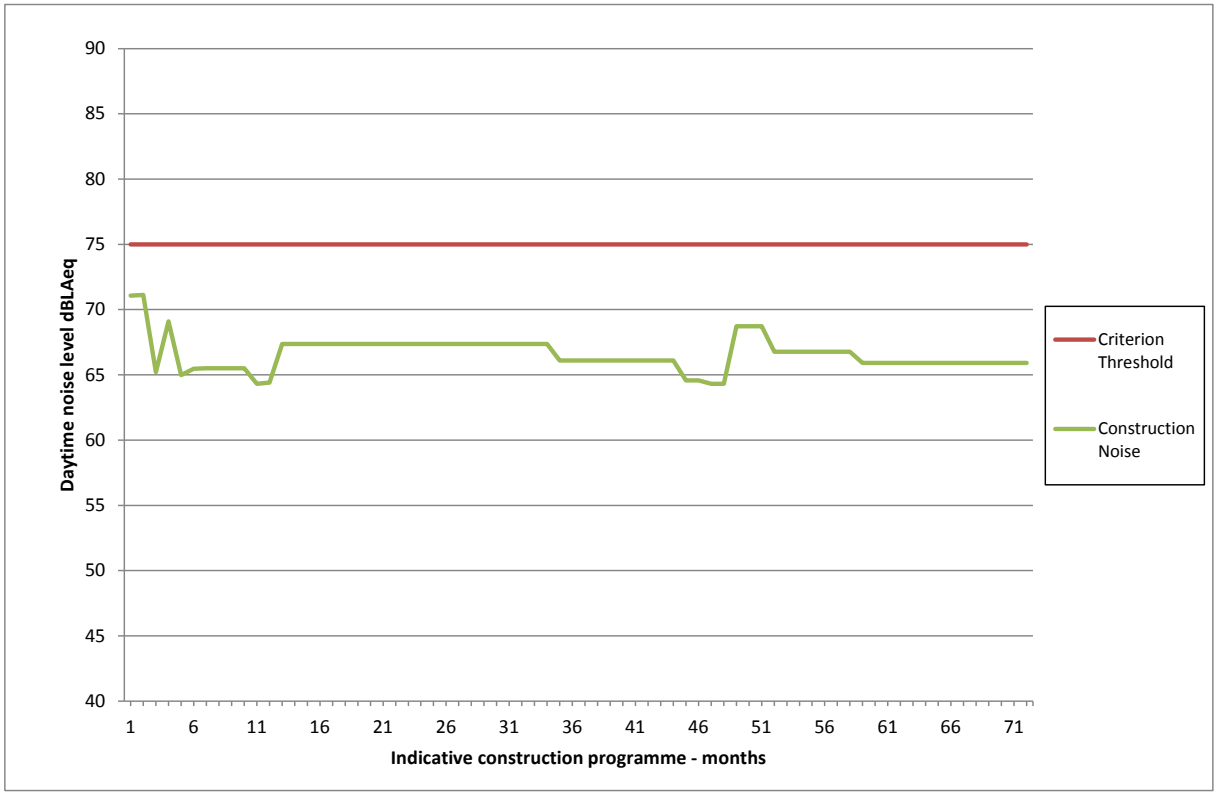
Vol 10 Plate G.7 Average monthly daytime noise level over duration of construction – 81-87 Carnwath Road (Residential) (CR2)



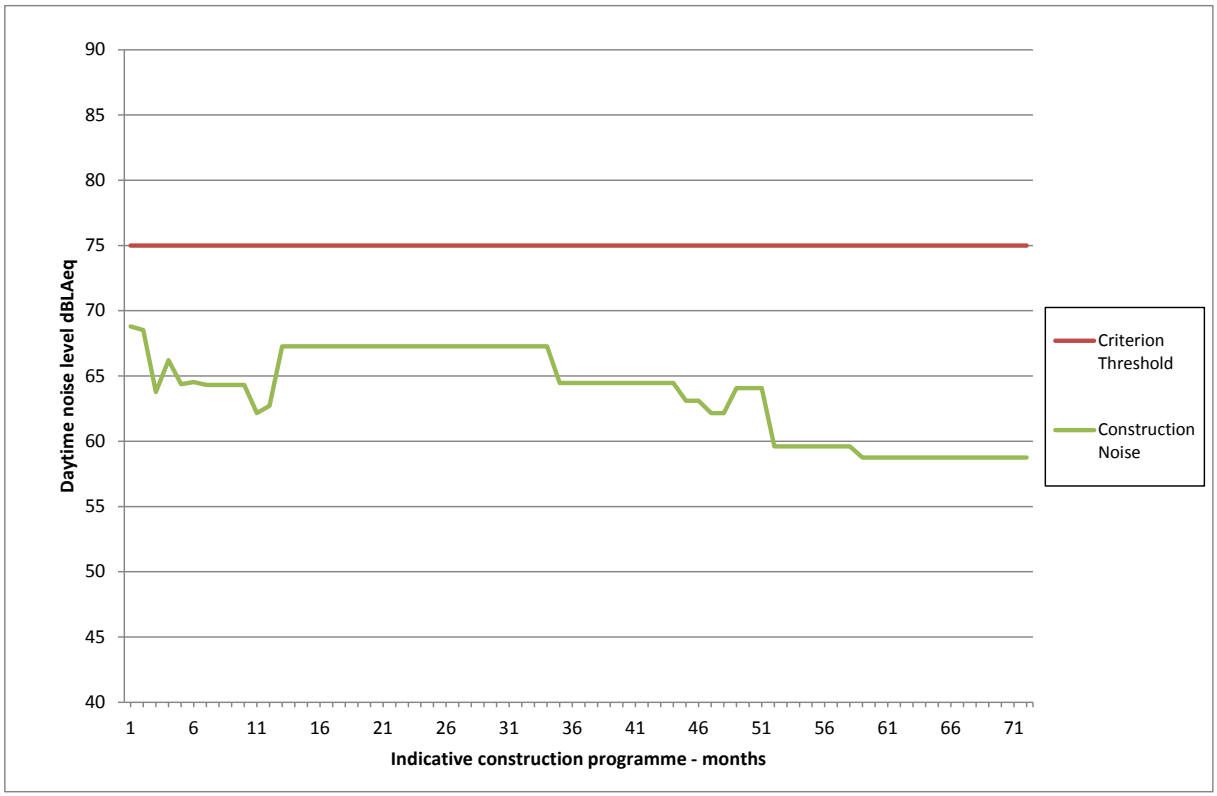
Vol 10 Plate G.8 Average monthly daytime noise level over duration of construction – 50 Carnwath Road (CR3)



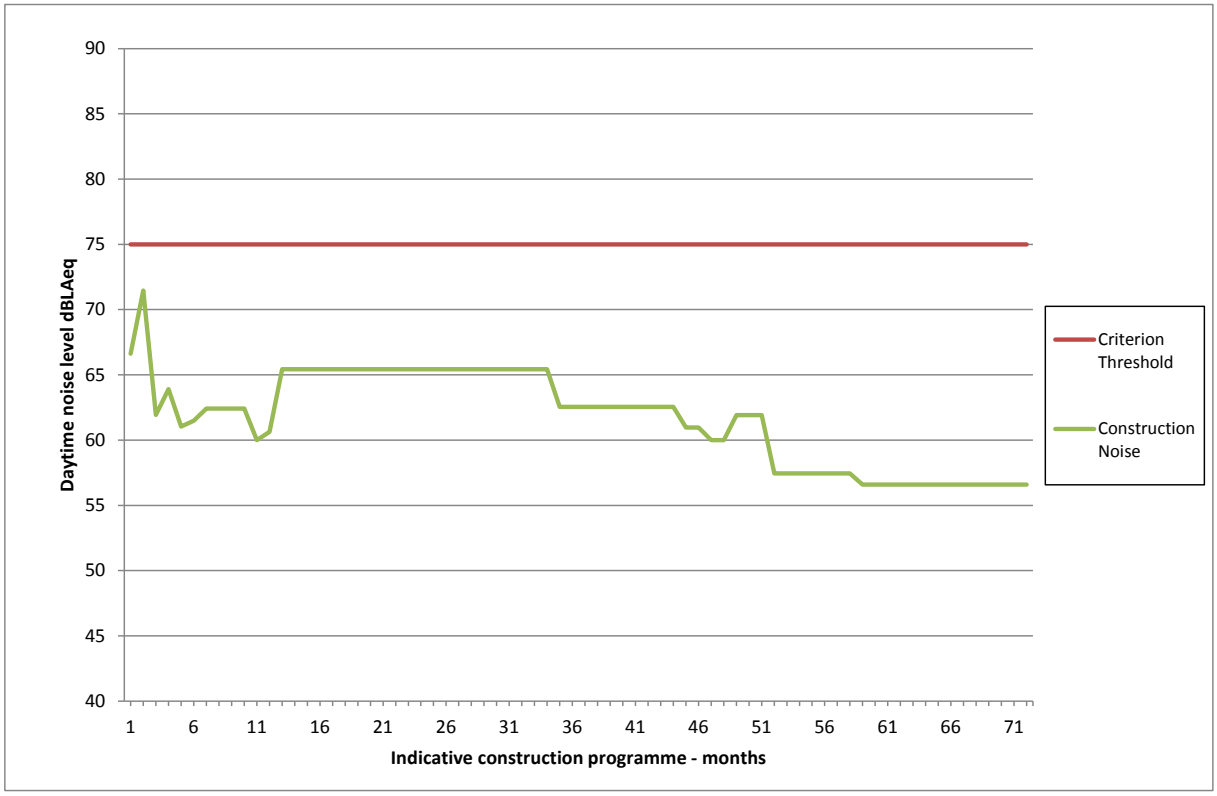
Vol 10 Plate G.9 Average monthly daytime noise level over duration of construction – Piper Building (CR4)



