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

Creating a cleaner, healthier River Thames

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.12**

Volume 12: Cremorne Wharf Depot appendices

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

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Thames Water Utilities Limited

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Appendix A: Introduction

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Appendix A: Introduction

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Appendix A: Introduction

A.1 Summary

A.1.1 This document presents the appendices that accompany the *Environmental Statement* Volume 12 Cremorne Wharf Depot 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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Appendix B: Air quality and odour

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Appendix B: Air quality and odour

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Appendix B: Air quality and odour

B.1 Model verification

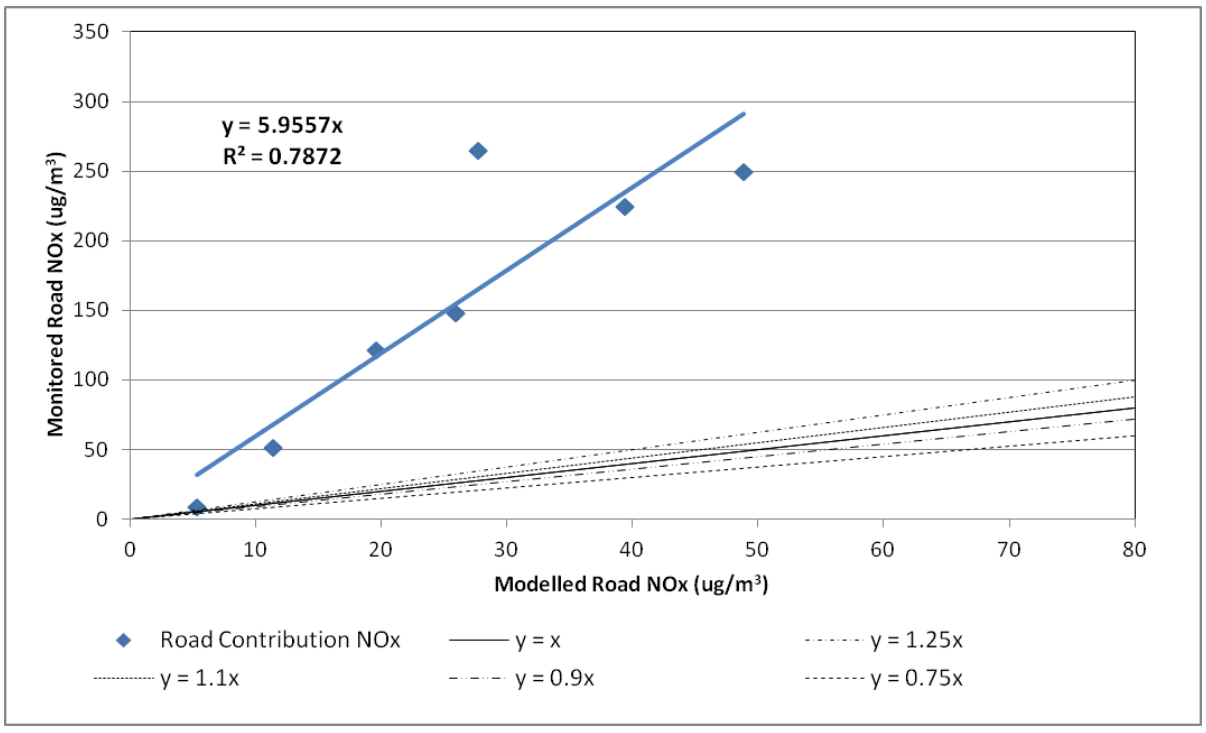
B.1.1 Modelled NO_2 concentrations have been plotted against monitored concentrations at seven diffusion tube sites (CWDM1-CWDM6 and KC39) as shown in Vol 12 Figure 4.4.1 (see separate volume of figures).

B.1.2 This showed that the modelled results underestimated NO_2 concentrations by between 3% and 55%. 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.

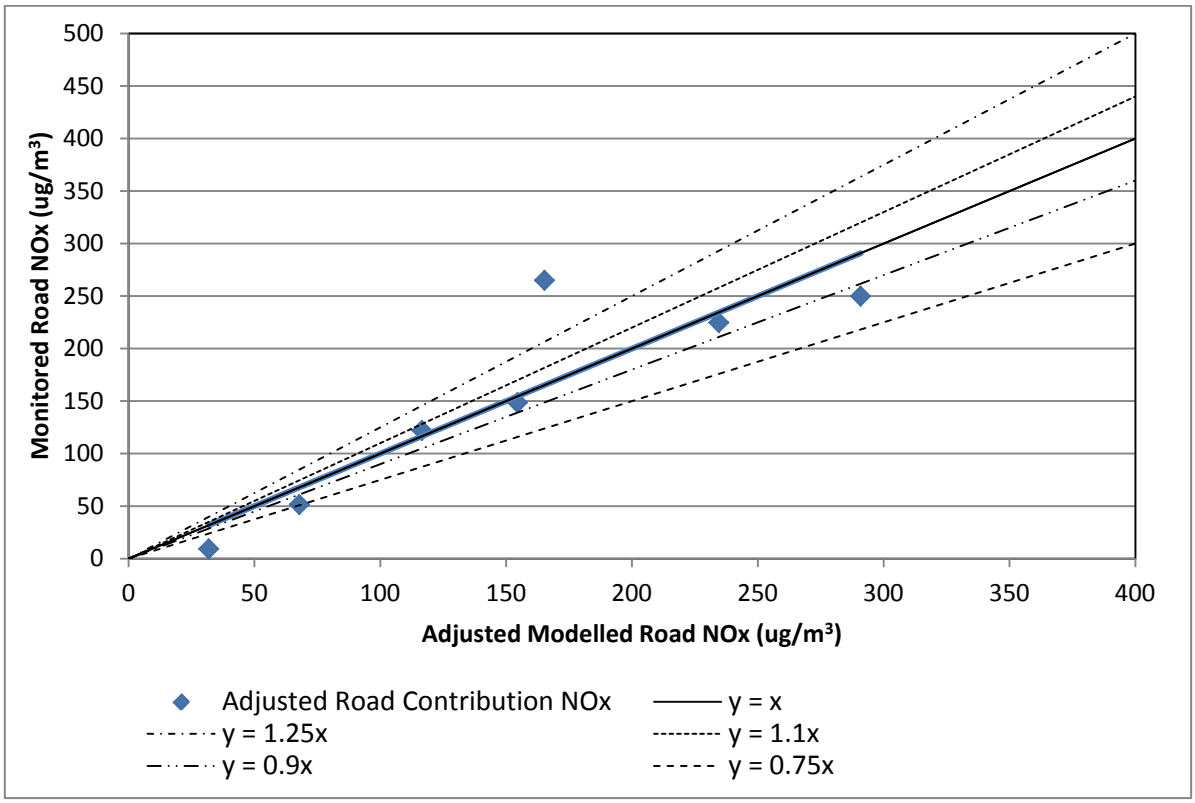
B.1.3 To derive the adjustment factor, modelled road NO_X concentrations were plotted against calculated monitored road NO_X concentrations (see Vol 12 Plate B.1 below). An adjustment factor of 5.96 was calculated for adjusting modelled roadside NO_X concentrations, in accordance with LAQM.TG(09) (Defra, 2009)[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 12 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 12 Plate B.3, indicated that five of the seven modelled concentrations were within 10% of the measured value and that the other two were within 25% of the modelled value.

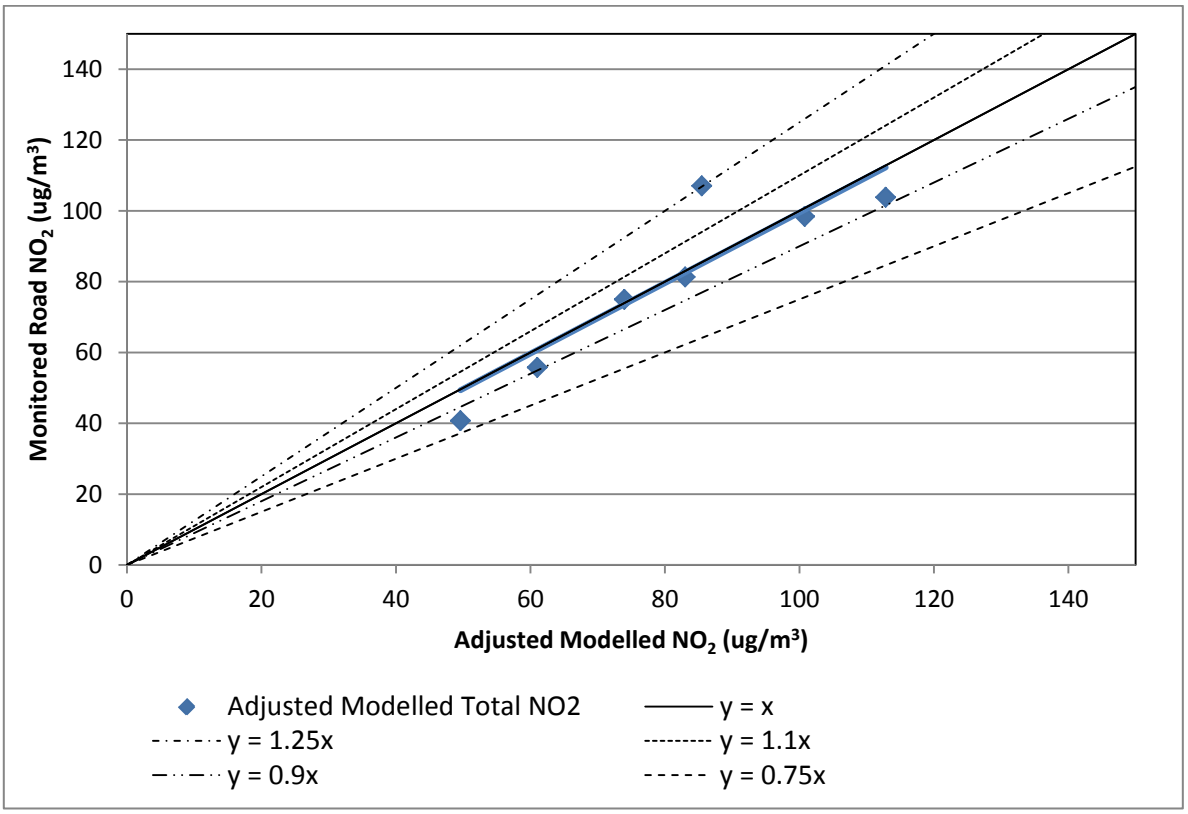
Vol 12 Plate B.1 Air quality - monitored road NO_X vs. modelled road NO_X



Vol 12 Plate B.2 Air quality – monitored road NO_X vs. adjusted modelled road NO_X



Vol 12 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 Cremorne Wharf Depot site are shown in Vol 12 Table B.1.

Vol 12 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 in % (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)
TfL Model	Kings Road W of Ashburnham Road	32014	6.4	30	12.1	9.5	35049	33	35100	6.5
TfL Model	Ashburnham Road N of Kings Road	23857	7.2	30	12.4	9.5	26119	21	26154	7.2
TfL Model	Edith Grove N of Kings Road	16282	8.8	30	12.9	9.5	17826	21	17878	8.9
TfL Model	Kings Road between Ashburnham Road and Edith Grove	26390	7.2	30	8.8	9.5	28892	17	28926	7.2
TfL Model	Ashburnham Road S of Kings Road	23028	5.8	30	10.7	9.5	25212	6	25222	5.8

Source	Road link	2010 baseline AADT*	Baseline % HGV >3.5t	Speed limit (mph)	Model input speed (mph)	Growth factor in % (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)
TfL Model	Edith Grove S of Kings Road	14392	6.3	30	20.3	9.5	15757	5	15778	6.3
TfL Model	Kings Road E of Edith Grove	25065	8.0	30	13.3	9.5	27441	3	27446	8.0
Speed Limit	Lots Road W of Ashburnham Road	7615	2.5	30	30.0	9.5	8337	10	8347	2.6
TfL Model	Cremorne Road	39881	7.3	30	15.6	9.5	43663	2	43689	7.3
TfL Model	Beaufort Street	16357	8.9	30	13.2	9.5	17908	3	17915	9.0

** AADT – annual average daily traffic.*

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 12 Table B.2 for the Cremorne Wharf Depot site.

Vol 12 Table B.2 Air quality - tug assessment model inputs

Parameter	Value	Units
Total tugs	119	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***	3370	m^2
NO_X emissions per tug	$1.7x10^{-04}$	$g/s/m^2$
PM_{10} emissions per tug	$1.5x10^{-05}$	$g/s/m^2$

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

B.4 Construction plant emission factors

B.4.1 For the purpose of the assessment, the following listed equipment in Vol 12 Table B.3 has been modelled for the peak construction year at the Cremorne Wharf Depot site.

Vol 12 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	$7.6x10^{-07}$	$4.7x10^{-08}$
	Ground level behind hoarding	Generator - 200kVA	1	100	160	$2.3x10^{-06}$	$1.5x10^{-07}$
	Ground level behind hoarding	JCB with hydraulic breaker	1	50	67	$4.9x10^{-07}$	$3.0x10^{-08}$
	Ground level behind hoarding	Cutting equipment (diamond saw)	2	10	2.3	$1.7x10^{-08}$	$3.7x10^{-08}$
	Ground level behind hoarding	Telescopic handler/FLT**	1	30	60	$2.6x10^{-07}$	$1.6x10^{-08}$
	Ground level behind hoarding	Hiab*** lorry/crane	1	5	56	$4.1x10^{-08}$	$2.5x10^{-09}$
	Ground level behind hoarding	Well drilling rig	1	50	403	$2.9x10^{-6}$	$1.8x10^{-7}$
Demolition	Ground level behind hoarding	Service Crane 25t mobile Crane	1	30	275	$1.2x10^{-06}$	$7.5x10^{-08}$
	Ground level behind hoarding	22t Excavator complete with hydraulic hammer	1	30	122	$5.3x10^{-07}$	$3.3x10^{-08}$

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 ($g/s/m^2$)
	Ground level behind hoarding	Site dumper	1	30	81	$3.5x10^{-07}$	$2.2x10^{-08}$
	Ground level behind hoarding	Concrete crusher	1	80	172	$2.0x10^{-06}$	$1.3x10^{-07}$
	Ground level behind hoarding	Vibrating rollers	2	50	145	$2.1x10^{-06}$	$1.3x10^{-07}$
Piling	Ground level behind hoarding	100t crawler crane	1	50	240	$1.7x10^{-06}$	$1.1x10^{-07}$
	Ground level behind hoarding	25t mobile crane	1	50	275	$2.0x10^{-06}$	$1.2x10^{-07}$
Shaft sinking by sprayed concrete lining	Within excavation	Shotcrete robot	1	20	14	$6.5x10^{-07}$	$6.1x10^{-08}$
	Ground level behind hoarding	Concrete deliveries (discharging)	1	80	223	$2.6x10^{-06}$	$1.6x10^{-07}$
	Ground level behind hoarding	Concrete deliveries (agitating)	1	20	223	$6.5x10^{-07}$	$4.1x10^{-08}$
	Ground level behind hoarding	12t excavator	1	80	66	$7.7x10^{-07}$	$4.8x10^{-08}$
	Ground level behind hoarding	100t crawler crane	1	80	240	$2.8x10^{-06}$	$1.7x10^{-07}$
	Ground level behind hoarding	25t mobile crane	1	20	275	$8.0x10^{-07}$	$5.0x10^{-08}$
	Ground level behind hoarding	25t excavator	1	50	125	$9.1x10^{-07}$	$5.7x10^{-08}$
	Ground level behind	400cfm compressor	1	50	104	$7.6x10^{-07}$	$4.7x10^{-08}$

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 ($g/s/m^2$)
	hoarding						
Drive connection tunnel in sprayed concrete lining	Within excavation	Shotcrete robot	1	20	14	$6.5x10^{-07}$	$6.1x10^{-08}$
	Ground level behind hoarding	Concrete deliveries (discharging)	1	80	223	$2.6x10^{-06}$	$1.6x10^{-07}$
	Ground level behind hoarding	Concrete deliveries (aggitating)	1	20	223	$6.5x10^{-07}$	$4.1x10^{-08}$
	Within tunnel	Butor tunnel excavator	1	50	30	$3.5x10^{-06}$	$3.3x10^{-07}$
	Within excavation	Piccini dumpers	2	50	81	$1.2x10^{-06}$	$7.4x10^{-08}$
	Ground level behind hoarding	100t crawler crane	1	50	240	$1.7x10^{-06}$	$1.1x10^{-07}$
	Ground level behind hoarding	25t mobile crane	1	20	275	$8.0x10^{-07}$	$5.0x10^{-08}$
	Ground level behind hoarding	25t excavator	1	50	125	$9.1x10^{-07}$	$5.7x10^{-08}$
	Ground level behind hoarding	400cfm compressor	1	50	104	$7.6x10^{-07}$	$4.7x10^{-08}$

** Note: For the purposes of this assessment, the above listed equipment has been modelled for the peak construction year. The data assumes a 10 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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Appendix C: Ecology - aquatic

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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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Appendix D: Ecology - terrestrial

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Appendix D: Ecology – terrestrial

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Appendix D: Ecology – terrestrial

D.1 Notable species survey report

Introduction

D.1.1 Surveys for the following species were undertaken at Cremorne Wharf Depot site, as suitable habitat for these species was recorded on site during the Phase 1 Habitat Survey conducted on 29 October 2012, as shown in Vol 12 Figure 6.4.1 (see separate volume of figures):

a. bats
b. wintering birds
c. black redstart *(Phoenicurus ochruros)*
d. invertebrates
e. botanical (river wall and jetty only)
f. invasive plants.

D.1.2 The purpose of the surveys is to determine the presence or likely absence of these species from 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 - D.1.15). The results from the surveys are then presented (paras. D.1.16 - D.1.33). The final section provides an interpretation of the results (paras to D.1.34 - D.1.49). Figures referred to in this report are contained within Vol 12 Cremorne Wharf Depot Figures (see separate volume of figures).