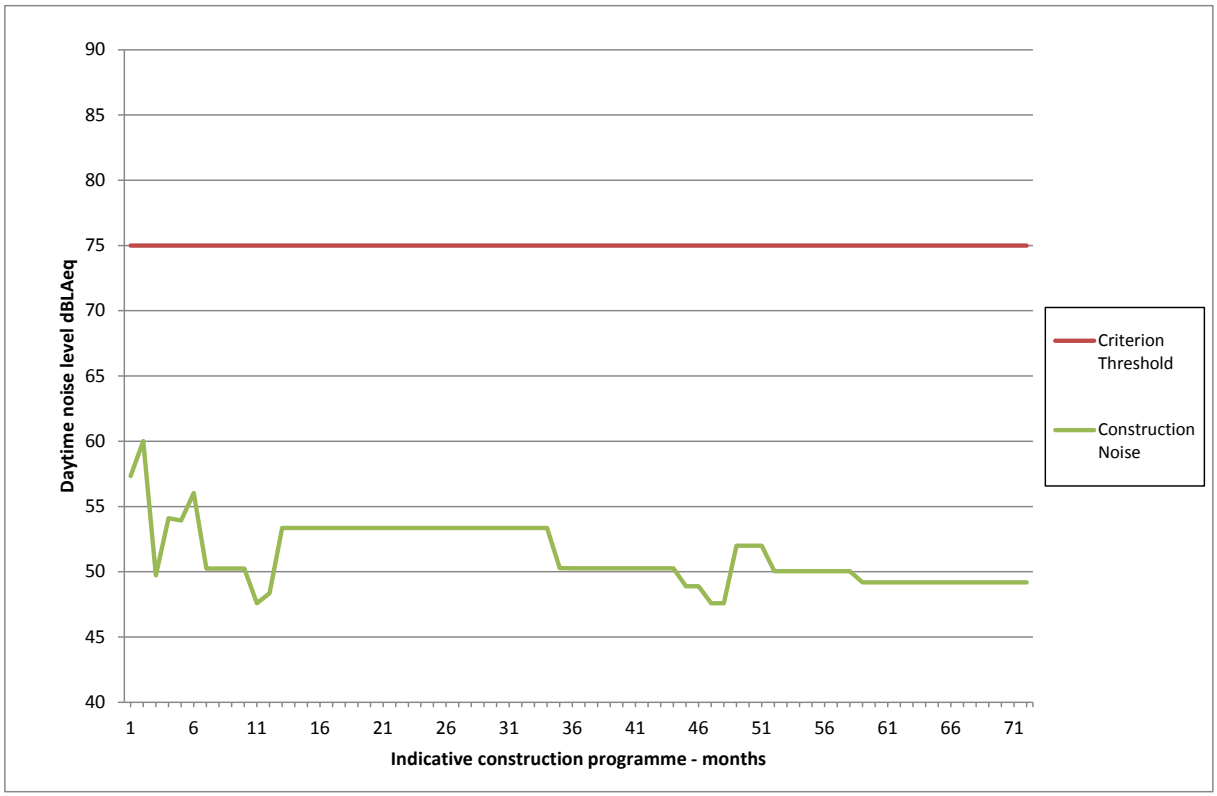
Vol 10 Plate G.10 Average monthly daytime noise level over duration of construction – 16-25 Philpot Square (CR5)



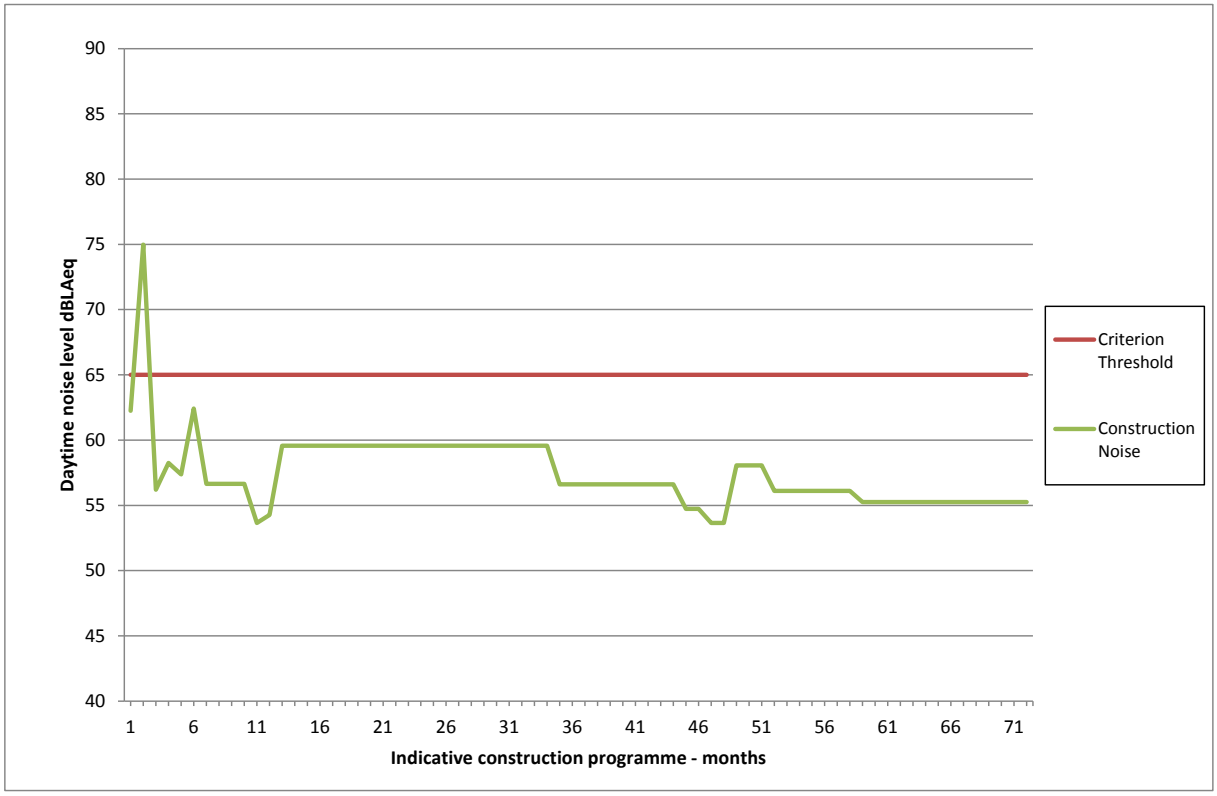
Vol 10 Plate G.11 Average monthly daytime noise level over duration of construction –26-41 Philpot Square (CR6)