D.1.4 Information on legislation, policy and methodology can be found in Vol 2 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 three stage bat survey was carried out. The first survey was a remote recording (bat triggering) survey using remote Anabat™ recording devices. Based on the habitat types identified during the Phase 1 habitat survey and their potential to support commuting bats, one location was chosen for the installation of the remote recording devices, as shown on Vol 12 Figure 6.4.2 (see separate volume of figures). This location was selected to capture bat activity along the river corridor on and adjacent to

the site, and any other activity from bats commuting through and foraging on and adjacent to the site. Cremorne Gardens was not surveyed as it was considered that there was not sufficient connectivity of habitat (terrestrial) between the Gardens and the site to warrant a survey.

D.1.7 The bat activity recorded during the remote recording surveys triggered the need for an additional dawn survey (see Vol 2 Methodology for bat triggering criteria). Therefore, a second stage of bat surveying was undertaken, comprising one dawn survey visit by two ecologists to assess the usage of the site and immediate surrounds by bats. The trees and introduced shrub on site, and the ephemeral short perennial vegetation adjacent to the site were included in the survey area as potential foraging resources. The River Thames within and immediately adjacent to the site was included in the survey as it is likely to be used as a corridor for commuting bats. The buildings on site were also included in the survey area, although the bat roost potential of the buildings was considered to be low (with the exception of the Pumping Station Building, where roof tiles could support small numbers of bats).

D.1.8 A third stage of bat surveying was undertaken to focus on the Lots Road Pumping Station building, where the desk study had revealed a historic bat roost within this building. The surveys comprised one dusk survey and one dusk and dawn survey. Two ecologists undertook the surveys.

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. The survey area, as shown in Vol 12 Figure 6.4.3 (see separate volume of figures), comprises intertidal foreshore, exposed shoals at low tide, an outfall, and a jetty. The foreshore mainly consists of stones of various sizes and silt. On the left hand (north) bank there is a large prefabricated building used to store street cleaning vehicles and waste disposal bins. The foreshore comprises habitat with potential for supporting foraging and resting purposes birds.

Black redstart

D.1.10 Black redstarts are associated with stony, montane areas and cliff-like habitats, but within the UK the species has expanded its range and habitat preferences, and as a breeding species is more typically associated with urban and industrial habitats, with sparsely vegetated open areas and disused buildings.

D.1.11 The survey area, as shown in Vol 12 Figure 6.4.4 (see separate volume of figures), includes the proposed development site (buildings and structures), the northern end of the disused power station building to the south of the site and the houses to the west of the site, which have potential to support nesting black redstart. The survey area also incorporates a sparsely vegetated potential foraging area for black redstart adjacent to the site to the south.

Invertebrates

D.1.12 An invertebrate survey was undertaken following the Phase 1 Habitat Survey, as the river wall habitat on and adjacent to the site was considered to have the potential to support notable invertebrate species. The survey area is shown on Vol 12 Figure 6.4.5 (see separate volume of figures).

Botanical

D.1.13 A botanical survey was undertaken following the Phase 1 Habitat Survey as the river wall habitat on and adjacent to the site and the jetty adjacent to the site have the potential to support a range of notable plant species. The survey area is shown on Vol 12 Figure 6.4.6 (see separate volume of figures).

Invasive plants

D.1.14 Invasive plants that are listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) can be found in almost any habitat, although these are more likely to occur in 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, and/or along watercourses where they are readily spread by water.

D.1.15 The invasive plants survey area, as shown on Vol 12 Figure 6.4.7 (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 (eg,. Japanese knotweed (*Fallopia japonica*)).

Results

D.1.16 The results of the desk study, notable species surveys and plant surveys are presented here. The results are then interpreted in para.D.1.34 - D.1.49

Desk study

D.1.17 Vol 4 Table D.1 indicates species recorded within 500m of the site from 2001 to 2011, as supplied by Greenspace Information for Greater London (GIGL).

Vol 4 Table D.1 Terrestrial ecology – species recorded within 500m of the site from 2001 - 2011

Common name	Species name (latin)	Record count
Mammals		
Common pipistrelle	*Pipistrellus pipistrellus*	1
Soprano pipistrelle	*Pipistrellus pygmaeus*	1
Vespertilionidae	*Vespertilionidae*	2

Common name	Species name (latin)	Record count
Birds		
Black redstart	*Phoenicurus ochruros*	5
Caspian gull	*Larus cachinnans*	1
Common starling	*Sturnus vulgaris*	18
Common tern	*Sterna hirundo*	7
Eurasian curlew	*Numenius arquata*	1
Greylag goose	*Anser anser*	11
Hedge accentor	*Prunella modularis*	15
Herring gull	*Larus argentatus*	19
House sparrow	*Passer domesticus*	13
Northern pintail	*Anas acuta*	7
Peregrine falcon	*Falco peregrinus*	2
Redwing	*Turdus iliacus*	1
Reed bunting	*Emberiza schoeniclus*	2
Song thrush	*Turdus philomelos*	3
Amphibians		
Common frog	*Rana temporaria*	1
Common toad	*Bufo bufo*	1

Bat surveys

Bat triggering (remote recording) survey

D.1.18 The bat triggering (remote recording) survey was undertaken over three nights between 3 and 5 May 2011. The weather conditions on the first two nights were sub-optimal. On the third night, the weather conditions were optimal for survey (Vol 4 Table D.2).

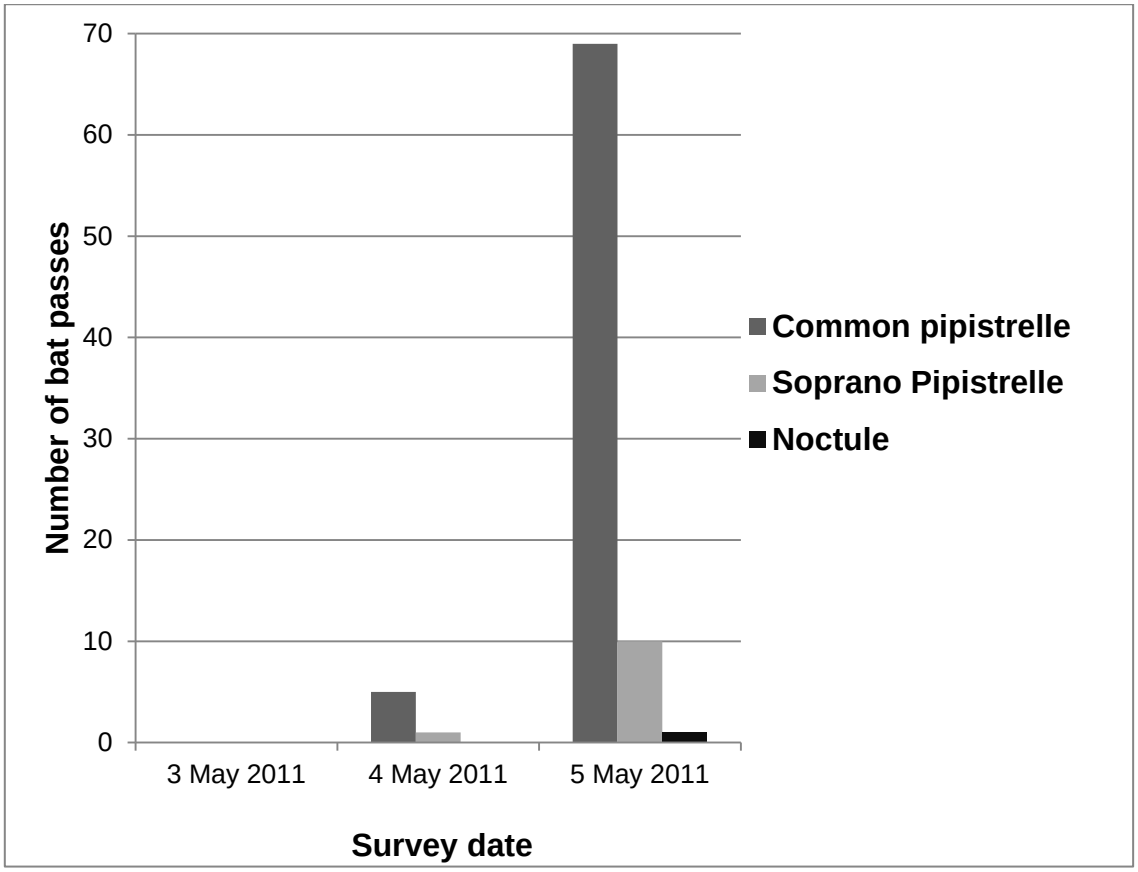
D.1.19 The survey recorded three species of bat using the site: common pipistrelle *(Pipistrellus pipistrellus)*; soprano pipistrelle *(Pipistrellus pygmaeus)*; and noctule *(Nyctalus noctula)* (Vol 4 Plate D.1). No bats were recorded on the first survey night (3 May 2011). Five common pipistrelle and one soprano pipistrelle bat were recorded on the second night (4 May 2011). Finally on the third night (5 May 2011), high numbers of common pipistrelle passes (69), ten soprano pipistrelle passes and one noctule bat pass were recorded.

Vol 4 Table D.2 Terrestrial ecology – bat survey weather conditions

Survey visit	Weather conditions
3 May 2011	6^{o}C, strong breeze, 100% cloud cover, dry
4 May 2011	6^{o}C, light breeze, 100% cloud cover, dry

Survey visit	Weather conditions
5 May 2011	9°C, light breeze, 50% cloud cover, dry

Vol 4 Plate D.1 Terrestrial ecology – bat passes recorded during remote recording survey at Cremorne Wharf Depot



Bat activity (dawn) survey

D.1.20 As high numbers of common pipistrelle bats and more than two bat species were recorded on site, a further survey visit was undertaken to record bat activity on site at dawn. The survey was undertaken on 21 June 2011 using hand held bat detectors (devices that record the echolocation of bats) in suitable weather conditions (14°C, light scattered showers, 60% cloud cover and a light breeze). The bat activity survey results are shown on Vol 12 Figure 6.4.2 (see separate volume of figures).

D.1.21 Seven common pipistrelle bats were recorded moving through the site during the dawn surveys, with one common pipistrelle bat recorded within one hour of dawn. Four of these records were associated with commuting along the foreshore and three were associated with commuting and foraging along the southern boundary of the site.

D.1.22 No soprano pipistrelle or noctule bats were recorded during the dawn survey, nor were any bat roosts identified in buildings on site or in close proximity to the site at the time of the survey.

Dusk and dawn bat surveys focussing on Lot's Road Pumping Station

D.1.23 A dusk emergence survey was undertaken on the 25 September 2012, with a following dawn activity survey on the 26 September 2012, an additional dusk survey was undertaken on 1 October 2012. The surveys were undertaken using hand held bat detectors (devices that record the echolocation of bats). Weather conditions were sub-optimal with heavy rain and strong winds earlier in the day on the 25 September, prior to the survey, which may have reduced the availability of the invertebrate foraging resource for bats. However, weather conditions during the dusk surveys were sufficient to allow bats to emerge given that bats were observed shortly after dusk.

D.1.24 During the September survey, approximately five soprano pipistrelle bats were recorded moving between and over the shed buildings on site within half an hour after sunset. A large bat, most likely to be a noctule, was observed flying along the western boundary of the site nearly one hour after sunset. No bats were observed emerging from the Lot's Road Pumping Station building during the dusk emergence survey.

D.1.25 The weather conditions during the night were sub-optimal for undertaking the dawn survey as there were rain showers during the early hours of the night. Bats normally return to their roosts within the two hour period before sunrise. However, the weather conditions are likely to have resulted in the majority of bats returning to their roost sites earlier. However, some bats were out of their roosts during the dawn survey, indicated by the presence of a common pipistrelle bat recorded on site approximately one hour prior to sunrise.

D.1.26 The dusk survey undertaken at the start of October identified two common pipistrelle bats, emerging from the southeast corner of the Pumping Station building. The bats emerged approximately half an hour after sunset and flew away to the southwest. No other bat activity was recorded during the survey.

Vol 4 Table D.3 Terrestrial ecology –wintering bird survey weather conditions

Survey visit	Weather conditions
25 September 2012 (dusk)	16^{o} C, light breeze, 50% cloud cover, wet from prior heavy rain
26 September 2012 (dawn)	13^{o} C, light breeze, 100% cloud cover, rain showers
1 October 2012 (dusk)	16^{o} C, light breeze, 10% cloud cover, fine and dry

Wintering bird survey

D.1.27 A total of six survey visits were undertaken by an experienced ornithologist (bird specialist) at monthly intervals between December 2010 and March 2011, and during October and November 2011 (from an hour before low

tide to at least one hour after low tide). The survey visits were undertaken in suitable weather conditions (Vol 4 Table D.4). The main foraging and resting areas for wintering birds are indicated on Vol 12 Figure 6.4.3 (see separate volume of figures). The numbers of individuals of each species recorded in each month are provided in Vol 4 Table D.5.

Vol 4 Table D.4 Terrestrial ecology –wintering bird survey weather conditions

Survey visit	Weather conditions
14 December 2010	2^{o} C, calm, 100% cloud cover, dry
21 January 2011	2^{o} C, light northeasterly wind, 100% cloud cover, dry
22 February 2011	6^{o} C, light northeasterly wind, 100% cloud cover, dry
23 March 2011	15^{o} C, light northeasterly wind, 10% cloud cover, dry
14 October 2011	14^{o} C, light southwesterly wind, no cloud cover, dry
10 November 2011	12^{o} C, light southeasterly wind, 100% cloud cover, dry

D.1.28 A total of 16 waterbird species were recorded on or in close proximity to the site including the following:

a. Gulls *(Larus sp.)* and cormorant *(Phalacrocorax carbo)* were recorded resting on the foreshore adjacent to the site.

b. Gadwall *(Anas strepera)*, teal *(Anas crecca)* mallard *(Anas platyrhynchus)*, black-headed gull *(Chroicocephalus ridibundus)*, common gull *(Larus canus)*, lesser black-backed gull *(Larus fuscus)*, herring gull *(Larus argentatus)* and great black-backed gull *(Larus marinus)* recorded foraging on exposed intertidal mud around the location of the outfall and near the confluence with Chelsea Creek at low tide.

c. Cormorant and mallard were recorded foraging on the muddy foreshore and along the water's edge as the tide receded.

d. Five species of gull (*Larus sp.*) were recorded resting on the foreshore, particularly on the exposed gravel shoals.

Vol 4 Table D.5 Terrestrial ecology - species and numbers of wintering waterbirds recorded during monthly wintering bird surveys

Species name	Latin name	Conservation designation[i]	Monthly wintering waterbird counts					
			14 December 2010	21 January 2011	22 February 2011	23 March 2011	14 October 2011	10 November 2011
Great crested grebe	*Podiceps cristatus*	Green List	-	1	-	-	-	-
Cormorant	*Phalacrocorax carbo*	Green List	7	9	16	2	24	17
Grey heron	*Ardea cinerea*	Green List	1	-	1	-	1	1
Mute swan	*Cygnus olor*	Green List	3	-	-	-	-	2
Greylag goose (Feral)	*Anser anser*	Green List	-	-	-	6	-	12
Canada goose	*Branta canadensis*	Green List	-	-	2	-	-	2
Gadwall	*Anas strepera*	Amber List	18	61	54	-	-	24
Teal	*Anas crecca*	Amber List	5	1	8	-	-	6
Mallard	*Anas*	Amber List	34	6	10	4	5	64

[i] 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[i]	Monthly wintering waterbird counts					
			14 December 2010	21 January 2011	22 February 2011	23 March 2011	14 October 2011	10 November 2011
	platyrhynchos							
Moorhen	*Gallinula chloropus*	Green List	4	2	1	1	2	2
Coot	*Fulica atra*	Green List	-	2	2	3	-	-
Black-headed gull	*Chroicocephalus ridibundus*	Amber List	47	82	114	-	86	56
Common gull	*Larus canus*	Amber List	2	3	6	5	1	1
Lesser black-backed gull	*Larus fuscus*	Amber List	2	1	1	2	1	3
Herring gull	*Larus argentatus*	Red List UK BAP Priority List	4	4	18	5	7	8
Great black-backed gull	*Larus marinus*	Amber List	1	-	2	2	-	1

Black redstart survey

D.1.29 A total of five back redstart survey visits were undertaken for a minimum of three hours each during the early morning period between May and July, and when weather conditions were suitable, as detailed below in Vol 4 Table D.6. The July visit was outside of the optimum survey period for black redstart. However, surveys can be undertaken during July as breeding usually continues into this month (Brown and Grice, 2005)[1]. The other four visits were undertaken during the peak breeding period for black redstart in May and June. Therefore, if black redstart were breeding on or near the site, then this would have been recorded with the survey effort undertaken. Consequently, a survey visit in July is not considered to limit the results of the survey.

D.1.30 No black redstarts were recorded during any of the five surveys.

Vol 4 Table D.6 Terrestrial ecology –black redstart survey weather conditions

Date	Weather conditions
17 May 2011	12^{o} C, Light easterly breeze, 100% cloud cover, dry.
27 May 2011	11^{o} C, Calm, 100% cloud cover, dry.
21 June 2011	15^{o} C, Light westerly breeze, 50% cloud cover, dry.
30 June 2011	12^{o} C, Calm, 0% cloud cover, dry.
14 July 2011	13^{o} C, Light westerly breeze, overcast, dry.

Invertebrate surveys

D.1.31 An invertebrate survey was undertaken on 23 June 2011. The invertebrate survey identified that the river wall on and adjacent to the site does not support any notable species of invertebrates. Based on professional judgement, no further invertebrate surveys were deemed necessary as the river wall does not support notable species of invertebrates.

Botanical surveys

D.1.32 The botanical survey was undertaken on 26 August 2011. No notable botanical species were identified.

Invasive plant surveys

D.1.33 The invasive plant survey was undertaken on 26 August 2011. One invasive plant species listed on Schedule 9 of the Wildlife and Countryside Act was recorded, entire-leaved cotoneaster (*Cotoneaster integrifolius)*, as part of introduced shrub planting on site (national grid reference TQ2653077079 to TQ2654077073).

Interpretation

Bats

D.1.34 A three-stage survey for bats was undertaken on the site. During the remote recording surveys, bats were recorded close to sunrise and sunset, three species of bat were recorded and high numbers of common pipistrelle were recorded. In accordance with bat triggering survey criteria, a further dawn survey was undertaken. Further dusk and dawn surveys were undertaken focussing on the Lot's Road Pumping Station building where a roost was suspected.

D.1.35 On the first night of the remote recording survey (first stage) no bats were recorded. On the second night small numbers of common pipistrelle bat were recorded. This is in contrast to much higher numbers on the third night. It is likely that this is the result of unpredicted poor weather conditions over the first two nights. The first night was cool and there was a strong breeze, which is sub-optimal for bats as this weather would limit the availability of invertebrate prey. The second night the temperature was similar but the wind had dropped. A few bats were then recorded. On the third night, the weather was warm and the wind was light, providing ideal conditions for bats. Therefore, higher levels of bat activity were recorded on this night compared to the other two nights.

D.1.36 The remote recording surveys recorded substantially higher numbers of common pipistrelle than soprano pipistrelle on both surveys. One noctule bat was also recorded during remote recording surveys. The dawn activity survey (second stage) recorded four common pipistrelle records associated with commuting along the foreshore and three associated with commuting and foraging along the southern boundary of the site. The River Thames provides a corridor for common and soprano pipistrelle bats to commute between foraging areas. The watercourse may also be used occasionally as a foraging resource. Therefore, the River Thames at this location is considered to be important for local populations of common pipistrelle and soprano pipistrelle.

D.1.37 The scrub and single tree on site may provide a limited resource for foraging bats, although such activity is likely to be limited due to the small extent of the scrub area, and no foraging activity specifically associated with this habitat was observed during surveys. The onsite buildings and hardstanding are not considered to provide a foraging resource.

D.1.38 A common pipistrelle was recorded within an hour of dusk and dawn (the period of time when bats leave and return to their roosts; however, the activity survey undertaken at dawn did not identify any bat roosts in buildings on site or in close proximity to the site at the time of the survey. (21 May 2011).

D.1.39 Given the prior record of bats within the Lot's Road Pumping Station building, further dusk and dawn bat surveys were undertaken in September and October 2012 (third stage). During these surveys, bats were seen flying between and over the shed buildings on site (September survey). At least four soprano pipistrelle bats were observed half an hour after sunset coming from between the shed buildings. One large bat, most

likely to be noctule, was observed passing through the site from north to south along the western boundary. Only one bat, a common pipistrelle, was recorded during the dawn survey. No bats were seen entering or leaving any buildings on or immediately adjacent to the site, although activity at dawn may have been reduced by rain showers during the night.

D.1.40 The dusk survey in October recorded two common pipistrelle bats emerging from the southeast corner of the Pumping Station building. It is therefore assumed that the Pumping Station is used as a roost by small numbers of common pipistrelle bats and has the potential to support soprano pipistrelle bats for roosting purposes. Common and soprano pipisitrelle bats may also be roosting off-site. The most likely locations for roosts in the area are the houses to the west of the site and the disused power station building to the south of the site.

Wintering birds

D.1.41 Of the 16 waterbird species that were recorded within the survey area, eight 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, teal, mallard, black-headed gull, common gull, lesser black-backed gull, herring gull and great black-backed gull.

D.1.42 Greylag goose (*Anser anser*) was recorded on site, which is an Icelandic species of international importance listed on the Amber List of conservation importance. The Icelandic 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 site do not qualify for Amber List status and are therefore considered to be Green List species.

D.1.43 Of particular note is the population of gadwall at the site with a maximum count of 61 individuals. However, gadwall was not present on all survey visits, which is indicative of the way waterbirds move along the River Thames to utilise foraging areas that are optimum on different days throughout the year.

D.1.44 Within the survey area, the intertidal foreshore is used for foraging and resting by gadwall, teal, mallard, black-headed gull, common gull, lesser black-backed gull, herring gull and great black-backed gull. The exposed mudflats and gravel shoals at low tide on and adjacent to the site attract this range of bird species. It is likely that the outfall adjacent to the site and the confluence of the River Thames with the Chelsea Creek provides high nutrient levels and foraging material in the water at this location. This in turn may increase the abundance of invertebrates and nutrient rich muds on which the waterbirds feed.

D.1.45 The gravel shoal and mudflat on site is exposed for a long period of time as the tide rises compared to adjacent foreshore areas due to the presence of an existing campshed on the foreshore. While other areas of

the foreshore are inundated, waterbirds are attracted to this area for resting.

Black redstart

D.1.46 Although there were opportunities for black redstart to nest and forage on and in close proximity to the site, the absence of black redstart observations indicates that this species does not currently use the site and the immediate surrounds for either 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].

Invertebrates

D.1.47 The river wall and jetty on and adjacent to the site does not support any notable species of invertebrates. This is likely to be associated with the inconsistent water quality at this location, caused by the outfall beneath the jetty.

Botanical

D.1.48 The river wall and jetty supports have cracks and crevices that could allow notable plants to grow. However, the river wall and jetty is at an outfall at this location and it is likely that the water quality is not consistently good enough for notable plants to grow.

Invasive plant species

D.1.49 Entire-leaved cotoneaster is an invasive plant species listed on Schedule 9, part II of the Wildlife and Countryside Act 1981 (as amended). This was included in the Schedule 9 list in 2010. Prior to this date, entire-leaved cotoneaster and many other cotoneaster species were commonly included in landscape planting scheme. At this site, the cotoneaster is present within an area of introduced shrubs in the south and west of the site.

References

[1] Brown, A. and Grice, P. *Birds in England*. Poyser, London (2005).

[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).

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.12**

Volume 12: Cremorne Wharf Depot appendices

Appendix E: Historic environment

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

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Thames Tideway Tunnel

Environmental Statement

Volume 12 Cremorne Wharf Depot appendices

Appendix E: Historic environment

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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 Vol 12 Table E.1 below, with their location shown on the historic environment features map (Vol 12 Figure 7.4.1, 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 12 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	Riverfront flood defences of post-medieval date from Chelsea Creek to Chelsea Wharf, recorded by the Thames Archaeological Survey in the 1990s.	FKN01 A110 MLO 70207 083832
1B	Lots Road Pumping Station. Grade II listed. Storm water pumping station in a Classical style. 1904 by London County Council Works Department under Chief Engineers Sir Alexander Binnie then Sir Maurice Fitzmaurice. Red and glazed brick with terracotta dressings and plaques. Slate roof.	1392309
1C	Counters Creek Sewer. Large red-brick arched sewer outlet with brick channel, running out of the river wall within the site and extending directly underneath Cremorne Pier into the Thames. This substantial feature has a brick base and sides topped with horizontal timber presumably to prevent damage from vessels loading and unloading. Possibly contemporary with, or pre-dating, the construction of Lots Road Pumping Station (1904), and possibly pre-dating the implementation of the Bazalgette scheme in the late 19th century.	---
1D	Site of campshed proposed for construction in 1937. It was not visible on the site visit carried out as part of the present assessment, and may have been obscured by foreshore silts.	---
2	Chelsea Wharf	

HEA Ref no.	Description	Site code/ GLHER ref/ List Entry Number
	Five storey former industrial warehouse dated 1894. Mansard roof with a terracotta name plaque below an oeil-de-boeuf central window, with the name 'CHELSEA WHARF'.	
3	Concrete riverside wall of post-medieval date recorded by Thames Archaeological Survey in the 1990s.	FWW11 A117
4	Lots Road. The findspot of Roman pot found by chance at this approximate location. Noted on the Greater London Historic Environment Record (GLHER).	MLO67580 083608 MLO10836 050292
5	Westbridge Road, Hyde Lane. The site of a medieval manor, recorded on the GLHER.	MLO542 031568
6	The GLHER notes the site of medieval meadows at this location, along with the findspot of a medieval ring found by chance.	MLO25994 106084 050623
7	A group of small eroded stakes (function unknown) identified on foreshore by Thames Archaeological Survey in the 1990s.	FKN01 A130
8	A layer of peat was recorded during the Museum of London Archaeology (MOLA) site walkover survey (with specialists from the Thames Discovery Programme) carried out in 2011 as part of the Thames Tideway Tunnel project. This is most likely related to a Neolithic peat layer found further to the north and is probably of the same date.	---
9	Town Meadows. The area is recorded as medieval meadows on the GLHER.	MLO40504 050623/07
10	Lots Road Pumping Station, Site B / Land at Thames Avenue Geotechnical boreholes monitoring by MOLA in 2002. The floodplain gravel was noted at c. 100.0m ATD (5–6m below present ground level), with peat/humic mud at between 99.0 and 101.0m ATD (5–7m below ground level/mbgl). Previous geotechnical boreholes showed that it falls to 98.0m ATD in the extreme south-eastern part of the site. The surface of the overlying alluvium was noted at 102.0m ATD.	LRP02
11	Chelsea Academy (former Lots Road School) MOLA evaluation in 2008. Eight trenches were excavated, revealing natural gravels overlain by horticultural soil, from 19th century allotments, along with truncation from 19th–20th century basements. In the SE of the site was a	CAU08

HEA Ref no.	Description	Site code/ GLHER ref/ List Entry Number
	deposit containing 17th–19th century finds with some residual (outside the context in which it was originally deposited) flint debitage (waste from flint knapping) of possible Mesolithic date. A small river channel was also recorded beneath by 19th/20th century dumping.	
12	Layer of clay with organic material/wood of possible post-medieval date recorded by the Thames Archaeological Survey in the 1990s.	FWW11 A110
13	Unclassified timber structure comprising one upright and two horizontal timbers forming a possible causeway of post-medieval date recorded by the Thames Archaeological Survey in the 1990s.	FWW11 A109 MLO71773 023216
14	Remains of a possible post-medieval causeway, recorded by the Thames Archaeological Survey in the 1990s.	FWW11 A103
15	Lots Road Power Station. Historic building recording in 2008. The power station was constructed between 1902 and 1904 and provided the electricity to power the London Underground system. The station was retained as a backup once the transfer of power went to the National Grid in the 1990s and was de-commissioned in 2002. The survey was followed by an geoarchaeological investigation by Archaeoscape in 2008. Seven boreholes revealed alluvium formed by slow moving water, and two thin layers of peat. One of the peat layers dated between the late Bronze Age and the middle Iron Age. The second peat layer dated to the Anglo Saxon period.	MLO100452 MLO100453
16	Unclassified post-medieval timber structure comprising vertical posts below existing Cremorne Pier recorded by the Thames Archaeological Survey in the 1990s.	FKN01 A107 MLO70200 083829
17	Two permanently submerged concrete obstructions recorded by acoustic sensor and digitised by Seazone.	6370000070 00993 4860000070 83523
18	Modern moored house boats and metal anchor recorded by the Thames Archaeological Survey at Old Ferry Wharf in the 1990s.	FKN01 A125 FKN01 A126
19	Unclassified submerged obstruction comprising a sailing budge rudder recorded by echo/sounder and digitised by	6370000011 06505

HEA Ref no.	Description	Site code/ GLHER ref/ List Entry Number
	Seazone.	
20	Battersea Reach. The site of a pontoon recorded by Seazone.	4860000061 47150
21	Battersea Reach. The site of a pontoon recorded by Seazone.	4860000061 47452
22	Battersea Reach. The site of a pontoon recorded by Seazone.	4860000061 47005
23	Battersea Reach. The site of a pontoon recorded by Seazone.	4860000061 49232
24	Battersea Reach. The site of a pontoon recorded by Seazone.	4860000061 46974
25	Modern drain recorded by the Thames Archaeological Survey in the 1990s.	FWW11 A113
26	Line of the Bazalgette Low Level Sewer.	---
27	Riverfront flood defences of post-medieval date from Chelsea Wharf to Chelsea Harbour, recorded by the Thames Archaeological Survey in the 1990s.	FKN01 A111 MLO70208 083833
28	Riverfront flood defences of post-medieval date at the end of Chelsea Harbour recorded by the Thames Archaeological Survey in the 1990s.	FKN01 A112 MLO70209 083834
29	Cremorne Wharf. The chance find of two Palaeolithic flint implements noted on the GLHER.	MLO12543 112057
30	Late 19th century river wall constructed projecting slightly into the Thames to support an industrial warehouse constructed on the site.	---
31	Cremorne Pier. Late 19th century industrial pier.	---
32	Thames Foreshore The approximate location of an early medieval spearhead recovered c. 250m south of the site and recorded by the Portable Antiquities Scheme (PAS).	LON-920814
33	Lots Road Power Station - The power station at Lots Road was originally planned by the Brompton and Piccadilly Circus Railway (now part of the Piccadilly line) in 1897. Construction started in 1902 and was completed in December 1904. At the time it was claimed to be the largest power station ever built, and it eventually powered	---

HEA Ref no.	Description	Site code/ GLHER ref/ List Entry Number
	most of the railways and tramways in the London Underground. It is characterised by four distinctive chimneys and brick work. The structure is undesignated, but because of its historic use, scale and prominence along the river frontage it is considered a heritage asset of medium significance.	
34	Cremorne Gardens - The existing undesignated Cremorne Gardens alongside the River Thames are a vestige of a larger garden opened to the public in 1845. The gardens are formed of modern hard standing and planting, offering commanding views across the river	---

E.2 Site location, topography and geology

Site location

E.2.1 The site is located on the north bank of the River Thames. It includes a council waste management depot with Cremorne Wharf and river wall. Lots Road borders the site to northwest; Chelsea Wharf and Cremorne Gardens lie to the northeast, Chelsea Creek lies c. 40m to the southwest. The foreshore of the River Thames lies immediately to the southeast. The site lies within the historic parish of St Luke, Chelsea, and formerly lay within the county of Middlesex.

Topography

E.2.2 The area is flat. Ground level on Lots Road adjacent to the site is at 105.5m ATD (above tunnel datum; the equivalent of 5.5m Ordnance Datum). The level of the foreshore beside the riverwall immediately adjacent to the site lies at 101.3m ATD, and drops down to the Thames at low tide at 98.5m ATD.

Geology

E.2.3 The site lies at the northern edge of the floodplain at the confluence of the Chelsea Creek and the River Thames. It is situated in an area of alluvial silts and clays overlying sand and gravel deposits[1]. The Kempton Park river terrace through which the river systems cut lies immediately northwest of the site[2].

E.2.4 A spread of borehole data exists around the site and across its southeastern part. These suggest the surface of gravel is irregular in this area. It lies at about 98.5m ATD (7.0m below ground level/mgbl) close to the southeastern boundary of the site[3], but rises to about 99.5m ATD (6.0 mbgl) beyond its western margin[4] and is absent beyond its northeastern boundary, where alluvium lies directly on London Clay bedrock, at c. 97.5m ATD[5]. The irregular surface is a result of river scour and deposition at the confluence of the Chelsea Creek and Thames, where multiple

shifting channels are likely to have existed in the Late Glacial and Early Holocene.

E.2.5 The gravels are overlain by alluvium comprising organic silty clays and peat. The surface of the alluvium lies at about 102.5m ATD[6] and the alluvial sequence is 3–4m thick. Boreholes from the site suggest the upper part of the alluvium could be variably truncated due to historic land use, and on the eastern boundary of the site all the alluvium and upper part of the underlying gravel has been removed (probably due to the construction of the existing Counters Creek sewer)[7]. On the foreshore beyond the southern boundary of the site, the alluvium is truncated to 100.2m ATD[8], where it has probably been eroded by the river.

E.2.6 Overlying the alluvium on the landward side of the river wall is made ground of around 3m thick (potentially deeper where there is localised truncation) up to current ground level. A considerable part of the 'made-ground' is infilling and ground-raising dumps associated with the late 19th century improvements to the riverfront.

E.2.7 The deposition of the organic silty clay over the gravels (and the marshy conditions which came to dominate the area over time) reflects a significant shift affecting the Thames catchment since the early Holocene (the last 10,000 years). Changes in relative sea-level rise (RSL) affected the Thames and its tributaries, which ultimately increased flood events leading to the periodic deposition of the silty clays across the floodplain. The irregular surface of gravel across the site will have led to a mosaic of wetland and dryland environments juxtaposed within the site in prehistory, although in general it appears that the southwestern part of the site might have lain on the edge of an island, which dipped into a channel beyond the northeastern boundary of the site.

E.2.8 Previous geoarchaeological investigations in the area (**HEA 10**) indicate that wherever sands and gravels exist above 99.5m ATD locally (which could be the case in the southwestern parts of the site) there is potential for recovering evidence of prehistoric (Mesolithic to at least early Iron Age) dryland activity. This evidence would be preserved below organic silty clay alluvial deposits laid down by flooding in late prehistory, which buried the earlier dry landsurface. In contrast, where the gravel surface lies below 99.0m ATD (as is likely to be the case elsewhere on the site and especially in the northeast), there is potential for the preservation of prehistoric organic remains and ecological evidence. Here organic, peaty sediments of Bronze Age and earlier date are likely to exist.

E.2.9 The varied wetland landscape of the site lay immediately adjacent to the river terrace, an area of higher, drier ground. It is in this type of location, adjacent to higher ground, that timber trackways of Bronze Age and occasionally Neolithic date have occasionally been found, especially further downstream (Sidell *et al.*, 2000)[9].

E.2.10 The organic and peaty nature of the alluvium recorded in the boreholes from the site suggests that palaeoenvironmental evidence might be obtained from plant remains, pollen and insects, which are likely to be well-preserved in these sediments. There is therefore likely to be good potential for past landscape reconstruction. In addition, deposit modelling,

based on the borehole data available for the site and its surroundings, might help to identify the distribution of wetland and dryland areas across the site.

E.3 Past archaeological investigations within the assessment area

E.3.1 The foreshore adjacent to the site and beyond was surveyed in the 1990s as part of the 'Alpha Survey' of the Thames Archaeological Survey (TAS). This revealed post-medieval riverfront flood defences from Chelsea Creek to Chelsea Wharf (**HEA 1A**), and an unclassified post-medieval timber structure comprising vertical posts below the existing Cremorne Pier (**HEA 16**) on the foreshore immediately outside the site. These features are still present. A number of additional features were identified during the site visit. An early 20th century arched outlet with brick channel (**HEA 1C**), associated with the Lots Road Pumping Station, was noted running out of the river wall directly underneath Cremorne Pier. In the foreshore area adjacent to the site, is the late 19th century Cremorne Pier (**HEA 31**).

E.3.2 Other than the foreshore survey, three small-scale archaeological investigations have been carried out within the assessment area in the past. Geotechnical borehole monitoring (**HEA 10**), c. 135m to the southwest of the site, and an evaluation (**HEA 11**), c. 170m to the west. recorded elements of ancient landsurfaces and floodplain deposits, as well as evidence of horticultural activity during the 20th century and several residual (outside the context in which they were originally deposited) early prehistoric finds.