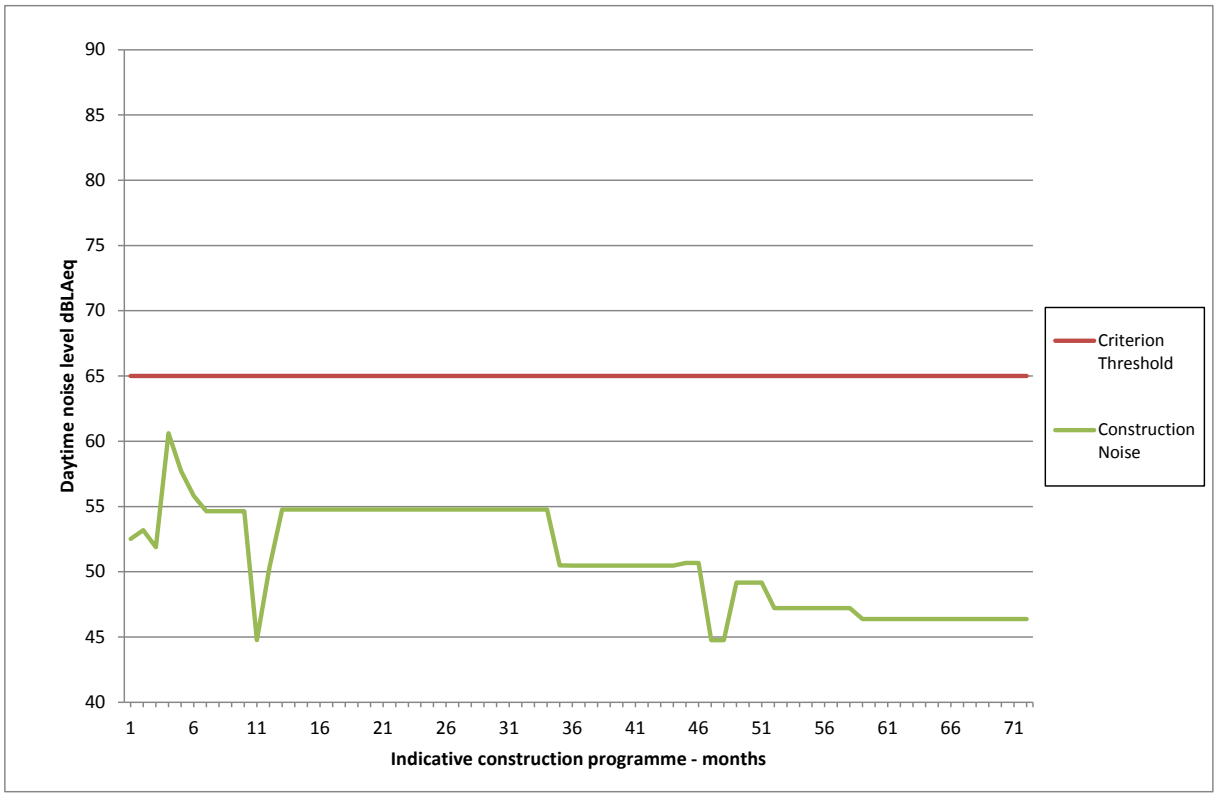
Vol 10 Plate G.12 Average monthly daytime noise level over duration of construction, 1b Dymock Street (CR7)



Vol 10 Plate G.13 Average monthly daytime noise level over duration of construction – 5 Carnwath Road (CR8)



Vol 10 Plate G.14 Average monthly daytime noise level over duration of construction – Riverside Quarter (CR9)



References

[i] British Standard Institution, *BS 5228 Code of Practice for Noise and Vibration Control on Open Construction Sites*, British Standards Institution (2009)

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.10**

Volume 10: Carnwath Road Riverside appendices

Appendix H: Socio-economics

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This page is intentionally blank

Thames Tideway Tunnel

Environmental Statement

Volume 10 Carnwath Road Riverside appendices

Appendix H: Socio-economics

List of contents

Page number

List of tables

Page number

This page is intentionally blank

Appendix H: Socio-economics

H.1 Baseline community profile

H.1.1 The community profile is based on both Output Area (OA) and local authority level data from the Office of National Statistics (ONS). The data have been obtained from four sources: Census 2001[1] (the last census for which data are available[i]), Department of Communities and Local Government Deprivation Indices 2010[2], London Public Health Observatory 2012[3], and the Network of Public Health Observatories 2011[4] (see Volume 2 Methodology).Data is grouped according to those 'protected characteristics'[ii] or groups which are relevant for consideration in relation to this socio-economic impact assessment. This baseline community profile provides context for this socio-economic assessment.

H.1.2 On the basis of likely impacts on receptors identified in this socio-economic assessment, the community profile examines the 'immediate area' surrounding the construction site (ie, within an assessment area of 250m[iii]), the 'wider local area' (ie, within an assessment area of 1km[iv]) and the overall borough level (which in this case is the London Borough [LB] of Hammersmith and Fulham).

H.1.3 The main protected characteristic groups concentrated[v] within the immediate area surrounding the proposed construction site are:

a. persons aged under 16 years old

b. persons suffering from income deprivation and overall deprivation.

H.1.4 The main protected characteristic group concentrated within the wider local area surrounding the proposed construction site is persons aged under 16 years old.

Resident population

H.1.5 The resident population was approximately 1,975 within 250m of the site and approximately 28,600 within 1km at the time of the last census.

Gender and age

H.1.6 Of the total population within 250m of the site 53.4% of residents are female, broadly in line with the proportion within 1km (52.4%) and for the LB of Hammersmith and Fulham (52.2%). At a Greater London level, there is also a slight predominance of females (51.6%).

[i] Census 2001. This type of data for the 2011 Census had not been released at the time of the assessment.

[ii] The Equalities Act 2010 defines 'protected characteristics' as: age, disability, gender reassignment, marriage and civil partnership, pregnancy and maternity, race, religion or belief, sex, and sexual orientation. Of these characteristics, age, disability, race and religion are relevant for consideration in relation to this socio-economic impact assessment.

[iii] The statistics presented for the study area within 250m of the site include only that area on the same side of the River Thames as the proposed development.

[iv] The statistics presented for the study area within 1km of the site include both sides of the River Thames.

[v] In this instance, 'concentrated' refers to the occurrence of a particular protected characteristic group, the proportion of which is notably higher than borough wide proportions.

H.1.7 Vol 10 Table H.1 outlines age breakdown by assessment area, it illustrates that within 250m, the proportion of under 16 year olds (18.5%) is slightly higher than the proportion within 1km (17.5%) and at the borough level (16.5%). Within 250m and 1km, and within the LB of Hammersmith and Fulham, the proportion of under 16 year olds is somewhat lower than the Greater London average (20.2%).

H.1.8 Within 250m, the proportion of over 65 year olds (6.8%) is moderately lower than the proportions recorded within 1km (9.2%) and at the borough wide level (10.5%), and considerably lower than the proportion for Greater London as a whole (12.4%).

Vol 10 Table H.1 Socio-economics - age breakdown by assessment area

Age group	Assessment area			
	Immediate area (250m)	Wider local area (1km)	Borough wide (LB of Hammersmith and Fulham)	Greater London
Under 16 years old	18.5%	17.5%	16.5%	20.2%
Over 65 years old	6.8%	9.2%	10.5%	12.4%

Ethnicity

H.1.9 Vol 10 Table H.2 outlines ethnicity by assessment area, showing that within 250m of the site, White residents comprise approximately four fifths of the population (78.7%). This is broadly in line with the proportion of White residents within 1km (80.3%) and at a borough wide level (77.8%). The proportion of White residents recorded at the Greater London level (71.2%) is slightly lower than within all of the above assessment areas.

H.1.10 The proportion of Black residents within 250m (10.4%) is broadly in line with that recorded within 1km (10.6%) the borough wide level (11.1%) and Greater London (10.9%).

H.1.11 Within 250m, Asian residents account for 4.0% of the population, broadly the same as within 1km (3.6%) and the LB of Hammersmith and Fulham (4.5%). At a Greater London level the proportion of Asian residents is considerably higher than within all of the above assessment areas (12.1%).

Vol 10 Table H.2 Socio-economics - ethnicity by assessment area

Ethnicity	Assessment area			
	Immediate area (250m)	Wider local area (1km)	Borough wide (LB of Hammersmith and Fulham)	Greater London
White	78.7%	80.3%	77.8%	71.2%
Black and Minority Ethnicity (BME)	21.3%	19.7%	22.2%	28.8%
Asian	4.0%	3.6%	4.5%	12.1%
Black	10.4%	10.6%	11.1%	10.9%
Other	3.0%	2.2%	2.8%	2.7%
Mixed	4.0%	3.4%	3.8%	3.2%

Note: The figure for BME data presented in Table H.2 is the sum of data for Asian, Black, Other and Mixed ethnicities.

Religion and belief

H.1.12 Within 250m and 1km of the site and at a borough wide level, people identifying themselves as Christians are the predominant religious group at 64.2%, 66.3% and 63.6% respectively. Within the above assessment areas, the proportions of Christians are slightly above the Greater London average (58.2%).

H.1.13 Muslims are the second most predominant religious group within 250m (7.5%), broadly in line with the proportion within the LB of Hammersmith and Fulham (6.7%) and moderately higher than within 1km (4.6%). The proportion of Muslims within Greater London (8.5%) is higher still.

H.1.14 Over 25% of residents within 250m do not follow a religion (25.6%) broadly in line with the proportion within 1km (26.7%), the LB of Hammersmith and Fulham (26.3%) and the Greater London average (24.3%).

Health indicators

H.1.15 Vol 10 Table H.3 outlines health indicators by assessment area, noting that the proportion of residents within 250m of the site suffering from a long term or limiting illness (11.1%) is broadly in line with the proportion within 1km (12.1%) and somewhat lower than that recorded for the LB of Hammersmith and Fulham (14.7%) and Greater London (15.5%).

H.1.16 The proportion of residents who claim disability living allowance within 250m (4.2%) is broadly in line with the proportion of claimants within 1km (3.7%), the LB of Hammersmith and Fulham (4.4%) and Greater London (4.5%).