E.3.3 Archaeological building recording was undertaken of the Lots Road Power Station (**HEA 15**), 60m to the southwest of the site, in 2008. This was followed by a geoarchaeological investigation which revealed alluvium formed by slow moving water and two thin peat layers. One of the layers, at 100.3m ATD, was dated to the Late Bronze Age and middle Iron Age. A second peat layer was dated to the Anglo-Saxon period.

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 Tideway Tunnel project, and the individual site-specific assessments, within a broader historic environment context (ie, 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 During the prehistoric an irregular and undulating gravel surface (a remnant topography of the late Glacial river system) existed across the

site. Dryland existed on outcrops of higher gravel, with a marshy wetland developing in the lower areas. Available borehole logs suggest higher ground in the southwest and a lower lying area particularly in the northeastern part. The marshland would have been rich in natural resources and would have been exploited by prehistoric people. As water levels rose in the late prehistoric, due to a rise in global sea level, the site would have become increasingly marshy and the outcrops of higher ground became isolated from the river terrace.

E.4.3 This area beside the confluence of the Chelsea Creek with the Thames would have provided rich natural resources, whilst the nearby high ground of the terrace would have provided a focus point for settlement/occupation.

E.4.4 Radiocarbon dating of samples taken from boreholes at Lots Road Power Station, on the floodplain c. 135m southwest (**HEA 10**) and c. 60m west respectively (**HEA 15**), has shown that the area became progressively waterlogged as the river level rose during the prehistoric period (Corcoran, 2002)[10]. This suggests a dry land-surface could have existed on outcrops of higher ground within the site, and particularly in its southwestern part until the early Iron Age, juxtaposed with a marshy wetland environment in the northeastern part of the site.

E.4.5 The Greater London Historic Environment Record (GLHER) records the chance finds of two redeposited Palaeolithic implements from the River Thames foreshore at Cremorne Wharf (**HEA 29**), 45m to the east of the site. An archaeological evaluation at Chelsea Academy (former Lots Road School), c. 170m west of the site (**HEA 11**) recorded a deposit containing re-deposited flint waste from tool manufacture, of possible Mesolithic date. Later prehistoric activity has been recorded 200m downstream of the assessment area, where a Neolithic wooden club, lithics and human remains dating to the Neolithic and Bronze Ages were recovered near the Chelsea Yacht Moorings, during the Thames Archaeological Survey of the foreshore in the 1990s (Corcoran, 2002)[11].

Roman period (AD 43–410)

E.4.6 The site lay some distance from known settlements, c. 6.2km to the southwest of the Roman city of *Londinium*, which was founded in the mid 1st century AD. A network of roads spread out from the city, and it is thought that one such road followed the line of the Kings Road, c. 400m to the north of the site, possibly to a river crossing in the area of Fulham, c. 2.5km to the southwest (Margary, 1967)[12]. The gravel terrace adjacent to the site would have been a rural landscape with a scatter of farmsteads, possibly used for farming.

E.4.7 By the Roman period a brackish water, seasonally flooded, wet meadowland / marsh environment probably existed across the entire site. This environment would have existed for much of the historic period. The area may have been to some extent drained and managed and exploited for a range of predictable resources.

E.4.8 The evaluation of the nearby Lots Road Power Station c. 170m west of the site (**HEA 11**) revealed that in the area to the west of the site, at the confluence of Chelsea Creek and in a similar environment, was situated in

a marginal wetland[13]. The only evidence of activity in the assessment area is residual Roman pottery from beside Chelsea Creek (**HEA 4**), c. 110m to the southwest.

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

E.4.9 The Roman administration of Britain collapsed in the early 5th century AD, and *Londinium* was largely abandoned. In London the trading port of *Lundenwic* developed in the area now occupied by Aldwych, the Strand and Covent Garden, 4.8km to the northeast of the site (Cowie and Blackmore, 2008)[14].

E.4.10 The site lay within the manor (estate) of Chelsea [*Chelcehithe*, *Cealchythe*], first mentioned in the Anglo-Saxon Chronicle, which records that a church synod was held there in AD 785; more were held there throughout the 8th and 9th centuries. King Alfred held a council at Chelsea in AD 899 (Victoria County History, 2004)[15]. Chelsea may have been a significant Royal estate, conveniently located for river access to the trading centre of London, and was close to the old Roman roads to west and southwest England. The original name possibly derives from the Old English for a landing place, possibly for chalk, stone or lime (Victoria County History, 2004)[16].

E.4.11 With the Danish invasions of the late 9th century, the old walled Roman city was reoccupied. The Saxon Minster system began to be replaced by local parochial organisation, with formal areas of land (parishes) centred on settlements served by a parish church. There is archaeological evidence of mid and late Saxon settlement, close to the Thames in the vicinity of Chelsea Old Church (Victoria County History, 2004)[17], (Farid, 2000)[18] c. 650m to the northeast of the site.

E.4.12 Towards the end of the period, references to manors, large landed estates which often formed the centre of local administration, begin to appear in documentary records. The manor (estate) of Chelsea was held at the end of the period by a woman called Wulfwynn; it included arable land, woodland and pasture (Williams and Martin, 1992)[19], (Victoria County History, 2004)[20].

E.4.13 Although there is clearly a Saxon settlement nucleus at Chelsea, this was on drier habitable ground to the northeast. There is no evidence for any Saxon activity close to the site, which would have been situated on the intertidal foreshore, some distance from the areas of known settlement. The adjacent gravel terrace was possibly cultivated or used for pasture. Two mid-Saxon fish traps have been recorded on the foreshore by the Thames Archaeological Survey, c. 200m downstream of the edge of the assessment area, and it is possible that the foreshore area of the site may have been used for fishing, although no evidence for such was found on the site walkover survey conducted as part of the present study. The Portable Antiquities Scheme (PAS) database records the finding of a spearhead dating to this period from the foreshore c. 250m south of the site (**HEA 32**).

Later medieval period (AD 1066–1485)

E.4.14 After the Conquest (AD 1066) the Chelsea manor (estate) was granted to Edward of Salisbury, and it is described in Domesday Book (1086) as including arable land to support five plough teams and nine tenants (Victoria County History, 2004)[21]. In the early 12th century the manor passed to Westminster Abbey, and was subsequently granted by the Abbey to a succession of tenants (Victoria County History, 2004)[22]. The church, close to the Thames on modern Cheyne Walk, c. 650m to the northeast of the site, is recorded in documents from AD 1157, and named as All Saints Church from AD 1290 (Victoria County History, 2004)[23]. The village which surrounded it remained the only known settlement nucleus in the parish until the 17th century. Old Church Street, then known as Church Lane, divided two large arable fields, Eastfield and Westfield (Victoria County History, 2004)[24].

E.4.15 The rural location close to Westminster attracted the nobility. In the years around AD 1300, a number of royal letters and orders were dated at Chelsea. During the 14th and 15th centuries an increasing number of landowners had occupations in the City or Westminster (Victoria County History, 2004)[25].

E.4.16 The terrace gravels adjacent to the site lay within common land of Westfield, and was used for arable cultivation. Throughout this period, prior to drainage and reclamation, the site would have been located on the foreshore, where there may have been a number of activities associated with the river, such as fishing (e.g. fishtraps).

E.4.17 Known later medieval sites or finds within the assessment area include the chance find of a medieval ring recovered from Chelsea Creek, c. 50m southwest of the site (**HEA 6**), and medieval meadows recorded in documentary sources and noted on the GLHER immediately to the north of the site (**HEA 9**).

Post-medieval period (AD 1485–present)

E.4.18 The floodplain and intertidal marshes at the confluence of Chelsea Creek and the Thames were drained and reclaimed during this period, for meadow and improved pasture. Across the open fields of Chelsea there was a great expansion of market gardening between the 17th and 19th centuries, in order to supply agricultural produce, formerly imported into London from further afield, to the growing London market. By 1600 garden crops were being grown closer to the city, particularly in the south-western parishes of Middlesex, where the easily cultivated gravels together with use of dung from London made intensive commercial cultivation of vegetable crops possible (Victoria County History, 2004)[26].

E.4.19 From at least the early 17th century the cultivation of root and other garden crops alongside traditional arable crops such as wheat and barley ensured that Chelsea's open fields survived far longer than those in other parishes around London. By the early 18th century a number of farmsteads had been built in the area, in connection with market gardening.

E.4.20 Hamilton's map of Chelsea of 1717 (Vol 12 Plate E.1) is a small scale map that shows the site and the surrounding area. The site is shown in open fields of reclaimed marsh, annotated as West Field. The surrounding area is sparsely populated and no buildings are shown in proximity of the site.

E.4.21 Rocque's map of 1756 (Vol 12 Plate E.2) shows the site within the reclaimed marshland close to the river and bounded by trees or a hedge, which later marks the line of Lots Road. The area to the west of the site is shown as extensive market gardens. The map shows a group of buildings to the north and northwest of the site. These are Chelsea Farm and Ashburnham House and Cottage, which are annotated on later maps. Ashburnham House was built on former garden ground by Dr Benjamin Hoadley in c. 1750. It was bought in 1767 by John Ashburnham 2nd Earl of Ashburnham. Chelsea Farm, located to the southwest of Ashburnham House, was built in 1745 for the Earl of Huntingdon. It remained a suburban country house until the 1820s, acquiring the name Cremorne House from Thomas Dawson, Lord Dartrey and Viscount Cremorne, its owner from 1778 to 1812 (Victoria County History, 2004)[27]. Chelsea Farm was often visited by King George III, Queen Charlotte, and the Prince of Wales. In 1825 the house and grounds were much improved (Chelsea: Cremorne Gardens,1878)[28].

E.4.22 Greenwood's map of 1827 (Vol 12 Plate E.3) is small scale but more detailed that earlier maps, and shows the site within reclaimed open marshland bounded by trees along Lots Road and also apparently along the top of the river embankment. The map shows Chelsea Farm to the northwest (outside) of the site and a building probably representing Ashburnham House to the north-west (outside) of the site. The configuration of buildings and the 'Chelsea Farm' label are not accurately represented and differ from the later Stanford map of 1862 (see Section E.4.23). Lots Road is shown for the first time along the northwestern boundary of the site. To the north of the road are landscaped gardens. In 1832, these were opened as 'Cremorne Stadium' by Charles Random de Berenger, formed out of an earlier estate of Cremorne House and Cremorne Farm (Weinreb and Hibbert, 2008)[29]. The sporting club did not prove profitable and in the 1840s, under new management, it became 'Cremorne Gardens' and was turned into an amusement park that could accommodate 1500 people, with a hotel, banqueting hall, theatre, grottos, pagodas and halls. The grand entrance was on Kings Road on the north side. The gardens were enormously popular, but eventually were blamed for vice and disorder in the neighbourhood and generally lowered the attraction of the area as a residential one (Victoria County History, 2004)[30].

E.4.23 Stanford's map of 1862 (Vol 12 Plate E.4) shows the site as open ground on the marshes, with no buildings. The map shows the original Chelsea Farm building, now incorporated into Cremorne Gardens to the north of the site. Ashburnham House is shown to its west, northwest of the site, and a third building further to its west is now annotated as Chelsea Farm.

E.4.24 In 1865, the lessee of Cremorne Gardens, TB Simpson, bought the freehold of much of the area, with a view to building. By 1866, three

terraces of houses on the south side of Lots Road, retaining access to the land behind stretching to the river. By his death in 1872 Simpson had built 18 houses at a cost of £18,000, and £2,000 for embanking the Cremorne frontage, £3,150 for sewers, £500 to the Thames Conservancy for the privilege of embanking, and another £1,500 for erecting two piers. In 1876 his widow Jane sold land between Lots Road and the Thames to John Bennett Lee and George Hervey Chapman, London timber merchants, on which Cremorne Wharf was built, and part was sold to the vestry for a pumping station the following year (Victoria County History, 2004)[31].

E.4.25 The Ordnance Survey 1st edition 25" mile map of 1862–95 (Vol 12 Plate E.5) shows the site straddling the river wall with the Thames foreshore (annotated 'mud') to the east of the site. On the landward side of the river wall, there is a row of terraced houses fronting onto Cremorne Road (now Lots Road), in the northwestern part of the site, and a large yard and rectangular building labelled 'Saw Mill' in the central part of the site. The majority of the site is open yard. Immediately north of (outside) the site is a maze, which forms part of the extensive landscaped Cremorne Gardens, which lie mostly on the north side of Cremorne Road.

E.4.26 The Ordnance Survey 2nd edition 25" mile map of 1896–98 (Vol 12 Plate E.6) shows substantial new development within the site and the vicinity. Cremorne Gardens is no longer shown (after its brief success, the gardens were closed in 1877). The surrounding area has been developed with a network of residential streets with rows of terraced housing. The riverfront has a distinctly industrial character, with a series of wharves and piers. The site is now 'Cremorne Wharf'. The saw mill and terraced housing are still present, but much of the open yard has been infilled with warehouses and industrial buildings. Parallel to the river wall on the landward side is a linear feature marked as a travelling crane on later maps. A large pier (**HEA 31**) extends across the foreshore 'mud' to the river. Chelsea Vestry Wharf lies immediately southwest of the site and Durham Wharf immediately northeast.

E.4.27 The Ordnance Survey 3rd edition 25" mile map of 1909–1920 (Vol 12 Plate E.7) shows the existing Lots Road Pumping Station building (**HEA 1B**) in the north-western part of the site. It is also shown on an air photograph of the site (Vol 12 Plate E.13). The construction of the building in 1904, entailed demolition of the row of terraced houses fronting onto Lots Road. Some of the Cremorne Wharf buildings in the north of the site have been demolished and replaced with a new structure, leaving a larger open yard in the centre. The Cremorne Wharf works building in the southern part has been slightly altered. The map marks M.P.s at the end of the pier, which presumably refers to mooring posts.

E.4.28 Archive plans held by Thames Water[32] show the extent of the pumping station works in plan following modification to increase pumping power in 1931 (Vol 12 Plate E.10). A section drawing shows the considerable depth of the basement and below ground infrastructure (Vol 12 Plate E.11).

E.4.29 The Ordnance Survey revised edition 25" mile map of 1947 (Vol 12 Plate E.8) shows a few minor changes within the site, comprising the addition of a smaller building to the western wharf complex as well the pumping

station. By this time a campshed (**HEA 1D**) had been constructed on the foreshore in front of the site (Vol 12 Plate E.14). A plan approved by the Port of London Authority shows the proposals for the campshed, which included dredging of the foreshore area, small piles and planking at the front of the levelled area.

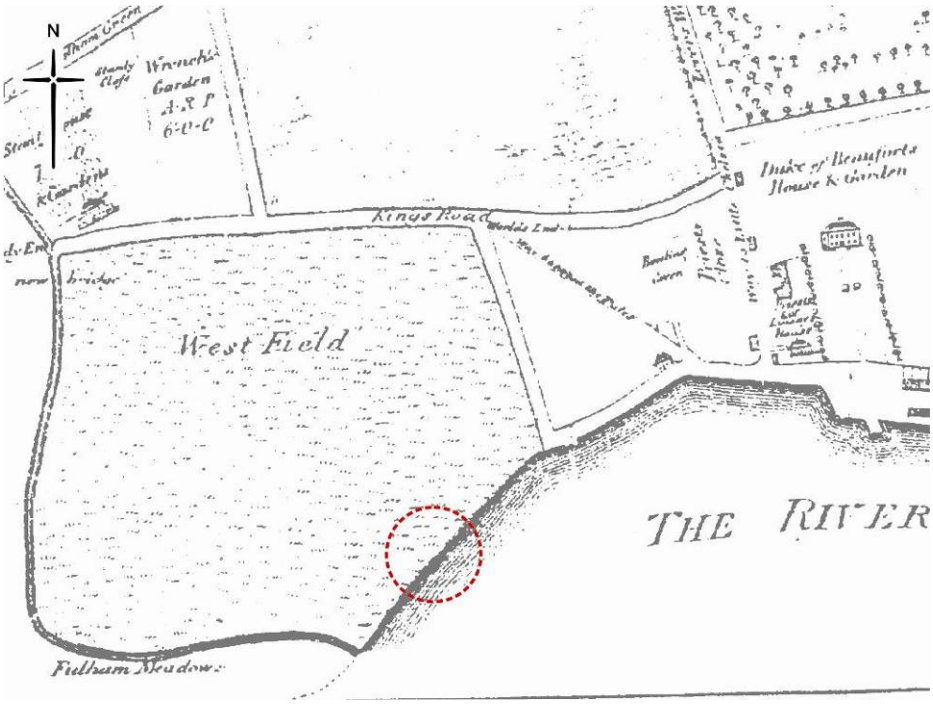
E.4.30 The Ordnance Survey 25" mile map of 1980–90 (Vol 12 Plate E.9) shows considerable change within the site, reflecting development in the 1970s, when the Cremorne Works were demolished and the open area in the central part of the site was used as a council refuse tip, accessed with semicircular ramps.