Vol 10 Table H.3 Socio-economics - health indicators by assessment area

Health indicator	Assessment area			
	Immediate area (250m)	Wider local area (1km)	Borough wide (LB of Hammersmith and Fulham)	Greater London
Long term limiting sick	11.1%	12.1%	14.7%	15.5%
Disability living allowance	4.2%	3.7%	4.4%	4.5%

H.1.17 In the Middle Layer Super Output Area (MSOA)[vi5] in which the site is located, adult obesity falls in the second highest quintile (ie, the highest being the worst) relative to Greater London. Levels of child obesity fall within the second highest quintile relative to Greater London.

H.1.18 Despite high levels of child obesity, data available for the LB of Hammersmith and Fulham overall indicates that adults and children within the borough have amongst the highest rates of physical activity (ie, they fall within the highest quintile) of all London boroughs.

H.1.19 Death rates by heart disease, circulatory disease and strokes within the MSOA) in which the site is located are all in the lowest quintile (ie, the lowest being the best) relative to Greater London. Respiratory disease is more prevalent, being within the middle quintile, and cancer falls within the highest quintile (ie, the highest being the worst) relative to Greater London.

H.1.20 Male life expectancy within the MSOA is in the highest quintile (ie, the highest being the best) relative to Greater London. By contrast, female life expectancy falls in the second lowest quintile relative to Greater London. Average life expectancy for male residents in the LB of Hammersmith and Fulham ranges from 84.9 to 93.1 years old and 80.3 to 81.9 years old for female residents.

Lifestyle and deprivation indicators

H.1.21 Vol 10 Table H.4 outlines lifestyle and income deprivation indicators by assessment area, showing that within 250m of the site the proportion households that do not own cars (38.0%) is broadly in line with the proportion within 1km (40.5%) and at a Greater London level (37.5%), somewhat lower than at a borough wide level (48.6%).

[vi] MSOAs are areas determined by the Office of National Statistics (ONS) to collect local area statistics. MSOAs have a minimum size of 5,000 residents and 2,000 households. MSOAs have an average population size of 7,200 residents.

H.1.22 Indices of deprivation[vii] measured by income within 250m (71.0%) are considerably higher than the levels recorded within 1km (32.2%) the borough (31.7%) and Greater London levels (30.8%). Overall deprivation within 250m (50.4%) is considerably higher than within 1km (14.3%) and somewhat higher than the LB of Hammersmith and Fulham (24.6%) and Greater London (24.5%) averages.

Vol 10 Table H.4 Socio-economics - lifestyle and income deprivation levels by assessment area

Indicator	Assessment area			
	Immediate area (250m)	Wider local area (1km)	Borough wide (LB of Hammersmith and Fulham)	Greater London
No car households	38.0%	40.5%	48.6%	37.5%
Income	71.0%	32.2%	31.7%	30.8%
Overall	50.4%	14.3%	24.6%	24.5%

H.2 Baseline economic profile

H.2.1 This section presents a profile of the economy local to the proposed construction site at Carnwath Road Riverside.

H.2.2 Data are presented for the geographical area within a radius or 'catchment' of approximately 250m from the boundary of the Limits of land to be acquired or used (LLAU) of the project site. Data are also provided at the overall borough level (which in this case is the LB of Hammersmith and Fulham) and for Greater London.

H.2.3 Data are sourced from Experian's National Business Database (2012)[6], which draws primarily on regularly updated records from Companies House[viii].

Employment and businesses

H.2.4 Within approximately 250m of the site there are approximately 2,700 jobs.[ix] Vol 10 Table H.5[x] below illustrates the breakdown of employment by sector, based on the UK Standard Industrial Classification (SIC) 2007[7].

[vii] Income deprivation and overall deprivation in this instance both refer to the percentage of the population which fall within the top 20% of deprived areas nationally. Percentages therefore refer to the proportion of residents within each assessment area who fall within the highest quintile of deprivation within England.

[viii] Information on employees and businesses reflects aggregated data for seven digit post-code units falling wholly or partially within a 250m boundary of the LLAU. This includes post code units on the opposite side of the River Thames, if relevant. Please refer to Volume 2 Appendix H for further details.

[ix] Employees data reflect a head count of workers on-site rather than Full Time Equivalent (FTE) jobs . While employee figures are mostly based on actual reported data, a proportion is based on modelled data.

[x] Data in tables rounded to nearest whole percentage and do not always sum due to rounding.

It presents data for those sectors which account for more than 5% of total employment within 250m. It can be seen that:

a. Wholesale and Retail Trade / Repair of Motor Vehicles and Motorcycles accounts for 19% of employment within 250m, somewhat more than within both the LB of Hammersmith and Fulham (15%) and within Greater London (16%).

b. Transportation and Storage Activities account for 17% of employment within 250m, over three times more than within both the LB of Hammersmith and Fulham (4%) and Greater London (4%).

c. Professional, Scientific and Technical Activities account for 13% of employment within 250m, somewhat more than within both the LB of Hammersmith and Fulham (10%) and Greater London (11%).

d. Administrative and Support Service Activities account for 7% to 8% of employment at all geographical levels.

e. Manufacturing accounts for 8% of employment within 250m, which is slightly more than within the LB of Hammersmith and Fulham (7%) but over double that within Greater London (3%).

f. Arts, Entertainment and Recreation accounts for 7% of employment within 250m, somewhat more than within both the LB of Hammersmith and Fulham (4%) and Greater London (3%).

Vol 10 Table H.5 Socio-economics - employment by top six sectors (2012)

Sector (Standard Industrial Code 2007)	Assessment area		
	Immediate area (250m)	Borough wide (LB of Hammersmith and Fulham)	Greater London
Wholesale and Retail Trade / Repair of Motor Vehicles and Motorcycles	19%	15%	16%
Transportation and Storage	17%	4%	4%
Professional, Scientific and Technical Activities	13%	10%	11%
Administrative and Support Service Activities	8%	7%	8%
Manufacturing	8%	7%	3%
Arts, Entertainment and Recreation	7%	4%	3%
Other (including unclassified)	28%	53%	55%

H.2.5 Within approximately 250m of the site there are approximately 390 businesses (defined here as business locations[xi]). The split of businesses

[xi] This count relates to business 'locations' or 'units'; an enterprise may have a number of business locations / units. It includes private sector, public sector and voluntary sector / charitable entities.

by sector within 250m generally reflects the breakdown of employment by sector set out in Vol 10 Table H.5, with a relatively high number of businesses engaged in Wholesale Retail and Trade /, Repair of Motor Vehicles and Motorcycles (16%), Professional, Scientific and Technical Activities (16%), Administrative and Support Services Activities (9%) and Manufacturing (7%). However, Transportation and Storage accounts for only 2% of businesses, while generating 17% of employment.

H.2.6 Vol 10 Table H.6 below illustrates the size of businesses in terms of the number of employees at each business location / unit. At all geographical levels, businesses within the smallest size band (one to nine employees) account for the majority. Overall, the size banding profile of businesses within approximately 250m of the site is similar to both the LB of Hammersmith and Fulham and Greater London, with between 87% and 88% of businesses employing one to nine employees at all geographical levels.

H.2.7 However, the size of businesses within approximately 250m varies somewhat by sector. For example within the Wholesale and Retail Trade, Repair of Motor Vehicles and Motorcycles sector, 80% of businesses employ one to nine employees compared to an average across all sectors of 87%. Businesses of ten to 24 employees in size account for 4% of businesses within the Other Service Activities sector, which contrasts with 17% within Administrative and Support Service Activities and 19% within Manufacturing. Businesses employing greater than 25 employees account for 8% or less of businesses in each leading sector.

Vol 10 Table H.6 Socio-economics - businesses by size band (number of employees)

Assessment area / sector		Size band (number of employees)					
		1-9	10-24	25-49	50-99	100-249	250+
Immediate area (250m)		87%	10%	2%	2%	0%	0%
	Wholesale and Retail Trade / Repair of Motor Vehicles and Motorcycles	80%	12%	3%	5%	0%	0%
	Professional Scientific and Technical Activities	88%	9%	2%	2%	0%	0%
	Administrative and Support Service Activities	81%	17%	3%	0%	0%	0%
-	*Other Service Activities*	93%	4%	4%	0%	0%	0%
	Manufacturing	77%	19%	0%	4%	0%	0%
Borough wide (LB of Hammersmith and Fulham)		87%	9%	2%	1%	1%	0%
Greater London		88%	8%	2%	1%	1%	0%

References

[1] ONS. *Neighbourhood Statistics* (2001). Available at: http://neighbourhood.statistics.gov.uk/dissemination/

[2] Department for Communities and Local Government. *Index of Multiple Deprivation 2010* (2010). Available at: http://www.communities.gov.uk/communities/research/indicesdeprivation/deprivation10/

[3] London Public Health Observatory. *Fair Society, Healthy Lives: The Marmot Review* (2012). Available from: http://www.lho.org.uk/LHO_TOPICS/NATIONAL_LEAD_AREAS/MARMOT/MARMOTINDICATORS.ASPX. Accessed 30 August 2012

[4] Network of Public Health Observatories. *Health Profiles: London* (2011-2012) Available at: http://www.apho.org.uk/resource/view.aspx?QN=HP_REGION_H. Accessed February 2012.