The current site

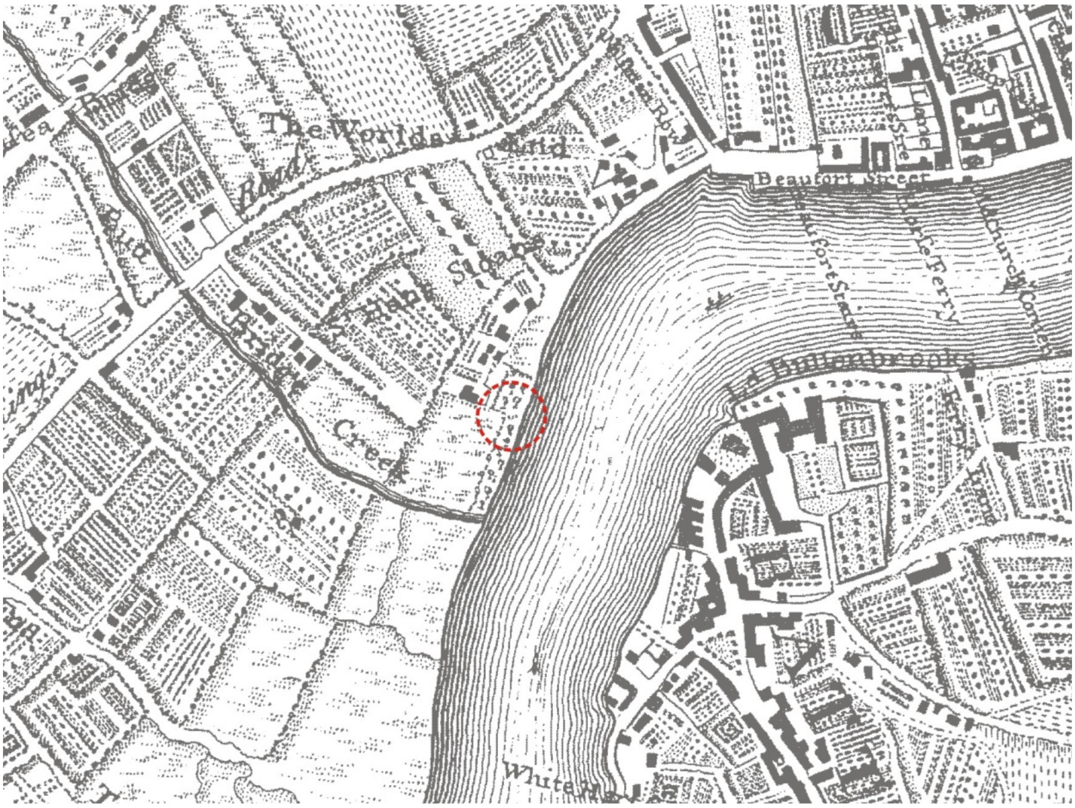
E.4.31 Subsequent development on the site includes the construction of a large shed associated with the waste management depot in the centre of the site, and an electricity substation in the southwestern part of the site. Cremorne Wharf itself is currently a safeguarded wharf, designated for waste management which includes rocksalt storage. Vol 12 Plate E.12 shows the existing early 20th century Lots Road Pumping Station. Vol 12 Plate E.15 shows the river wall and existing council refuse centre in the site, with Cremorne Pier (**HEA 31**) and the Chelsea Wharf building (**HEA 2**) beyond (the latter both outside the site). Vol 12 Plate E.16 and Vol 12 Plate E.17 are photographs of the Counter Creek sewer outlet (**HEA 1C**).

E.5 Plates

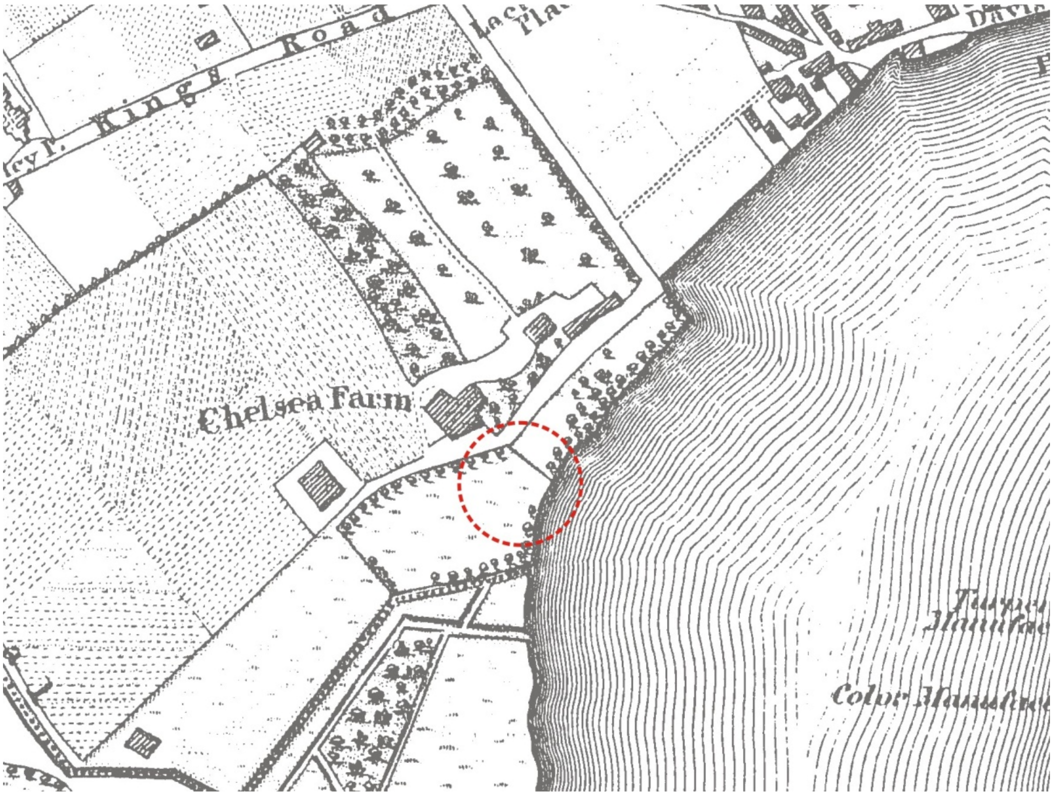
Vol 12 Plate E.1 Historic environment – Hamilton's map of Chelsea of 1717



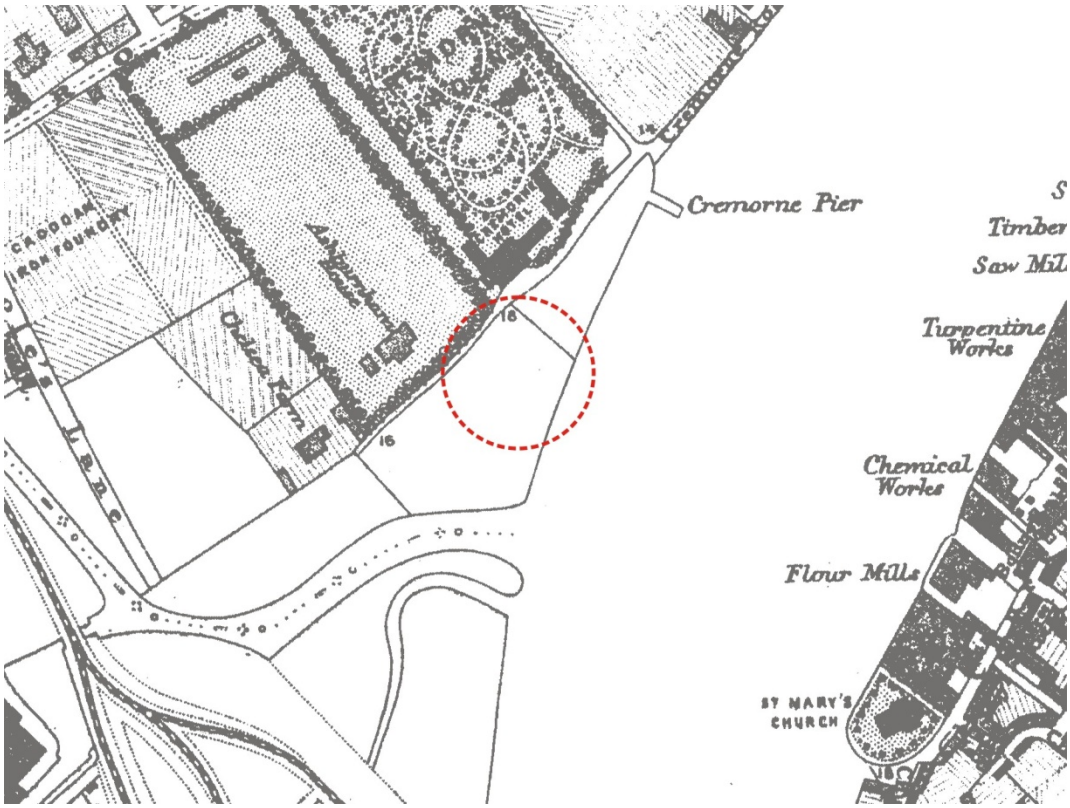
Vol 12 Plate E.2 Historic environment - Rocque's map of 1756



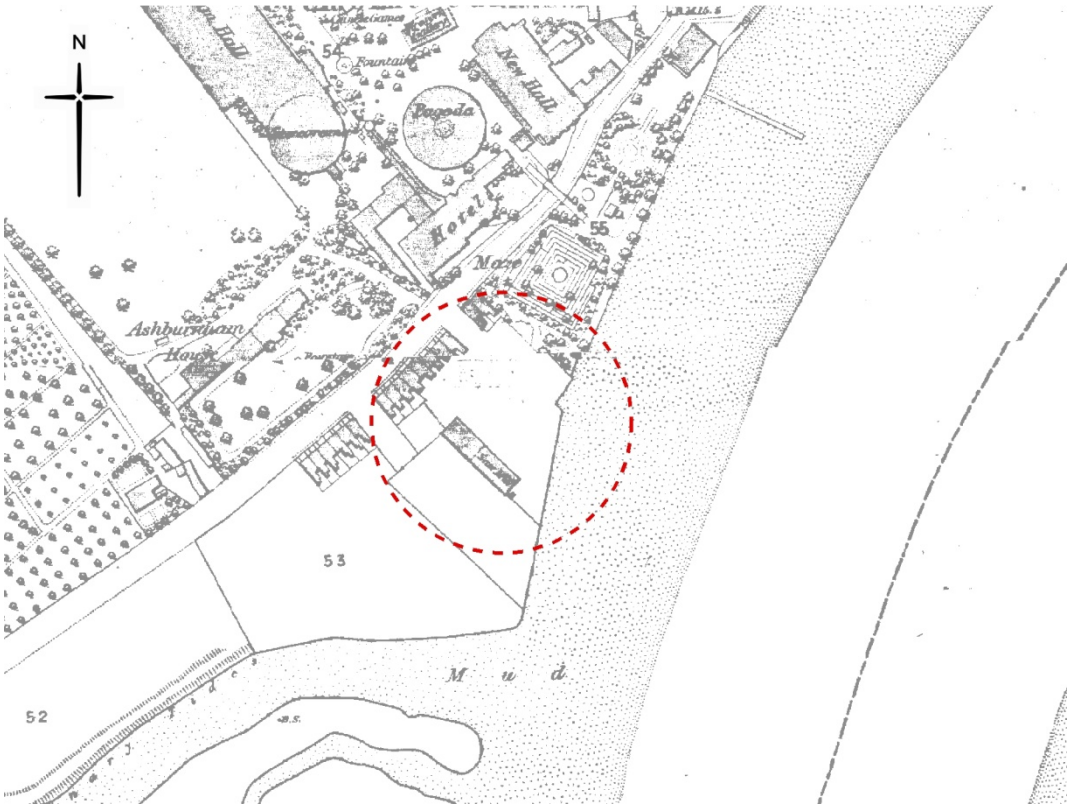
Vol 12 Plate E.3 Historic environment - Greenwood's map of 1827



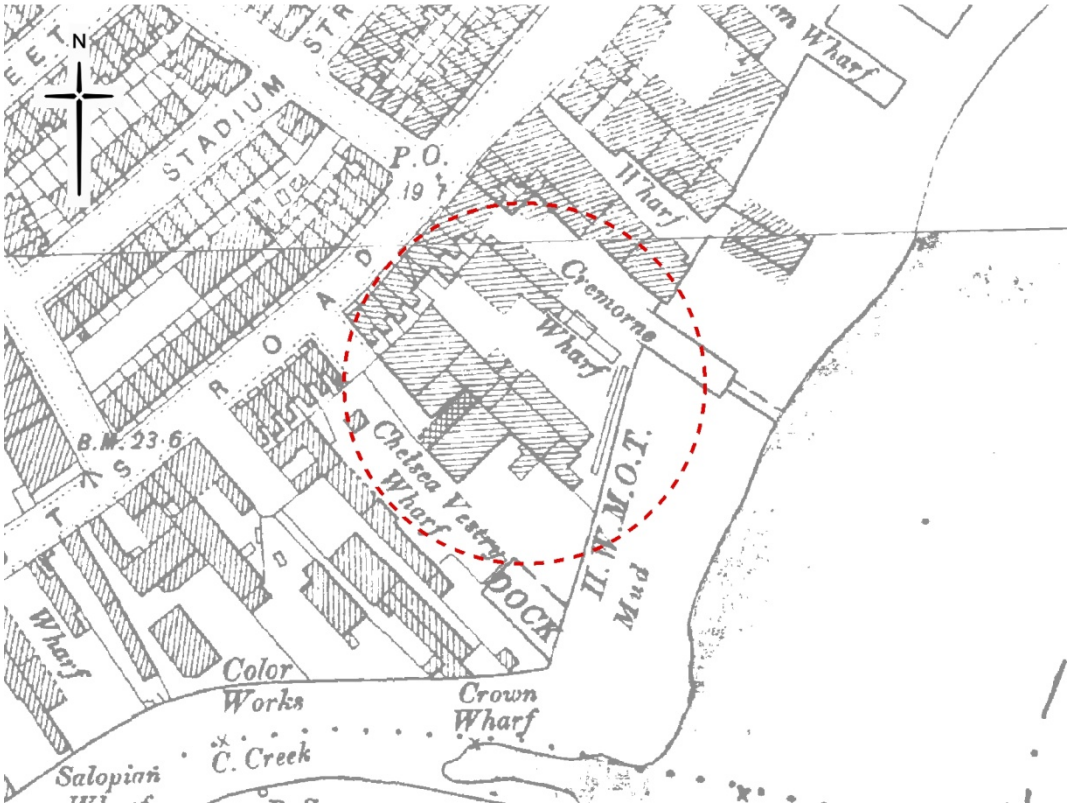
Vol 12 Plate E.4 Historic environment - Stanford's map of 1862



Vol 12 Plate E.5 Historic environment - OS 1st edition 25" mile map of 1862–95 (not to scale)

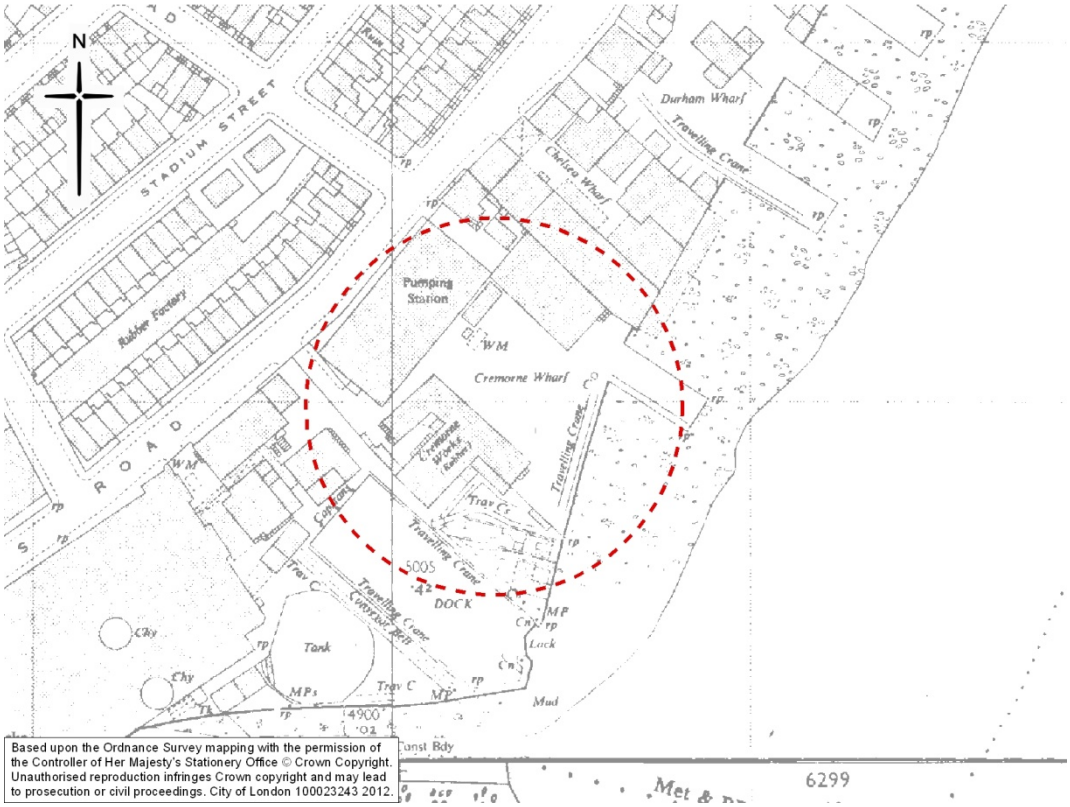


Vol 12 Plate E.6 Historic environment - OS 2nd edition 25" mile map of 1896–98 (not to scale)

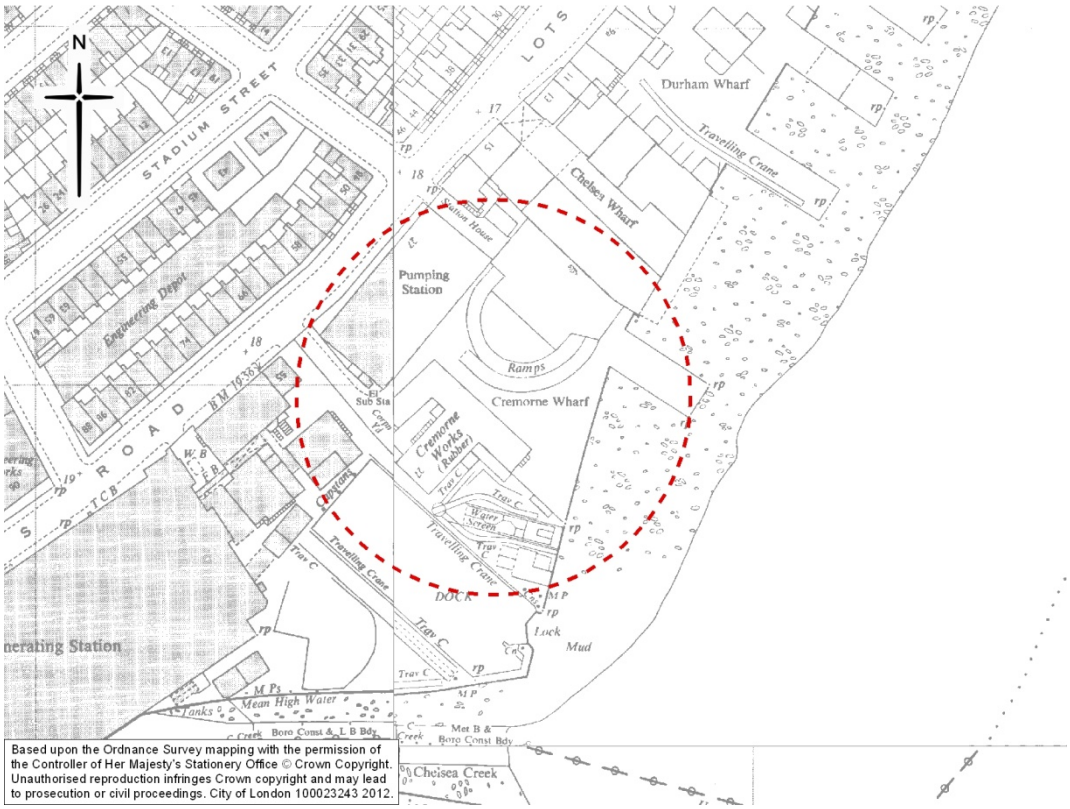


Vol 12 Plate E.7 Historic environment - OS 3rd edition 25" mile map of 1909–1920 (not to scale)