[5] Office of National Statistics. *Neighbourhood Statistics, Super Output Areas (2012)*. Available at: http://www.neighbourhood.statistics.gov.uk/dissemination/Info.do;jessionid=vtvdPZRWZ3yhT9ShjB6TcwQ00WNTZcPQgyVpGLvZjTzh7nYnBhqL!1624269762!1327075798387?m=0&s=1327075798387&enc=1&page=aboutneighbourhood/geography/superoutputareas/soa-intro.htm&nsjs=true&nsck=true&nssvg=false&nswid=1225. Accessed on 17 April 2012.

[6] Experian. *National Business Database* (Database of employment and enterprise statistics). Accessed: September 2012.

[7] Office of National Statistics. *UK Standard Industrial Classification of Economic Activities 2007 (SIC 2007)*, 2009. Available at: http://www.ons.gov.uk/ons/guide-method/classifications/current-standard-classifications/index.html. Accessed 5/9/12.

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.10**

Volume 10: Carnwath Road Riverside appendices

Appendix I: Townscape and visual

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Thames Tideway Tunnel

Environmental Statement

Volume 10 Carnwath Road Riverside appendices

Appendix I: Townscape and visual

List of contents

Page number

.

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Appendix I: Townscape and visual

I.1 Introduction

I.1.1 Construction and operational effects assessments at this site for this topic do not require the provision of any supporting information, so this appendix is intentionally empty.

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.10**

Volume 10: Carnwath Road Riverside appendices

Appendix J: Transport

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Environmental Statement

Volume 10 Carnwath Road Riverside appendices

Appendix J: Transport

List of contents

Page number

.

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Appendix J: Transport

J.1 Introduction

J.1.1 Construction and operational effects assessments at this site for this topic do not require the provision of any supporting information, so this appendix is intentionally empty.

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Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.10**

Volume 10: Carnwath Road Riverside appendices

Appendix K: Water resources - groundwater

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Thames Tideway Tunnel

Environmental Statement

Volume 10 Carnwath Road Riverside appendices

Appendix K: Water resources – groundwater

List of contents

Page number

List of tables

Page number

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Appendix K: Water resources – groundwater

K.1 Geology

K.1.1 A summary of the anticipated geology succession at the Carnwath Road Riverside site is shown in Vol 10 Table K.1.

Vol 10 Table K.1 Groundwater – anticipated geological succession

Period	Series	Group	Formation
Quaternary	Pleistocene	Superficial deposits	Alluvium
			River Terrace Deposits
Palaeogene	Eocene	Thames	London Clay
			Harwich
	Palaeocene	Lambeth	Upper Shelly Beds
			Upper Mottled Beds

K.1.2 The superficial and solid geology in the vicinity of the site, as published by the British Geological Survey (BGS), (BGS, February 2009)[1], is shown in Vol 10 Figure 13.4.1 and Vol 10 Figure 13.4.2 respectively (see separate volume of figures).

K.1.3 The ground investigation undertaken for the Thames Tideway Tunnel project has involved drilling boreholes both on the banks and within the main river channel for the purposes of understanding the geology and hydrogeology within the assessment area. For the ES, there were no boreholes specifically dedicated to the Carnwath Road Riverside shaft site due to its design relocation subsequent to procurement of the borehole investigation. The depths and thicknesses of geological layers have therefore been extrapolated from an overwater borehole drilled within the main river channel adjacent to the site; this borehole is SR2082. The location of this borehole is shown in Vol 10 Figure 13.4.1 (see separate volume of figures). The extrapolated depths and thicknesses of the geological layers based on this borehole are summarised in Vol 10 Table K.2 below.

Vol 10 Table K.2 Groundwater – anticipated ground conditions

Formation	Top elevation* mATD**	Depth below ground level (m)	Thickness (m)
Alluvium	96.97	0.00	2.00
River Terrace Deposits	94.97	2.00	0.60
London Clay			
B	94.37	2.60	11.63
A3ii	82.74	14.26	11.95
A3i	73.79	26.18	1.92
A2	68.87	28.1	10.57
Harwich Formation	58.30	38.67	0.48
Lambeth Group			
USB	57.82	39.15	1.71
UMB	56.11	40.86	2.54

** Based on an assumed ground level of 96.97mATD*
*** mATD = metres above tunnel datum. A commonly used term for sub-surface construction projects, which defines height above a temporary datum set at -100mAOD (above Ordnance Datum).*
USB – Upper Shelly Beds, UMB – Upper Mottled Beds

K.1.4 The main tunnel shaft at the Carnwath Road Riverside site would extend down to approximately 63.32mATD and would pass through the Alluvium, River Terrace Deposits, London Clay Formation, units B, A3ii and A3i and into the London Clay Formation, unit A2. The base slab would extend to approximately 55.32mATD and would extend into the top of the Lambeth Group.

K.1.5 The Frogmore connection tunnel and Tunnel Boring Machine (TBM) break-in would be within the London Clay Formation, unit A2, the Harwich Formation (where present) and the Lambeth Group (Upper Shelly Beds and Upper Mottled Beds).

K.1.6 The Alluvium, comprising slightly gravely, slightly sandy silty clay and is expected to be 2.0m thick at the site.

K.1.7 The River Terrace Deposits are formed of extensive alluvial sand and gravel deposits laid down in river terraces by a braided river system of approximately 5km width, in river terraces since the Anglian glaciation. The River Terrace Deposits are expected to be 0.6m thick at the Carnwath Road Riverside site.

K.1.8 The London Clay comprises firm to very stiff clay, slightly sandy and slightly gravely in places and fissured in places. The London Clay is divided into sub-units referred from oldest to youngest as A to E, with some of these sub-units dividing further, for example A1, A2, A3i-iii in

decreasing age order. The London Clay Formation is expected to be 36m thick at the site.

K.1.9 The Harwich Formation is described by the BGS as "glauconitic sandy clays and very fine-grained glauconitic sands; marine fauna, locally brackish" (BGS, 2012) and is expected to be 0.48m thick at the Carnwath Road Riverside site.

K.1.10 The Upper Shelly Beds (USB) of the Lambeth Group comprises grey, shelly clays with scattered glauconite grains. The Upper Shelly Beds are expected to be 1.71m thick at the site.

K.1.11 The Upper Mottled Beds (UMB) of the Lambeth Group comprises silty clay and clay, generally un-bedded, fissured and blocky, with up to 50% silt and sand. The Upper Mottled Beds are expected to be 2.54m thick at the site.

K.2 Hydrogeology

K.2.1 A summary of the anticipated hydrogeological conditions at Carnwath Road Riverside is shown in Vol 10 Table K.3.

Vol 10 Table K.3 Groundwater – anticipated hydrogeological units

Group	Formation	Hydrogeology
Superficial deposits	Alluvium	Confining layer[i] (Schwartz, F.W. & Zhang, H , 2003)[2]
	River Terrace Deposits	Upper aquifer
Thames	London Clay	Aquiclude[ii] (USGS , August 1989)[3]
	Harwich	Aquitard[iii] (EA, Accessed April 2012)[4]/aquifer
Lambeth Group	Upper Shelly Beds Upper Mottled Beds	Aquitards/ aquifers

K.2.2 There have been no ground investigation or monitoring boreholes specifically dedicated to the Carnwath Road Riverside site. Therefore the anticipated hydrogeological conditions have been based on information collected from two ground investigation boreholes (SR1102A and SA1105), located at approximately 160m and 460m to the southeast and south respectively on the opposite side of the River Thames.

[i] *Confining layer – units of low permeability that bound an aquifer (Schwartz & Zhang, 2003).*

[ii] *Aquiclude - a geological formation through which virtually no water moves (EA website, 2012).*

[iii] *Aquitard - a poorly-permeable geological formation that does not yield water freely, but may still transmit significant quantities of water to or from adjacent aquifers (EA website, 2012).*

K.2.3 The Alluvium overlies the River Terrace Deposits or upper aquifer. The ground investigation boreholes show that the Alluvium was drilled dry and comprises of low permeability material. The Alluvium acts to confine the underlying River Terrace Deposits at this location.

K.2.4 The upper aquifer (River Terrace Deposits) is defined by the Environment Agency (EA) as a secondary A aquifer. These deposits are described as "permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers". (EA, Accessed April 2012)[5]

K.2.5 The lower aquifer, comprising of the Upnor Formation, the Thanet Sands and the Chalk, is not expected to be encountered by the Thames Tideway Tunnel project at the Hammersmith Pumping Station site.

K.2.6 The main tunnel shaft would pass through the upper aquifer and into the London Clay Formation (B, A3ii, A3i and A2 sub divisions). The London Clay Formation is generally acknowledged as an aquiclude between the upper and lower aquifers. Any groundwater present in a majority of the London Clay Formation is likely to consist of localised seepages and/or minor flows. It is anticipated that below the River Terrace Deposits the main tunnel shaft would be excavated in predominantly dry London Clay Formation with the exception of minor seepage at various horizons, namely silt or claystone horizons. In unit A3ii, the presence of fine sand laminea/lenses at this horizon, may act as horizontal conduits for migration of groundwater from a nearby source.

K.2.7 The Lambeth Group is considered to act as an aquitard, in which groundwater is present in several confined groundwater bodies, such as in the upper units, the Upper Shelly Beds and Upper Mottled Beds (potentially small inflows).

K.3 Groundwater level monitoring

K.3.1 Groundwater level monitoring was undertaken at a number of ground investigation boreholes across the assessment area with a few exceptions. In addition, the EA has a regional network of monitoring boreholes, mainly within the lower aquifer, across London which records are available dating back over 50 years.

K.3.2 There were no baseline groundwater quality or land quality data available for the upper aquifer at or near the Carnwath Road Riverside site. Information on groundwater levels for this assessment was therefore collected from the nearest monitoring points (SR1102A and SA1105), located on the opposite side of the River Thames. These boreholes have response zones[iv](EA, 2006)[6] and monitor groundwater levels in the River Terrace Deposits and the Upper Shelly Beds respectively. The response zone depths, the monitored strata and the frequency of monitoring are

[iv] Response zone -the section of a borehole that is open to the host strata (EA, 2006)

detailed in Vol 10 Table K.4. The logger data and manual dip data collected from these monitoring boreholes are shown in Vol 10 Table K.5.

Vol 10 Table K.4 Groundwater – monitoring borehole

Borehole	Response zone depths mATD	Strata	Monitoring
SR1102A	95.21 – 100.21	River Terrace Deposits	Fortnightly dip and logger
SA1105	52 – 53.9	Upper Shelly Beds	Irregular dips

Vol 10 Table K.5 Groundwater – summary level data

Borehole ID	Period of record	Maximum		Minimum		Average over period of record	
		mbgl	mATD	mbgl	mATD	mbgl	mATD
SR1102A	22/10/2009 – 18/05/2012	3.51 (Mar. 2010)	102.2 (Mar. 2010)	5.90 (Oct. 2011)	99.81 (Oct. 2011)	4.84	100.86
SA1105	20/10/2009 – 12/07/2012	2.42 (Aug. 2011)	102.80 (Aug. 2011)	2.77 (Oct 2010)	102.45 (Oct 2010)	2.58	102.64

K.3.3 The recorded water levels in the River Terrace Deposits at SR1102A range from 99.81 to 102.2mATD. These water levels consistently remain above the top of this formation, which is at 94.97mATD, indicating that this formation is fully saturated and is confined by the overlying Alluvium at this location. The water levels show seasonal variation and fluctuate with the tidal cycle.

K.3.4 The recorded water levels in the Upper Shelly Beds at SA1105 range from 102.45 to 102.8mATD. These water levels consistently remain above the top of this formation, which is at 57.82mATD, indicating that this formation is fully saturated and is confined by the overlying London Clay Formation at this location.

K.3.5 A plot of groundwater levels within the River Terrace Deposits in the vicinity of the site is shown in Vol 10 Figure 13.4.3 (see separate volume of figures). In the absence of further monitoring boreholes within the upper aquifer near the site and it is not possible to accurately determine the direction of groundwater flow within this waterbody. However it is expected that the direction of groundwater movement is to the south, towards the River Thames, in these shallow deposits.

K.3.6 The EA has a network of observation monitoring boreholes, mainly within the lower aquifer, across London for which records are available dating back over 50 years. The nearest EA monitoring borehole is located at

Young's Brewery (TQ 2561 7467); however this records levels in the lower aquifer. The EA network does not include any monitoring boreholes sufficiently close by to provide representative water level in the upper aquifer at the site.

K.4 Groundwater abstractions and protected rights

Groundwater licensing policy

K.4.1 The London Catchment Abstraction Management Strategy (CAMS), (EA, 2006)[7] does not identify a condition status for the upper aquifer.

K.4.2 The status of the lower aquifer is not relevant to this assessment as the construction would not reach to this depth at the Carnwath Road Riverside site.

K.4.3 No dewatering of the upper or lower aquifers is anticipated at the Carnwath Road Riverside site. Any water entering the excavation from either the superficial deposits, from minor seepages through silt layers in the London Clay Formation or from water-bearing horizons in the Lambeth Group would be pumped to the River Thames via appropriate settlement tanks.

Licensed abstractions

K.4.4 The EA licences abstraction from groundwater within London for all sources in excess of $20m^3/d$. Groundwater abstractions within 1km around the site have been identified.

K.4.5 The nearest licensed groundwater abstraction from the River Terrace Deposits or upper aquifer is located approximately 0.7km to the north-northwest of the site (see Vol 10 Table K.6). The licensed abstraction is held by the Trustees of the Hurlingham Club and is used for industrial, commercial or public services. A capture zone for this abstraction has been calculated at a radius of approximately 109m, based on conservative estimates of recharge. The outer boundary of this catchment area would be approximately 0.6km from the Carnwath Road Riverside site.

K.4.6 The licensed abstractions from the lower aquifer (Chalk) would be unaffected due to construction taking place entirely within the upper aquifer and the London Clay.

K.4.7 There are no known unlicensed groundwater abstractions within a 1km radius of the site.

Vol 10 Table K.6 Groundwater – licensed abstractions

Licence number	Licence holder	Purpose	Aquifer	Licensed volume [m^3/annum]
28/39/39/0177	Trustees of the Hurlingham Club	Industrial, commercial or public services (sports grounds/ facilities)	River Terrace Deposits	15,000

K.5 Groundwater source protection zones

K.5.1 The EA defines Source Protection Zones around all major public water supply abstractions sources and large licensed private abstractions in order to safeguard groundwater resources from potentially polluting activities. The nearest SPZ to the site lies about 3.3km to the northeast.

K.6 Environmental designations

K.6.1 There are no designated sites relevant to groundwater such as SSSI, SAC or SNCIs within 1km of the Carnwath Road Riverside site.

K.7 Groundwater quality and land quality assessment

K.7.1 There have been no ground investigations or monitoring boreholes specifically dedicated to the Carnwath Road Riverside site due to access restrictions at the site. The nearest available ground investigation and monitoring data is from a nearby site at Jews Road (the original site selected) on the opposite side of the River Thames and situated approximately 400m to the southeast of the Carnwath Road Riverside site. Given that groundwater flow in the River Terrace Deposits is likely to be towards and into the River Thames, the groundwater and land quality at these boreholes are unlikely to be representative of site conditions.

K.7.2 The EA monitors groundwater quality at number of points across London, mainly the Chalk and Lower London Tertiaries (Lambeth Group) (EA, 2006)[7]. Although part of this network lies 2km to the south, within King George's Park (PGWU1514), this borehole monitor water quality in the lower aquifer only and is therefore not relevant as construction would take place entirely with the superficial deposits and the London Clay Formation.

K.8 Groundwater status

K.8.1 The EC Water Framework Directive (WFD) requires the status of groundwater management units (groundwater bodies) within each river basin to be determined as 'good' or 'poor' by 2015. For groundwater there are two separate classifications for groundwater bodies; chemical status and quantitative status.

K.8.2 The Thames River basin management plan (EA, 2009)[8] shows no groundwater body designation for either the upper or lower aquifers within the area in which the Carnwath Road Riverside is located; therefore no baseline assessment of quantitative or chemical status is available.

K.8.3 The baseline assessment for groundwater status classification for the nearby Greenwich Chalk and Tertiaries (consisting of the Lambeth Group, Thanet Sands, Blackheath Formation and Chalk Formation) shows poor quantitative status and poor quality status for 2009. The predicted quantitative and chemical quality was poor for 2015 due to treatment or improvement being disproportionately expensive or technically infeasible.

K.8.4 The baseline assessment for groundwater status classification for the nearby Lower Thames Gravels is good quantitative status and poor quality status for 2009. The predicted chemical quality was poor for 2015 due to treatment or improvement being disproportionately expensive or technically infeasible.

K.8.5 The Thames Tideway Tunnel project would prevent deterioration of the current and predicted status where practicable.

K.9 Data sources

K.9.1 A list of data used for the Carnwath Road Riverside assessment is given in Vol 10 Table K.7.