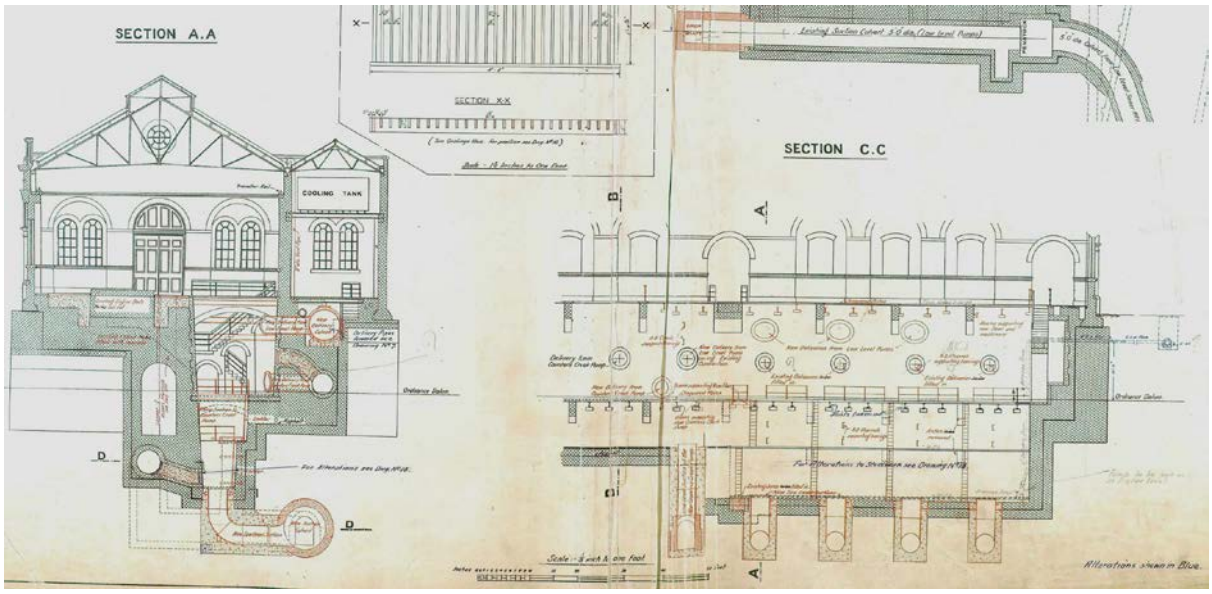
Vol 12 Plate E.8 Historic environment - OS revised edition 25” mile map of 1947 (not to scale)



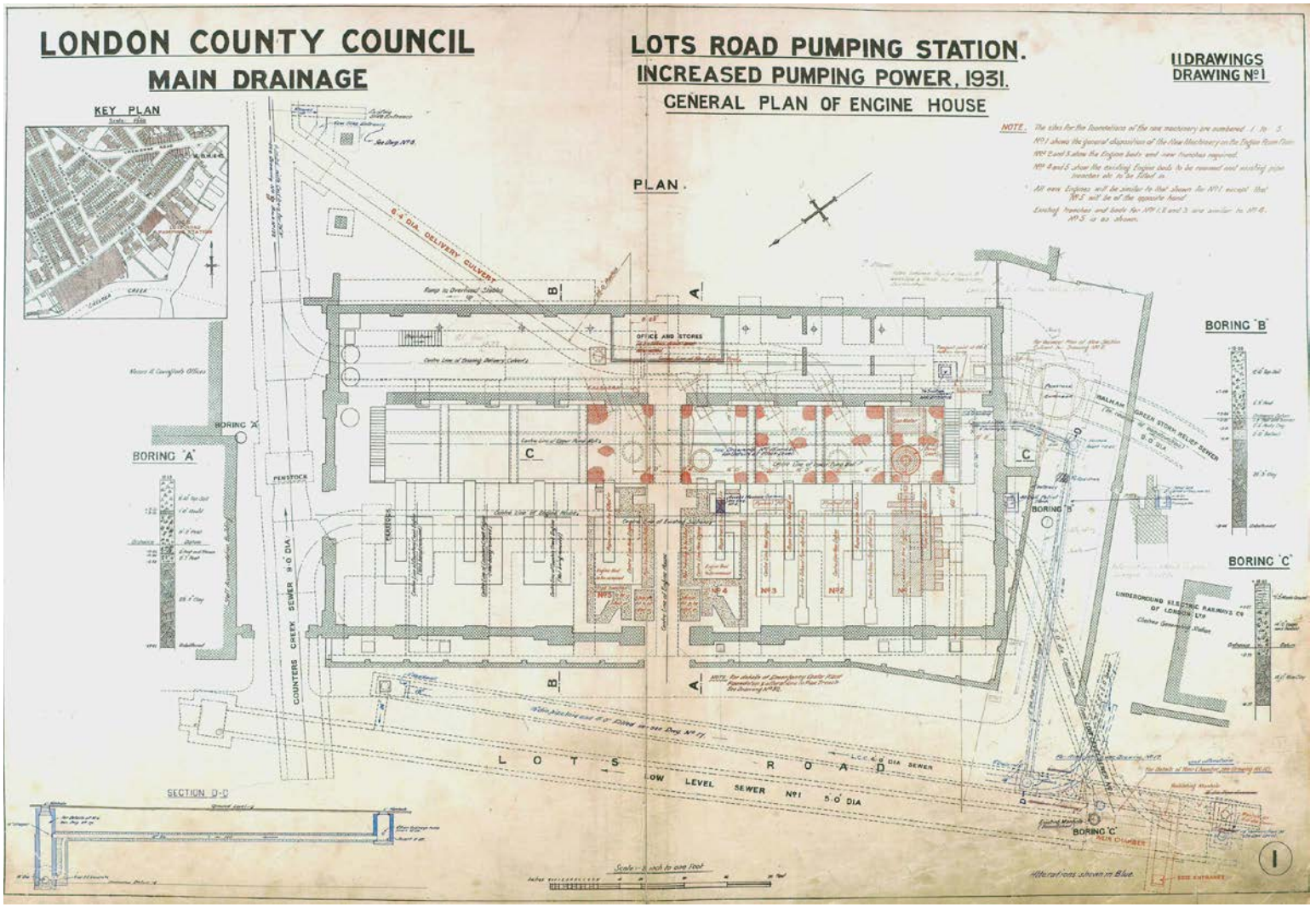
Vol 12 Plate E.9 Historic environment - OS 25” mile map of 1980–90 (not to scale)



Vol 12 Plate E.10 Historic environment – 1931 section through the Lots Road Pumping Station showing the depth of the basement. Thames Water 'Abbey Mills Books' Book 29A: Lots Road Increased Pumping Power Works As Executed 1931



Vol 12 Plate E.11 Historic environment – plan of Lots Road Pumping Station. Thames Water 'Abbey Mills Books' Book 29A: Lots Road Increased Pumping Power Works As Executed 1931

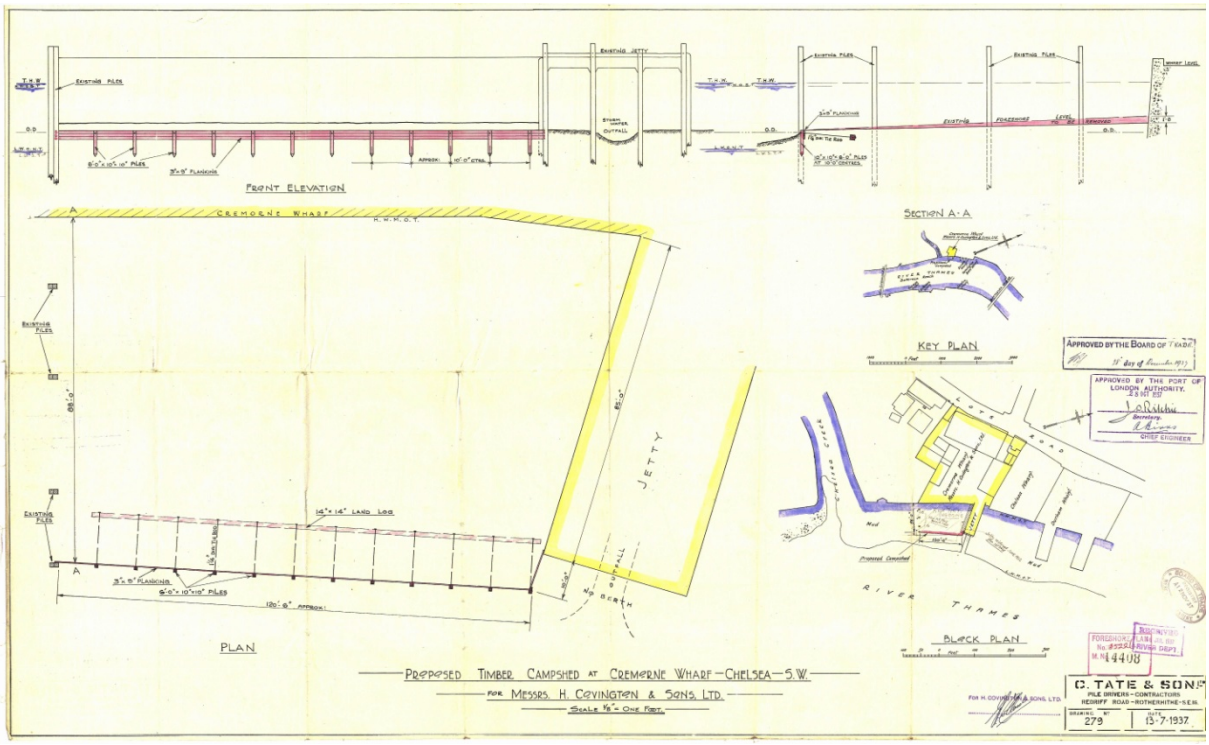


Vol 12 Plate E.12 Historic environment - North elevation of the Lots Road Pumping Station.

**March 2011; standard lens, corner of Ashburnham Road and Lots Road looking southwest (MOLA 2011)*

Vol 12 Plate E.13 Historic environment – Air photograph showing the site in the first quarter of the 20th century.

Vol 12 Plate E.14 Historic environment – archive plan dated to 1937 showing the-then approved proposals to construct a campshed (HEA 1D) on the foreshore in front of the site.



Vol 12 Plate E.15 Historic Environment – view north of foreshore and river wall, and the waste management depot within the site. Cremorne Pier (HEA 31) is visible and Chelsea Wharf building (HEA 2) beyond.

**March 2011; standard lens, looking north (MOLA 2011)*

Vol 12 Plate E.16 Historic Environment - view of red–brick sewer outlet directly underneath Cremorne Pier (HEA 1C).

**March 2011; standard lens, looking northwest (MOLA 2011)*

Vol 12 Plate E.17 Historic Environment - view of red–brick sewer outlet and apron (HEA 1C) directly underneath the safeguarded pier (HEA 31)

**March 2011; standard lens, looking northwest (MOLA 2011)*

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[4] Thames Water borehole ref.BHN310 (NGR: 532780/180494).

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.12**

Volume 12: Cremorne Wharf Depot appendices

Appendix F: Land quality

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

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Thames Tideway Tunnel

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Thames Tideway Tunnel

Environmental Statement

Volume 12 Appendices: Cremorne Wharf Depot site assessment

Appendix F: Land quality

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Appendix F: Land quality

F.1 Baseline report

F.1.2 Baseline data is sourced from:

a. walkover survey

b. the Landmark Information Group database, including historic maps and environmental reports

c. stakeholder consultation

d. the initial results from a preliminary intrusive ground investigation.

Site walkover

F.1.1 A site walkover survey of Cremorne Wharf Depot was undertaken on 9th November 2010.

F.1.2 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.1.3 The proposed development site is located on Cremorne Wharf and is currently occupied by an existing Royal Borough of Kensington and Chelsea (RBKC) waste management depot, the safeguarded Wharf, the Lots Road Pumping Station and an area of the River Thames foreshore.

F.1.4 Much of the site is covered by buildings, including a steel clad warehouse, and the brick built pumping station, which is a Grade II listed building. An existing jetty is located on the foreshore in the northeast corner of the site. The remainder of the site is entirely hard surfaced.

F.1.5 The waste facility accepts dry recycling for bulking prior to onwards transmission to a materials recovery facility outside of the borough.

F.1.6 Cremorne Wharf is currently designated a safeguarded wharf, which requires that it remains as a working wharf.

F.1.7 The surrounding area is characterised as suburban residential with pockets of commercial properties. The river frontage is primarily industrial / mixed use with vacant warehouses and Lots Road Power Station, a disused coal and later oil-fired power station, in close proximity to the proposed worksite.

F.1.8 Directly to the west of proposed site lies a vacant area of hardstanding and an electricity substation, which both form part of the wider Lots Road Power Station.

F.1.9 Detailed site walkover notes are provided in Vol 12 Table F.21 below

Vol 12 Table F.2 Land quality – site walkover report

Item Site ref (PKC3X, Cremorne Wharf Depot)		Details
Date of walkover	9th November 2010	
Site location and access	The proposed work site is located adjacent to the foreshore of the River Thames adjacent to Cremorne Gardens, Lots Road, Kensington. On the site of the Lots Road Pumping Station and council waste management depot. Site observed from Cremorne Gardens.	
Size and topography of site and surroundings	Record elevation in relation to surroundings, any hummocks, breaks of slope etc.	The foreshore area is separated from the gardens and adjacent Lots Road by the river wall. The foreshore site is relatively wide and comprised of mudflat and gravel. There is a jetty located in the northeast area of the site. The site is currently developed, the hardstanding is relatively flat.
Neighbouring site use (in particular note any potentially contaminative activities or sensitive receptors)	North	Residential properties are located to the north and northwest of the site. Chelsea Wharf, which comprises a number of multi-storey buildings, is located adjacent to the northeast. Cremorne Gardens and Cremorne Riverside Activity Centre are located to the northeast of the site.
	South	Lots Road Power station is located southwest of the site. The River Thames and Chelsea Creek are located southeast. Chelsea Academy is located southwest of the site.
	East	River Thames borders the eastern edge of the site.
	West	To the southwest of proposed site is a vacant cleared area of hardstanding and an electricity substation. The surrounding area is largely residential with pockets of commercial properties.
Site buildings	Record extent, size, type and usage. Any boiler rooms, electrical switchgear?	The Lots Road Pumping Station and council waste management depot which is no longer open to the public.
Surfacing	Record type and	Hardstanding on-site and mudflats

Item Site ref (PKC3X, Cremorne Wharf Depot)		Details
	condition	and gravels within the foreshore.
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
	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 on-site	Record locations, tanks and inspection pits etc.	None observed
Waste generated/stored on-site	Adequate storage and security? Fly tipping?	Cremorne Wharf Depot has a jetty located on site which is used for storage of recycling bins
Surface water	Record on-site or nearby standing water	River Thames and Chelsea Creek
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	None observed

Item Site ref (PKC3X, Cremorne Wharf Depot)		Details
	ground, seepage of liquids, strong odours?	
Summary of potential contamination sources		Recycling storage bins, waste management depot
Any other comments	Eg access restrictions/ limitations	No

Review of historical contamination sources

F.1.10 Historical mapping (dated between 1896 and 1988) has been reviewed in order to identify potentially contaminating land-uses at the site and within the 250m assessment area.

F.1.11 Vol 12 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)[1] and former Department of the Environment industry profiles (Department of the Environment, 2011)[2].

F.1.12 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.1.13 Items listed in Vol 12 Table F.2 below are also shown on Vol 12 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 12 Appendix E.