Vol 10 Table K.7 Groundwater – desk based baseline data sources

Source	Data	Date received	Notes
BGS	British Geological Survey (BGS) 1:50,000 scale digital geological data	February 2009	
EA	Licensed groundwater abstraction boreholes, their ownership and purpose	December 2010,February 2011 and March 2012	Licensed abstraction rates, aquifer, and status (active or dormant)
LB's*	Unlicensed groundwater abstraction boreholes and their details	June 2009	Contacted 14 LB's along tunnel alignment
EA	Designated source protection zones	December 2010	
EA	Groundwater level records for EA observation boreholes	September 2009, June 2011, December 2011 and	

Source	Data	Date received	Notes
		October 2012	
EA	Groundwater quality results for EA observation boreholes	August 2009 and May 2011	
EA	Ground Source Heat Pump (GSHP) schemes and their details	December 2010 and March 2012	
Thames Tunnel project	Ground Investigation (2009) borehole logs, construction details, monitoring regime and available water level records and water quality results from 2009 to 2012	Last updated September 2012	Final ES
Thames Tunnel project	Groundwater monitoring strategy	Draft strategy Feb 2012	
Thames Tunnel project	Land quality data	February 2011	
Individual licence holders	Letters sent out to 30 licence holders	December 2011 (last updated 15th October 2012)	

** LBs – London Boroughs*

References

[1] British Geological Survey. *British geology onshore digital maps 1:50 000 scale*. Received from Thames Tunnel, February 2009.

[2] Schwartz, F.W. & Zhang, H. *Fundamentals of Groundwater*. John Wiley & Sons Inc. 2003.

[3] USGS. *Glossary of Hydrologic Terms in The Federal Glossary of Selected Terms: Subsurface-Water Flow and Solute Transport*": Department of Interior, U.S. Geological Survey, Office of Water Data Coordination, August 1989.

[4] Environment Agency. Environment Agency Website (Accessed April 2012). Available at: http://www.environment-agency.gov.uk/homeandleisure/117020.aspx.

[5] Environment Agency. See citation above.

[6] Environment Agency. *Guidance on the design and installation of groundwater quality monitoring points Science Report SC020093* (2006). Available at: http://publications.environment-agency.gov.uk/PDF/SCHO0106BKCT-E-E.pdf.

[7] Environment Agency. The London Catchment Abstraction Management Strategy (CAMS). *Final Strategy Document* (2006). Available at: http://publications.environment-agency.gov.uk/PDF/GETH0406BKRM-E-E.pdf.

[8] Environment Agency. *River Basin Management Plan, Thames River Basin District* (December 2009). Available at: http://publications.environment-agency.gov.uk/PDF/GETH0910BSWA-E-E.pdf.

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.10**

Volume 10: Carnwath Road Riverside appendices

Appendix L: Water resources - surface water

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Thames Tideway Tunnel

Environmental Statement

Volume 10 Carnwath Road Riverside appendices

Appendix L: Water resources – surface water

List of contents

Page number

.

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Appendix L: Water resources – surface water

L.1 Introduction

L.1.1 Construction and operational effects assessments at this site for this topic do not require the provision of any supporting information, so this appendix is intentionally empty.

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.10**

Volume 10: Carnwath Road Riverside appendices

Appendix M: Water resources - flood risk

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This page is intentionally blank

Thames Tunnel

Environmental Statement

Volume 10 Carnwath Road Riverside appendices

Appendix M: Water resources – flood risk

List of contents

Page number

This page is intentionally blank

Appendix M: Water resources – flood risk

M.1 Policy considerations

M.1.1 The relevant planning document that would be used to assess the proposals is the National Policy Statement (NPS) for Waste Water (DEFRA, 2012)[1] which was published in February 2012.

M.1.2 The Waste Water NPS considers the Thames Tideway Tunnel project as 'nationally significant waste water infrastructure.'

M.1.3 General policy documents (eg, NPS) have been reviewed within Volume 2 Environmental assessment methodology. A summary of local and regional policy relevant to flood risk at Carnwath Road Riverside is provided below

Local policy

Strategic Flood Risk Assessment

M.1.4 The Carnwath Road Riverside site lies within the London borough (LB) of Hammersmith and Fulham. The LB of Hammersmith and Fulham has produced a Strategic Flood Risk Assessment (SFRA) (JBA and Entec UK Ltd. 2010)[2]. This outlines the main flood sources to the borough through a review of existing information. Key sources of flood risk in the borough are from surface water and sewer flooding, and the residual risk associated with the failure of the Thames tidal defences.

M.1.5 The SFRA confirms that the Thames Tidal Defence network (Thames Barrier and Tidal flood defence walls) reduces the annual probability of flooding from the River Thames to less than 0.1%. The risk of flooding is a residual risk associated with a breach in the defences.

M.1.6 According to the SFRA:

a. The site is within the Environment Agency (EA) Flood Zone 3

b. There have been between 101 – 200 sewer flooding incidences recorded by Thames Water in the last 10 years in the vicinity of the site

c. The site is within the Rapid Inundation Zone (RIZ)[i]

d. The site has a high residual risk as, although it is not inundated during the modelled breach event, there is no dry access/egress from the site as the surrounding area is inundated with floodwater

e. The existing flood defence near the site is in fair/good condition

M.1.7 The SFRA promotes the use of Sustainable Drainage Systems (SuDS) suitable to specific site locations within the borough, depending on underlying geology.

[i] An area which is at risk of rapid flooding should a flood defence structure be breached or overtopped. The zones at highest risk of rapid inundation are typically located close behind the flood defences.

Surface Water Management Plan

M.1.8 The LB of Hammersmith and Fulham, in partnership with the Greater London Authority (GLA), Thames Water and the EA has produced a Surface Water Management Plan (SWMP) (Halcrow and MWH, 2011)[3] as part of the Drain London project. The SWMP sets out the preferred surface water management strategy for the borough.

M.1.9 The SWMP has not been made available to inform this study.

Regional policy

Thames Estuary 2100

M.1.10 The Carnwath Road Riverside site lies within the Hammersmith Policy Unit which has been assigned the P5 flood risk management policy within the Thames Estuary 2100 (TE2100) Plan (Environment Agency, 2012)[4] meaning that further action will be taken to reduce flood risk beyond that required to keep pace with climate change.

M.1.11 The TE2100 Plan identifies the local sources of flood risk (relative to the Carnwath Road site) as including:

a. tidal and fluvial from the River Thames

b. pluvial (heavy rainfall)

c. urban drainage sources

d. a risk of groundwater flooding from superficial strata which is possibly connected to high water levels in the River Thames.

M.1.12 Flood mitigation from these sources include:

a. the Thames Barrier and secondary tidal defences along the Thames frontage (both making up the Thames Tidal Defences)

b. combined sewer overflows (CSOs) for mitigation of urban drainage

c. flood forecasting and warning.

M.1.13 The TE2100 Plan seeks to promote, where possible, defence improvements that ensure views are maintained and impacts to river access/views are minimised. Where defence raising in the future to manage the consequences of climate change is not possible,, secondary defences and floodplain management should be introduced. There is also the objective to increase flood risk awareness within the area.

London Regional Flood Risk Appraisal

M.1.14 For the reach between Hammersmith Bridge and the Thames Barrier (City Reach) the London Regional Flood Risk Appraisal (RFRA)(Greater London Authority, 2009)[5] encourages small scale set back of development from the river walls where possible. The aim of this is to enable modification, raising and maintenance in a sustainable, environmentally and cost effective way. Development should be designed in such a way as to take opportunities to reduce flood risk and include resilience.

M.1.15 There is particular concern surrounding confluences and the interactions between tidal and fluvial flows in the future due to climate change. This should be taken into consideration during the re-development process.

M.1.16 The RFRA indicates that where possible SuDS should be included within developments to reduce surface water discharge.

References

[1] Department of Environment, Food and Rural Affairs (Defra), *National Planning Policy for Waste Water.* (February 2012)

[2] JBA and Entec UK Ltd. *London Borough of Kensington and Chelsea and London Borough of Hammersmith and Fulham Strategic Flood Risk Assessment Final Report*. (June 2010).

[3] Halcrow and MWH. *LB Hammersmith and Fulham Surface Water Management Plan Final Report.* (Jul 2011).

[4] Environment Agency. *Thames Estuary 2100 Plan*. (November 2012)

[5] Greater London Authority. *London Regional Flood Risk Appraisal.* (October 2009).

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

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Volume 10: Carnwath Road Riverside appendices

Appendix N: Development schedule

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Thames Tideway Tunnel

Environmental Statement

Volume 10 Carnwath Road Riverside appendices

Appendix N: Development schedule

List of contents

Page number

List of tables

Page number

This page is intentionally blank

Appendix N: Development schedule

N.1 Summary

N.1.1 The assessments undertaken for this site take account of other relevant development projects within the vicinity of the site which are under construction, permitted but not yet implemented or submitted but not yet determined. In order to identify the relevant developments for consideration, the Planning Inspectorate, local planning authorities and the Greater London Authority have been consulted on the methodology (see Volume 2) and asked to assist in identifying and verifying the development projects included in the assessment. A schedule is provided in Vol 10 Table N.1 of the resulting development projects, a description of what is proposed and assumptions on phasing. Longer term development projects may be included under both base case, with construction preceding that of the Thames Tideway Tunnel site, and cumulative with construction or operation occurring at the same time as a given Thames Tideway Tunnel site.