Vol 12 Table F.3 Land quality – potentially contaminating land-uses

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item1,2
On-site			
1	Wharf	c1896-present	Heavy metals, arsenic, asbestos, phenols, oil/fuels, hydrocarbons, poly aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), sulphides, sulphates, chlorinated aromatic hydrocarbons, chlorinated aliphatic

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item1,2
			hydrocarbons
2	Rubber works	c1951-c1988	Zinc, sulphur, sulphides
3	Sewage pumping station	c1951-c1988	Heavy metals, arsenic, nitrates, sulphates, sulphides, asbestos, oil/fuel hydrocarbons, chlorinated aliphatic hydrocarbon, chlorinated aromatic hydrocarbons, PCBs, pathogens (eg, faecal coliforms)
4	Refuse tip/recycling centre	c1988-present	Heavy metals, arsenic, sulphate, sulphide, asbestos, oil/ fuel hydrocarbons, chlorinated aliphatic hydrocarbons, PCBs
Off-site			
5	Dock (185m southwest)	c1896	Heavy metals, arsenic, asbestos, phenols, oil/fuels, hydrocarbons, PAHs, PCBs, sulphides, sulphates, chlorinated aromatic hydrocarbons, chlorinated aliphatic hydrocarbons, hexachlorocyclohexane
6	Colour works (70m southwest)	c1896	Heavy metals, boron, asbestos, nitrate, sulphate, phenol, acetone, oil/fuel hydrocarbons, aromatic hydrocarbons, chlorinated aliphatic hydrocarbons, dieldrin, PCBs
7	Lots Road Power Station (former coal and oil fuelled facility) (55m southwest)	c1904-c2002 (operational period)	Heavy metals, arsenic, selenium, sulphates, sulphides, asbestos, oil/fuel hydrocarbons, PAHs, chlorinated aliphatic hydrocarbons, PCBs

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item1,2
8	(a) Garages x2 (40m west and 80m southwest)	c1916-c1951 and c1956	Heavy metals, asbestos, total petroleum hydrocarbons (TPHs), aromatic hydrocarbons, PAHs, chlorinated aliphatic hydrocarbons
	(b) Engineering works (80m southwest)	c1956	Heavy metals, arsenic, boron, nitrates, sulphates, sulphides, asbestos, aromatic hydrocarbons, chlorinated aliphatic hydrocarbons, PCBs
9	Dock (adjacent south)	c1920-c1951	Heavy metals, arsenic, asbestos, phenols, oil/fuels, hydrocarbons, PAHs, PCBs, sulphides, sulphates, chlorinated aromatic hydrocarbons, chlorinated aliphatic hydrocarbons, hexachlorocyclohexane
10	Tank (25m south)	c1920-c1951	Contents unknown
11	Goods sheds, cranes and moorings (85m south)	c1951-c1988	Heavy metals, arsenic, asbestos, phenols, oil/fuels, hydrocarbons, PAHs, PCBs, sulphides, sulphates, chlorinated aromatic hydrocarbons, chlorinated aliphatic hydrocarbons
12	Ashburnham Depot (130m southwest)	c1951	Heavy metals, asbestos, TPHs, aromatic hydrocarbons, PAHs, chlorinated aliphatic hydrocarbons
13	(a) Rubber factory (40m west)	c1951-c1956	Zinc, sulphur, sulphides
	(b) Engineering depot (40m west)	c1956	Heavy metals, asbestos, TPHs, aromatic hydrocarbons, PAHs, chlorinated aliphatic

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item1,2
			hydrocarbons
14	Garage (150m northwest)	c1951	Heavy metals, asbestos, TPHs, aromatic hydrocarbons, PAHs, chlorinated aliphatic hydrocarbons
15	Engineering works (160m northwest)	c1951	Heavy metals, arsenic, boron, nitrates, sulphates, sulphides, asbestos, aromatic hydrocarbons, chlorinated aliphatic hydrocarbons, PCBs
16	Tanks (140m southwest)	c1956-c1987	Contents unknown
17	Print works (105m southwest)	c1956	Heavy metals, arsenic, selenium, acetone, asbestos, aromatic hydrocarbons, chlorinated aliphatic hydrocarbons, PCBs
18	Asphalt works (160m south)	c1988	Heavy metals, arsenic, sulphides, asbestos, acetone, oil/fuel hydrocarbons, PAHs, PCBs
19	Coal yard (245m south)	c1988	Heavy metals, arsenic, hydrocarbons

On-site

F.1.14 The historical mapping identifies a number of previous on-site land-uses that could be regarded as potentially contaminating, notably a rubber works, the Lots Road Pumping Station and a wharf area. More recently the site has been utilised as a waste management depot.

Off-site

F.1.15 Within the 250m assessment area, the historical mapping shows numerous industrial and commercial activities, most notably the presence of fuel tanks and pumps (the closest of which is located 25m to the south of the site), and a power station and wharves present since the late 19th Century.

Geology

F.1.16 Data from the Thames Tideway Tunnel project ground investigation indicates anticipated geological succession, as summarised in Vol 12 Table F.3 below. The table below differs from the anticipated geology presented in the groundwater main report and appendix. This is because the groundwater geology has been derived from overwater boreholes where no made ground would be found.

Vol 12 Table F.4 Land quality – anticipated site geology

Geological unit / strata	Description	Approximate depth below ground level (m)
Made Ground	Brown slightly silty gravelly sand with occasional cobbles. Gravel is subangular and subrounded fine to coarse of flint, brick, concrete and tile.	0.0-6.6
River Terrace Deposits	Medium dense to dense sand and gravel (predominantly quartz sand and flint gravel).	6.6-8.7
London Clay Formation	Fissured grey clay that weathers to a chocolate brown. Locally with pockets of selenite crystals (gypsum).	8.7-40.0
Harwich Formation	Sand and shelly sandstone	40.0-40.1
Lambeth Group (Upper Shelly Beds)	The Upper Shelly Beds is mainly a grey shelly clay, occasionally sand and shelly limestone.	40.1-41.6
Lambeth Group (Upper Mottled Beds)	The Lower and Upper Mottled Beds are mottled or multicoloured, stiff or very stiff fissured clay, compact silt, and dense or very dense sand.	41.6-46.3
Lambeth Group (Laminated Beds/Lower Shelly Beds)	The Laminated Beds consist of thinly interbedded fine- to medium-grained sand, silt and clay, with locally more extensive sands and thin shell and lignite beds.	46.3-48.6
Lambeth Group Lower Mottled Beds)	The Lower Shelly Clay is a dark grey to black clay with abundant shells, sometimes Shelly sand. Where shells predominate, thin limestone bands are formed.	48.6-56.2
Lambeth Group (Upnor Formation)	The Upnor Formation comprises dense silty glauconitic sand with bands of rounded black pebbles.	56.2-60.0
Thanet Sand Formation/Bullhead beds	Generally dense glauconitic silty fine sand with occasional rounded flint gravel. Bullhead Beds mark the bottom of the	60.0-70.5

Geological unit / strata	Description	Approximate depth below ground level (m)
	formation and comprise gravel and cobbles of flint.	
Chalk Group	Weak fine grained limestone with nodular and tabular flints.	70.5-unproven

Unexploded ordnance

F.1.17 During World Wars 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.1.18 A desk based assessment for UXO threat was undertaken by 6 Alpha Associates Limited at the Cremorne Wharf Depot site (see Vol 12 Appendix F.3).

F.1.19 The assessment covered two areas within the Cremorne Wharf Deport site. Area A (land aspect of the main work area) and Area B (foreshore and river of main work area). The report reviews information sources such as the Ministry of Defence (MoD), Public Records Office and the Port of London Authority (PLA).

F.1.20 The report advises that no high explosive bomb strikes were recorded as occurring within Area A or Area B. In addition, three were recorded within the buffered site boundary and a further five within 100m of the buffered site boundary.

F.1.21 Since WWII there have been redevelopment activities within Area A and these activities may have led to the removal of UXO items. No such activity has taken place within Area B.

F.1.22 Taking into account the findings of this study and the known extent of the proposed works, it was considered that there is an overall low/medium threat from UXO associated with works at Area A, and a high threat from UXO associated with Area B.

Thames Tideway Tunnel ground investigation data

F.1.23 This section summarises the preliminary ground investigation undertaken by the Thames Tideway Tunnel project.

F.1.24 One borehole was drilled just inside the northern boundary of the Cremorne Wharf Depot site (borehole reference SA1098), and a second was drilled approximately 60m to the northeast of the site (SA1097), as shown on Vol 12 Figure F.1.2 (see separate volume of figures).

F.1.25 Vol 12 Figure F.1.2 (see separate volume of figures) also identifies a number of other boreholes excavated in the vicinity of the site. These are not considered relevant, either due to their distance from the proposed shaft location or because certain boreholes were excavated purely for geotechnical purposes.

F.1.26 Additional ground investigation within the site boundaries is programmed for completion at the site during 2012 as shown on Vol 12 Figure F.1.2. Results of the investigation will be reported as part of contamination assessment works to support the development consent application.

Soil contamination testing

F.1.27 Eleven soil samples were taken from the Made Ground and River Terrace deposits encountered between 0.4m and 7.2m depth and sent for laboratory analysis.

F.1.28 Samples were tested for a range of common contaminants including heavy metals and metalloids, PAHs, TPH, VOCs, cyanide and soil quality parameters such as pH and organic matter content.

F.1.29 The testing recorded no contaminants above light industrial/commercial human health screening values (Defra/EA, 2009)[3] (Land Quality Management / Chartered Institute of Environmental Health, 2009)[4] with the exception of a single sample of Made Ground (at 2m depth) which was found to have an elevated concentration of the PAH compound benzo(a)pyrene (of 51mg/kg in comparison with the screening value of 14mg/kg). Refer to Volume 2 Environmental assessment methodology for full guidance on the screening values used.

Soil gas testing

F.1.30 No soil gas testing has been undertaken at the Cremorne Wharf Depot site.

F.1.31 Soil gas testing has been undertaken on two boreholes (SA1097 to the northeast of the site and SA1098 on-site) on three separate occasions.

F.1.32 Monitoring of the shallow standpipe in borehole SA1098, located on the northeast edge of the site, recorded no substantially elevated carbon dioxide or methane nor depleted oxygen.

F.1.33 Monitoring of borehole SA1097 (60m to the northeast) also recorded no substantially elevated carbon dioxide or methane nor depleted oxygen in either standpipe.

Groundwater contamination data

F.1.34 Samples were taken from borehole SA1098, results from the groundwater testing showed slight PAH contamination.

F.1.35 Refer to Section 13 Water resources – groundwater of this volume for further information.

Sediment quality analysis

F.1.36 No sediment quality testing has been undertaken on the foreshore of the River Thames at the Cremorne Wharf Depot site.

Third party ground investigation data

F.1.37 No third party ground investigation was available for the Cremorne Wharf Depot site.

Other environmental records

F.1.38 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 12 Table F.4. Pertinent records are discussed in further detail below.

F.1.39 The location of these records is shown on Vol 12 Figure F.1.3 (see separate volume of figures).

Vol 12 Table F.5 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	0
LA pollution prevention and control	0	1
Licensed waste management facility	2	0
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*	1	2
Registered waste transfer site	2	0
Registered waste treatment or disposal site	0	0

**Does not include regular CSO discharges*

F.1.40 Inspection of the data has identified two licences for waste management facilities and transfer sites at the Cremorne Wharf Depot site. These both relate to the on-site waste transfer station.

F.1.41 Within 250m of the Cremorne Wharf depot site, the data has shown areas of past potentially contaminated industrial use both on-site and within the 250m assessment area. From an analysis of the historical mapping data, the past industrial uses can be attributed to various industries as highlighted on Vol 12 Figure F.1.1 (see separate volume of figures).

F.1.42 Contaminants typically associated with these types of industries are identified in Vol 12 Table F.4.

F.1.43 Three pollution incidents to controlled water have been recorded. One of these is located on-site, and the other two located approximately 200m to the southwest of the site on Lots Road.

F.1.44 Information provided by the RBKC shows that these incidents were most likely caused by CSO overflows. The borough also has records of additional sewage overflow incidents in the last ten years, but only one of these has been classified as noteworthy (see Section F.2).

Land quality data from local authority

F.1.45 The RBKC was consulted with respect to land quality information for this area. The full response is presented in Section. F.2.

Summary of contamination sources

F.1.46 Following the review of the baseline data, the following on-site sources of contamination which may impact on construction of the proposed development have been identified:

a. potential ongoing contamination of underlying soil and groundwater from current industrial land uses including the waste management depot. Contaminants may include heavy metals, PAHs, sulphate, sulphide, asbestos, oil/ fuel hydrocarbons, chlorinated aliphatic hydrocarbons and PCBs

b. a cover of Made Ground has been recorded at the site which also represents a potential source of contamination and has been recorded to contain elevated PAH compounds

c. potential soil and groundwater contamination associated with historical land-use, for example the Lots Road Pumping Station, rubber works and the Wharf. Contaminants may include heavy metals, asbestos, phenols, oil/fuels, hydrocarbons, PAHs, PCBs, sulphides, sulphates, chlorinated aromatic hydrocarbons, chlorinated aliphatic hydrocarbons and pathogens

d. potentially elevated ground gases or vapours from past development or alluvial deposits

e. potential UXO.

F.1.47 Off-site sources include historical and existing industries for example, the power station (coal and later oil fired), wharves and fuel storage.

F.1.48 Potential contaminants associated with these industries include heavy metals, arsenic, selenium, sulphates, sulphides, asbestos, oil/fuel hydrocarbons, PAHs, chlorinated aliphatic hydrocarbons, PCBs.

F.2 Local authority consultation

Housing Health and Adult Social Care
Council Offices, 37 Pembroke Road, Kensington, LONDON, W8 6PW

Executive Director Housing Health and Adult Social Care
Ms Jean Daintith

Director of Environmental Health
Mr Paul Morse

Mott MacDonald House
8-10 Sydenham Road
Croydon
CR0 2EE

28th January 2011
My reference:11/095809
Your reference:
Please ask for:Davene chatter- Singh or Ashley Smith

Dear Ms C Peretti – (fao Mr D. Giordanelli)

Cremorne Awharf - Environmental Information

Thank you for your enquiry and cheque for **£ 96.85**. A search of our records has highlighted a number of past industrial uses at the above site and within 250m of the proposed development area.

Our records show both the site and adjacent land to have had potentially contaminative land uses since the late 1800's. The proposed site and directly adjacent areas to the W of the development area were predominantly an industrial wharf/dock until the late 1900's early 2000's.

Potentially contaminative land uses
The following table has been produced from information extracted from our digitised historical maps (up until 1996, plus 2002 Landline map) and tanks database. **Table 1** below and attached maps show that there are several former industrial uses within **250m** of the property.

Table 1

No	Industry	Date	Address	Distance and direction from property
1	Kensington Vestry/Borough Wharf	1891-1970	Lots Road 3	32m NNE
2	Durham Wharf	1891-1970	Lots Road 4	On site
3	Chelsea Wharf	1891-2002	Lots Road 5	Adjacent
4	Cremone Wharf/Recycling Centre	1891-2002	Lots Road	On site
5	Generating station - Crown Wharf/ Salopian Wharf/Swan Timber Wharf and Dock/Colour Works/Chelsea	1891-2002	Lots Road	Adjacent

	Vestry			
6	Garage/Rubber Factory	1904-1970	Tadema Street	137m W
7	Garage	1891-1939	Tadema Street	150m W
8	Ashburnham Depot	1945-1970	Lots road	183m W
9	Engineering Works - Ashburnham Road	1945-1970	Ashburnham Road	167m NNW
10	Electricity Sub Station	2002	Ashburnham Road	235m NNW
11	Underground Storage Tank - Shell (UK) Ltd Filling Station records indicate Operational. Tanks 1-3 and 5 capacity 2849 gal. Tank 4 capacity 1232 gal. Tanks 1-5 all installed in 1962. Tank 1 Diesel. Tanks 2-5 petroleum	Years holding B Licence 1962 – 1998.	Tadema Road	241m NNW
12	Underground Storage Tank. No record of licensee. According to the LFEPA records this site hold G licence - for car park, however, there is a disused tank recorded. Current tank status is water filled. Tank 1 capacity 500 gal. Records indicated discontinued use – no date available.	Record indicates no-hold G licence	Durham Wharf	48m NNE

Attached maps show the locations of the industries listed in the above table as well as all other former industrial uses within 250m of the property.

Table 2 below has been produced from information extracted from Kelly's Kensington and Chelsea Trade Directories (from 1890, 1935, 1953).

Table 2 - Entries from Kelly's directories

Property number	Trade	Business name	Trade directory year
15 Lots Road	Unknown Manufacturer	Chelsea Manufacturers (Chelsea) Ltd	1953
Cremorne Wharf Lots Road – No Street Number	Dredging contractor	Ter-Elst Brick Co (The)	1891
Cremorne Wharf Lots Road– No Street Number	Pumping Station	London County Council's Pumping Station	1904-1970

Cremorne Wharf Lots Road – No Street Number	Rubber Requisites, Hot Water Bottles and Mats	The Reliance Rubber Co Ltd	1904-1970
Chelsea Dock Lots Road– No Street Number	Coal and Coke Merchant - railway goods &coal station. Coal offices	Brentnall & Cleland	1904 - 1939
55 Lots Road	Generating Station	No record of business name	1904-1939
90 Lots Road	Paste Manufacturer	Rex Paste Ltd	1935
71 Uverdale Road	Motor Engineer	Lane H & Co Ltd	1935
Tadema Road - No street number	Rubber Company	The Reliance Rubber Co Ltd	1953
31 Luna Street	Cabinet Maker	Cooper Ernest	1953
7 Raasay Street	Laundry	Littlejohn Robert	1890
48 Uverdale Road	Laundry	Maxwell Laundries Ltd	1953

Planning Records

Table 3

Date of Planning Permission	Decision type	Proposal
27/09/07 - Planning granted	conditional	Air quality issues – Investigated PPSD Chelsea Academy Site; Adventure Playground, Lots Rd, Heatherly School of Art, 80 Upcerne Rd. Demolition of existing buildings and construction of new part 5 storey part 2 storey secondary school at lower ground floor level with associated works.

It can be seen from **Table 3** that a search of the Borough's planning records indicate that a planning application was made for the demolition of existing buildings and construction of new secondary school in an area 227m W of the proposed development. The Environmental Health Department were involved in dealing with air quality issues and hold the following reports that contain information on the works:

- AQ Assessment, Phlorum, Jun 2007.

This report can be viewed at the Council Offices by appointment. If you would like to arrange a viewing please contact me on the details below. Alternatively all reports can be viewed at our Planning Department Reception at the Town Hall.

Part 2A of the Environmental Protection Act

Durham Wharf and Cremone Wharf/Recycling Centre, both present on site of the proposed development area, have **not** been designated as Contaminated Land under Part 2A of the

Environmental Protection Act 1990 (EPA). The Royal Borough of Kensington and Chelsea have not designated any sites as Contaminated Land under the regulations and have not served any remediation notices to date.

Under Part 2A of the EPA (1990), the council has a duty to investigate all sites in the Borough with a former industrial use.

The generating station at Lots road, the underground storage tank at lots road 3 in addition to Durham wharf at lots road 4 and Chelsea wharf at lots road 5 have been highlighted as requiring further investigation under Part 2A due to its history of wharfs and various industrial activities on site. These sites are currently on our priority list of sites to investigate as the former uses are considered a medium risk to current site users. Due to the rate at which we are working through our list of priority sites, it is unlikely that we will undertake any further investigation on the site in the near future.
However, if the site is ever redeveloped, land contamination will be investigated through the planning process. Under Planning Policy Statement 23 the Council will ensure that the redevelopment of the site is carried out safely without posing any risks to site workers or future site users.