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Vol 10 Table N.1 Development schedule for Carnwath Road Riverside

Category types:

a. Under construction

b. Permitted but not yet implemented

c. Submitted but not yet determined

Development within 1km (IPC or Mayoral referral unless otherwise noted)	Dist from site (closest point)	Development description			Category type (based on 'current' status)	Year specific assumptions			Source of assumption information / Notes	Base case or cumulative dev?
		Appl. No.	Developer	Description		2016 (Site Year 1 of construction)	2018 (peak construction traffic year)	2023 (Year 1 of operation)		
Wandsworth Riverside Quarter, Point Pleasant/Osiers Road	Approx 200m southwest	2009/3372	Frasers Riverside Quarter Ltd	Erection of six buildings ranging in height up to fifteen-storeys and two single-storey commercial pavilions to provide approximately 8,712sq.m. of commercial floorspace (including community and leisure uses) and 504 residential units (308 private/196 affordable). Provision of open space, new vehicular and pedestrian access points and associated parking.	A	Phase A (Buildings 5A, 5B, 5C and 5D) complete & operational. Phase B (Buildings 6A & 6B) under construction.	Phase A (Buildings 5A, 5B, 5C and 5D) complete & operational. Phase B (Buildings 6A & 6B) under construction.	100% complete & operational	Planning application information held on the LBW online database and site visit conducted December 2011. Planning Statement states the development will be constructed in two phases but does not indicate over what time period. As construction has commenced, it is assumed that Phase A (Buildings 5A, 5B, 5C & 5D) will be complete and occupied by 2016 and Phase B (Buildings 6A & 6B) by 2019/20.	**2016 & 2018:** Base case = Buildings 5A, 5B, 5C & 5D Cumulative = Buildings 6A & 6B **2023:** Base case = all buildings No cumulative
Jetty adjacent to 51 Townmead Road	Approx 200m east	2012/02897/FUL	Barratt West London	Erection of single storey Environmental Education Centre (D1 use class) on existing jetty with ecological reserve and temporary use of 122 square metres of floorspace for a period of five years as a marketing suite (sui generis use class)	C	100% complete and operational (Jetty Education Centre & Marketing Suite)	100% complete and operational (Marketing Suite decommissioned and fit-out for Education Centre for entire pavilion building carried out to complete building for its legacy use.)	100% complete and operational	Planning application information held on the LBW online database	Base case (all years)
Townmead Road	Approx 230m east	2010/01792/FUL	Cemex UK Operations,	Redevelopment of site involving the demolition of existing concrete plant, conveyors, aggregate building, workshop and related structures and the erection of a replacement concrete plant, aggregate storage facility, transfer building and conveyors and siting of batch cabin and office portacabin with associated cycle storage area.	B	100% complete and operational	100% complete and operational	100% complete and operational	LBHF online planning applications database. The information submitted does not indicate that the development is proposed to be built out in phases and therefore assumption made that the development would be built out in full by Year 1 of construction.	Base case (all years)

Development within 1km (IPC or Mayoral referral unless otherwise noted)	Dist from site (closest point)	Development description			Category type (based on 'current' status)	Year specific assumptions			Source of assumption information / Notes	Base case or cumulative dev?
		Appl. No.	Developer	Description		2016 (Site Year 1 of construction)	2018 (peak construction traffic year)	2023 (Year 1 of operation)		
Western Riverside Transfer Station	Approx 230m south	2009/1239	Cory Environmental Ltd	Replacement of existing Civic Amenity facility with a building with open sides to south and west elevations for use as a Civic Amenity facility including revised public access/queuing arrangements to the east of the proposed building. Revised staff car park.	A	100% complete & operational	100% complete & operational	100% complete & operational	Planning application information held on the LBW online database and site visit conducted December 2011.	Base case (all years)
Units 1 -20 Enterprise Way	Approx 350m south	2009/3017	Barratt Homes Ltd	Demolition of existing buildings. Erection of 8 buildings ranging in height from 2 to 21 storeys comprising 275 flats of which 89 would be affordable; 3,587sq.m. of commercial floor space to include shops, financial and professional services (Class A1).	A	100% complete & operational	100% complete & operational	100% complete & operational	Chapter 6 of ES - development programme, demolition and Construction.	Base case (all years)
Osiers Road	Approx 380m southwest	2011/5207	Boyer Planning	Demolition of existing buildings. Erection of buildings up to 8-storeys high plus basement to provide 158 flats (including 48 affordable units), 2,228sq.m. of commercial accommodation for retail, food and drink, business and community uses (Class A1, A2, A3, B1, D1) with associated parking, private amenity space and public realm with access through the site.	B	100% complete & operational	100% complete & operational	100% complete & operational	Planning application information held on the LBW online database.	Base case (all years)
Battersea Reach	Approx 400m southeast	2011/0324	St. George South London Limited	Erection of five buildings ranging in height between 6 and 15-storeys (Blocks M, N, P, Q & T) to south-west part of site, to include 374 flats and 2,636sq.m. of commercial floorspace comprising retail, restaurants/cafes/bars (Class A1, A2, A3 and B1 Use), with associated car parking, access and landscaping. (Revision to Outline planning permission dated 02.01.2008 ref: 2006/4533)	B	Under construction	100% complete and operational	100% complete and operational	No information in planning application documentation on construction phasing. As the development is permitted it is expected that construction will begin by 2013 and take several years. Given the scale of the development it is therefore assumed that the development is still under construction in 2016 but complete and operational by 2018.	**2016:** Cumulative **2018 & 2023:** Base case
Southside Shopping Centre, Garratt Lane	Approx 850m south	2011/5534	Metro Shopping Fund LP	Demolition of Block B and erection of replacement building of up to four-storeys; erection of front extensions and formation of mezzanine floors to Block A to provide up to 3 levels of accommodation including existing basement; proposed floorspace to accommodate retail, financial and professional services, restaurants, pubs and bars and a gym (Classes A1, A2, A3, A4 and D2) together with improvements to existing facade and service yard E, landscaping, public art, signage, advertising and associated works.	B	100% complete & operational	100% complete & operational	100% complete & operational	Planning application held on the LBW online database.	Base case (all years)

Development within 1km (IPC or Mayoral referral unless otherwise noted)	Dist from site (closest point)	Development description			Category type (based on 'current' status)	Year specific assumptions			Source of assumption information / Notes	Base case or cumulative dev?
		Appl. No.	Developer	Description		2016 (Site Year 1 of construction)	2018 (peak construction traffic year)	2023 (Year 1 of operation)		
Cockpen House, Buckhold Road	Approx 880m south	2008/0960	Minerva (Wandsworth) Ltd	Demolition of all existing buildings. Erection of 5 to16-storey buildings plus basement made up of a 5-storey building to the rear, stepping up to a 10-storey building along Buckhold Road with the 4-storey element and 16-storey tower facing King George's Park along the new pedestrian route to Hardwicks Square. Provision of 207 flats. 1010sq. m of commercial space including shops, community uses, offices, bars and restaurants. Underground parking for 78 vehicles and 206 cycles.	A	100% complete & operational	100% complete & operational	100% complete & operational	Environmental Statement Non Technical Study (Section 6 Development Programme and Construction) Site visit conducted December 2011	Base case (all years)
Imperial Wharf	Approx 900m northeast	2009/00974/FUL	St George (West London) Ltd.	Erection of a 10 storey building, to provide a mixed use development comprising 165 residential units at level 1 to level 9; 1190 sq.m of Class A1, A2, A3, A4, A5 floorspace at ground and first floor; 492 sq.m office floorspace (Class B1) at level 2; associated car parking and landscaping.	B	100% complete & operational	100% complete & operational	100% complete & operational	No information in planning application documentation on construction phasing. On the basis that the application has been permitted and needs to commence within three years, it has been assumed that it will be built by 2018.	Base case (all years)
The Business Village, Broomhill Road	Approx 950m south	2007/2999	Workspace Glebe Ltd	Demolition of existing buildings. Erection of buildings between four and sixteen-storeys in height to provide 10,500 sq.m. of B1 floorspace (office, research and development, and light industry), 209 residential units, retail, cafe+/restaurant and crèche/nursery uses with 120 parking spaces within the basement and provision of new public routes/spaces.	A	100% complete & operational	100% complete & operational	100% complete & operational	ES not available online Site visit conducted December 2011 As it is currently under construction, it is assumed it will be complete and operational by Site Year 1 of construction.	Base case (all years)

Note: phasing and site layout information has been sourced from local authority planning portals unless otherwise indicated.

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

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