Part of the proposed development area is due to be redeveloped. The Environmental Health department has been involved with initial plans for the site and will ensure that any contamination found is remediated to the necessary standard. It is likely that when the redevelopment occurs the process will be regulated through planning conditions.

Radioactive substances
There are no entries on our Radioactive Substances Register at the site and within 250 metres of the proposed development area.

Part B Processes
There is one Part B Process authorisation licensed within 250m of the proposed development area. This licence is for an operational Shell filling station at 49 tadema Road. Authorisation is to operate a process for the unloading of petrol into storage - vapour recovery from tanker to storage facility. Authorisation is dated 15/02/1999.

Waste Sites:
Two waste sites are present at the site and within 250m of the proposed development area:

- Western Riverside Waste Authority. Cremorne Wharf, Lots Road - A11 - Household, Commercial & Industrial Waste Transfer Stn.

- Kensington & Chelsea Royal Borough, Cremorne Wharf, Lots Road, A13 - Household Waste Amenity Site.

Landfill sites
We hold no records of any active or historical landfill sites in the Royal Borough of Kensington and Chelsea.

Licence abstractions
A Licence abstraction has been undertaken since 05/05/2004 for the production of energy for electricity - Boiler Feed. The source of the abstraction is THAMES GROUNDWATER, LOTS ROAD, CHELSEA- BOREHOLE. NGR TQ26477708.

Discharge consents
Our records show the following discharge consents at the site and within 250m of the proposed development area:

- COUNTERS CREEK, LOTS ROAD PS, LONDON - Sewerage Network - Pumping Station - water company.

- 55 LOTS ROAD, CHELSEA, LONDON - Other Transport.
- CHELSEA HARBOUR DEVELOPMENT - Undefined or Other.

Pollution Incidents
Our records indicate that the following pollution incidents have occurred at the site and within 250m of the proposed development area:

03/07/2001. LOTS ROAD. Category 4 (No Impact). Containment and Control Failure. Pipe Failure above ground. Power Generation and Supply. Gas-Fired. Oils and Fuel. Gas and Fuel Oils.

20/02/2002. Chelsea (Kensington and Chelsea). Category 3 (Minor). Authorised Activity. Other Authorised Activity. Water Industry. Combined Sewer Overflow. Sewage Materials. Storm Sewage.

24/02/2002. Lots Road. Chelsea. London. sw10OQH. Category 3 (Minor). Authorised Activity. Other Authorised Activity. Water Industry. Combined Sewer Overflow. Sewage Materials. Storm Sewage.

26/02/2002. Lots Road, London. Category 3 (Minor). Authorised Activity. Other Authorised Activity. Water Industry. Pumping Station. Sewage Materials. Storm Sewage.

18/03/2002. Creekmouth Category 3 (Minor). Authorised Activity. Other Authorised Activity. Water Industry. Pumping Station. Sewage Materials. Storm Sewage.

13/05/2002. Lots Road, London. Category 3 (Minor). Authorised Activity. Other Authorised Activity. Water Industry. Pumping Station. Sewage Materials. Storm Sewage.

22/05/2002. Battersea Reach. Category 3 (Minor). Authorised Activity. Water Industry Combined Sewer Overflow. Sewage Materials. Storm Sewage.

05/06/2002. Lots Road, London. Category 3 (Minor). Natural Causes. Natural Process. Water Industry. Pumping Station. Sewage Materials. Storm Sewage.

03/07/2002. Battersea Reach Category 2 (Significant). Authorised Activity. Other Authorised Activity. Water Industry. Storm Tank. Sewage Materials. Storm Sewage.

09/07/2002. Pumping Station, 27 Lots Road, London. Category 3 (Minor). Natural Causes. Other Extreme Weather Conditions. Water Industry. Combined Sewer Overflow. Sewage Materials. Storm Sewage.

01/08/2002. Lots Road, London. Category 3 (Minor). Authorised Activity. Other Authorised Activity. Water Industry. Pumping Station. Sewage Materials. Storm Sewage.

24/08/2002. Battersea Reach. Category 3 (Minor). Authorised Activity. Other Authorised Activity. Water Industry. Pumping Station. Sewage Materials. Storm Sewage.

09/09/2002. Lots Road, London. Category 3 (Minor). Natural Causes. Natural Process. Water Industry. Pumping Station. Sewage Materials. Storm Sewage.

11/04/2003. Battersea Reach. Category 4 (No Impact). Cause Not Identified. Not Identified. Oils and Fuel. Other Oil or Fuel.

29/08/2008. Battersea Reach. Category 3 (Minor). Cause Not Identified. Pollutant Not Identified.

09/02/2009. Battersea Reach. Category 4 (No Impact). Containment and Control Failure. Normal Operation. Water Industry. Combined Sewer Overflow. Sewage Materials. Crude Sewage.

For further information relating to pollution incidents please contact the Environment Agency on their general enquiries number 08708 506 506.

Summary
Please note that Kensington and Chelsea Council has provided the above reply based upon data currently available to the Council and only within the Royal Borough of Kensington and Chelsea boundary limits. This data set is not yet complete and is continually being updated and reviewed. Therefore, the above information may be changed upon the receipt of additional data and no warranty can be given as to the accuracy or completeness of the information provided. Any previous developer of the site would have had responsibility for land contamination issues and may have further information.

Our Contaminated Land Inspection and Remediation Strategy is available for viewing and downloading on our website at http://www.rbkc.gov.uk/environmentandtransport/landquality.aspx. If you have any further questions do not hesitate to contact me on the number below.

Yours sincerely,

Miss Davene chatter-Singh
Assistant Environmental Pollution Officer

Environmental Quality and Public Health Team

F.3 Detailed Unexploded Ordnance (UXO) risk assessment

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Detailed Unexploded Ordnance (UXO) Risk Assessment

Study Site: Work Area PKC3X – Cremorne Wharf
Document Number: 336-RG-TPI-PKC3X-000001
Client Name: Thames Water
6 Alpha Project Number: P2853_R6_V2.0
Date: 23rd May 2012

Originator: Max Chainey (23rd May 2012)
Quality Review: Lisa Askham (24th May)
Released by: Lee Gooderham (24th May)

Contents

Figures

EXECUTIVE SUMMARY

Study Site	The Client has specified the Study Site as Work Area PKC3X, located at National Grid Reference "526522, 177111". For the purposes of this report, the Site has been divided into **AREA A** (Land aspect of main Work Area) and **AREA B** (Foreshore and river of main 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** is situated on what was primarily developed land during *World War Two* (WWII). The area was used for a "pumping station" and for *Cremorne Wharf*. As the wharf was fully operational, an unexploded bomb (UXB) would have been observed. **AREA B** overlaps the foreshore of the *River Thames* and contains a docking area for *Cremorne Wharf*. • **AREA A and B** are located in a particularly prominent area of bombing targets, including a "pumping station" and "wharves" within **AREA A**, as well as several primary targets in close proximity to the Site. These include a "gas works" and a "power station". • *Chelsea Metropolitan Borough* experienced a bombing density of 343 High Explosive (HE) bombs per 1,000 acres. This is a high bombing density for *London*. • No HE bomb strikes occurred within **AREA A or AREA B**, however three bomb strikes were recorded within the buffered Site boundary and a further five HE bomb strikes were recorded within 100m of the buffered Site boundary. • Only one structure was "seriously damaged" by bombs within **AREA A**. • Within **AREA A,** the pumping station remained on Site pre- and post-WWII undamaged. Additionally, a new structure has been built in the area of "open ground" at the south of the Work Area, and there has been demolition to the west. It is therefore likely that items of UXO may have been removed from **AREA A** during this redevelopment. However, no redevelopment has occurred within **AREA B** and therefore it is unlikely that buried UXO items would have been removed. 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 primarily posed 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**
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 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. **AREA A** **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 and 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 PKC3X. The Site is located at National Grid Reference "526522, 177111". 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 and B** for the purpose of this report. See *Figures 1* and *2* for the Site location.
Location Description *(Figure 3)*	The Work Area is situated to the southwest of the *City of London* within the *Chelsea Metropolitan Borough*. Current aerial photography has identified the following within each area: **AREA A:** Two building structures, one of which has been identified as *Lots Road Pumping Station*. **AREA B:** *River Thames*, foreshore and a "jetty".
Proposed Engineering Works	*Thames Water* have specified a summary of the proposed engineering works, including working draft plans with drawing no. 100-DA-CNS-PKC3X-250105_AH; 100-DA-CNS-PKC3X-250106_AH_1; and 100-DA-CVL-PKC3X-350020_AF. These works have been divided between **AREAS A and B**, however where not explicitly stated, 6 Alpha has made an assumption of which area the work will be carried out. **AREA A** • An 8m internal diameter combined sewer overflow (CSO) drop shaft, approximately 45m deep. • A 6m internal diameter intermediate shaft, approximately 45m deep. • A 4m diameter (reducing to 3.6m) connection tunnel to link the CSO shaft with the main Thames Tunnel (within **AREA B** also). • A connection culvert linking the CSO and intermediate shaft. • Underground chambers and ventilation ducts. • Removal of existing piles. • Replacement of existing shed structure. The construction site will include storage areas for shaft and connection tunnel lining materials, material handling facilities, grout batching and silo facilities, stockyard and spares storage facilities. The site will also contain a power supply for the operation and an area for vehicle parking. **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.
Ground Conditions	*Thames Water* have indicated the following ground conditions for the Work Areas as:

Site Geology	Depth Below Ground Level (m)	Thickness (m)
River Terrace Deposits	0.00	2.00
London Clay	2.00	38.00
Harwich Formation	40.00	0.10
Lambeth Group	40.10	19.90
Thanet Sand	60.00	10.50
Seaford Chalk	70.50	Not Proven

It is important to establish the ground conditions within this report to determine both the maximum *German* unexploded bomb (UXB) bomb penetration depth (BPD) as well as 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 situated on developed land, and contains one unidentified building on Site and *Cremorne Wharf*. **AREA B** contains no building developments, however *Cremorne Wharf* is located within this area. **1949 OS mapping** – No noticeable or significant changes have been observed in **AREA A or B.**
1945 Aerial Photography ***(Figure 4)***	**AREA A:** 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. **AREA B**: The 1945 aerial photography shows a docking area and docked vessels for *Cremorne Wharf* within this area.
WWII Luftwaffe Bombing Targets ***(Figure 5)***	**ALL AREAS:** "Wharves" are located within and around the Site, and would have been "opportunistic" bombing targets for the *Luftwaffe*. Primary bombing targets include a "pumping station" within the Work Area, a "power station" located immediately adjacent and to the west of the buffered Site boundary, a "gas works" located 300m to the west and *Fulham Power Station* 950m to the southwest. "Opportunistic" targets include "works", "tanks", and "docks" all located within 1km of the Site.
WWII HE Bomb Strikes ***(Figure 6)***	Air Raid Precaution (ARP) reports indicate the following: **AREA A:** No bomb strikes. **AREA B:** No bomb strikes. Additionally, three bomb strikes occurred within the buffered Site boundary. A further five HE bomb strikes were recorded within 100m of the buffered Site boundary.
WWII Bomb Damage ***(Figure 7)***	*London County Council* (LCC) bomb damage maps indicate the following: **AREA A:** This area has largely been undamaged by bombs, however one structure within the west of the Work Area was recorded as "seriously damaged; doubtful if repairable". **AREA B:** No bomb damage. There is further various damage to structures within the north of the buffered Site boundary.
WWII HE Bomb Density ***(Figure 8)***	The Study Site is located within the *Chelsea Metropolitan Borough,* which recorded 343 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	According to the Official Abandoned Bomb Register, no abandoned bombs were recorded within 1,000m of the Site.

STAGE THREE – DATA ANALYSIS	
Was the ground undeveloped during WWII?	**AREA A:** No; the main area was predominantly developed with a "pumping station" and *Cremorne Wharf*. **AREA B:** Mostly; this area overlaps the *River Thames* and was undeveloped, however there was a small built-up docking area for *Cremorne Wharf.*
Is there a reason to suspect that the immediate area was a bombing target during WWII?	**ALL AREAS:** Yes; the Site boundary sits directly adjacent to a "power station" which would have been a bombing target. There are also numerous bombing targets within and around the areas and buffered Site boundary.
Is there firm evidence that ordnance landed on Site?	**AREA A:** No. **AREA B:** No; but unlikely to have been recorded given the environment. Additionally, three bomb strikes were recorded within the buffered Site boundary.
Is there evidence of damage sustained on Site?	**AREA A:** Yes; the area suffered bomb damage to one structure. **AREA B:** No; but unlikely to have been recorded given the environment. Within the buffered Site boundary there has been varied damage to a number of structures.
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:** Likely; the land was mostly developed and a UXB entry hole would be witnessed. However the significant bomb damage to the structure within the western portion of the Work Area would have created debris, and this may have obscured any bomb strike observations and decreased the likelihood of finding UXB entry holes. **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. However, it is possible that the wharf was in constant use, and therefore docking vessels may have either been damaged by bomb strikes or witnessed UXBs on the foreshore.
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:** Likely; whilst the "pumping station" has remained, a large structural development has occurred within the south of the Work Area, and structures to the west have been demolished. **AREA B:** Unlikely; there has been no development of the foreshore or docking area of *Cremorne Wharf*.

STAGE FOUR – RISK ASSESSMENT		
Threat Items	The threat is predominately posed by WWII *German* HE bombs and Incendiary Bombs. Additionally, 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**, 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 **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. Given the alluvium and river terrace deposits contained within the foreshore, it is likely the BPD will be between 5-7m. It is important to note that strong river currents, sedimentation build-up and erosion over time can significantly alter the depth of UXO. Whilst the *Luftwaffe* used larger bombs, their deployment was so few and only used against notable targets, therefore 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	1x2=2	2x2=4
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	2x2=4	1x2=2	4x2=8
Dredging	2x3=6	3x2=6	6x6=36

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 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. Posters and information of the general nature of the UXB threat should be held in the site office for reference and as a reminder.	ALARP
AREA A	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. It should be noted that there is likely to be scrap metal on the foreshore and riverbed that will reduce the effectiveness of non-intrusive magnetometry.	
This assessment has been conducted based on the information provided by the Client, should the proposed works change then 6 Alpha should be re-engaged to refine this risk assessment.		

Report Figures

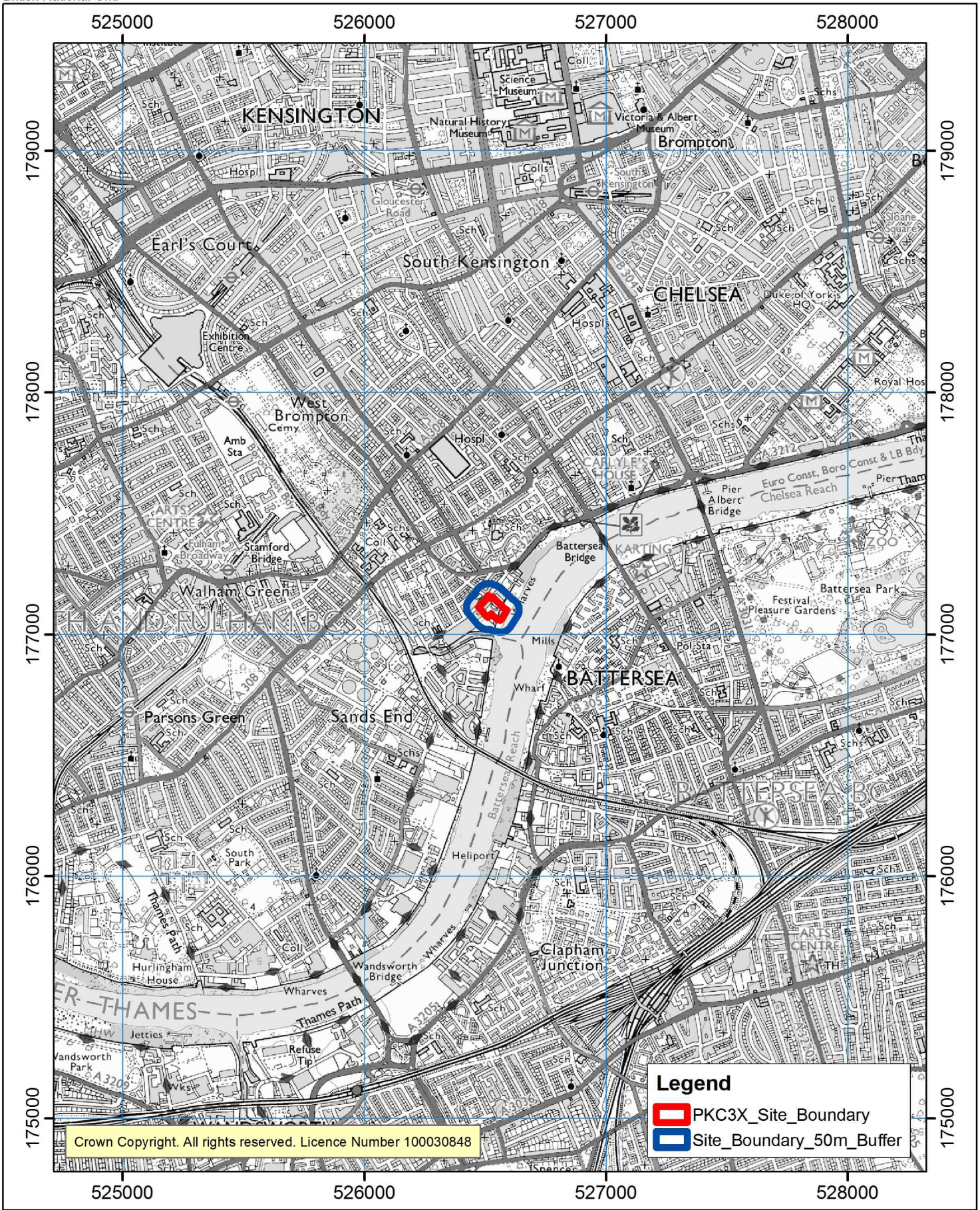
Figure One

Site Location

Thames Tideway Tunnel - Work Area PKC3X
Site Location

Figure 1

British National Grid



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Drawn By: Dominique René
Checked by: Lee Gooderham
Date: 14th May 2012

Figure Two

Site Plan

Thames Tideway Tunnel - Work Area PKC3X
Site Boundary

Figure 2

British National Grid

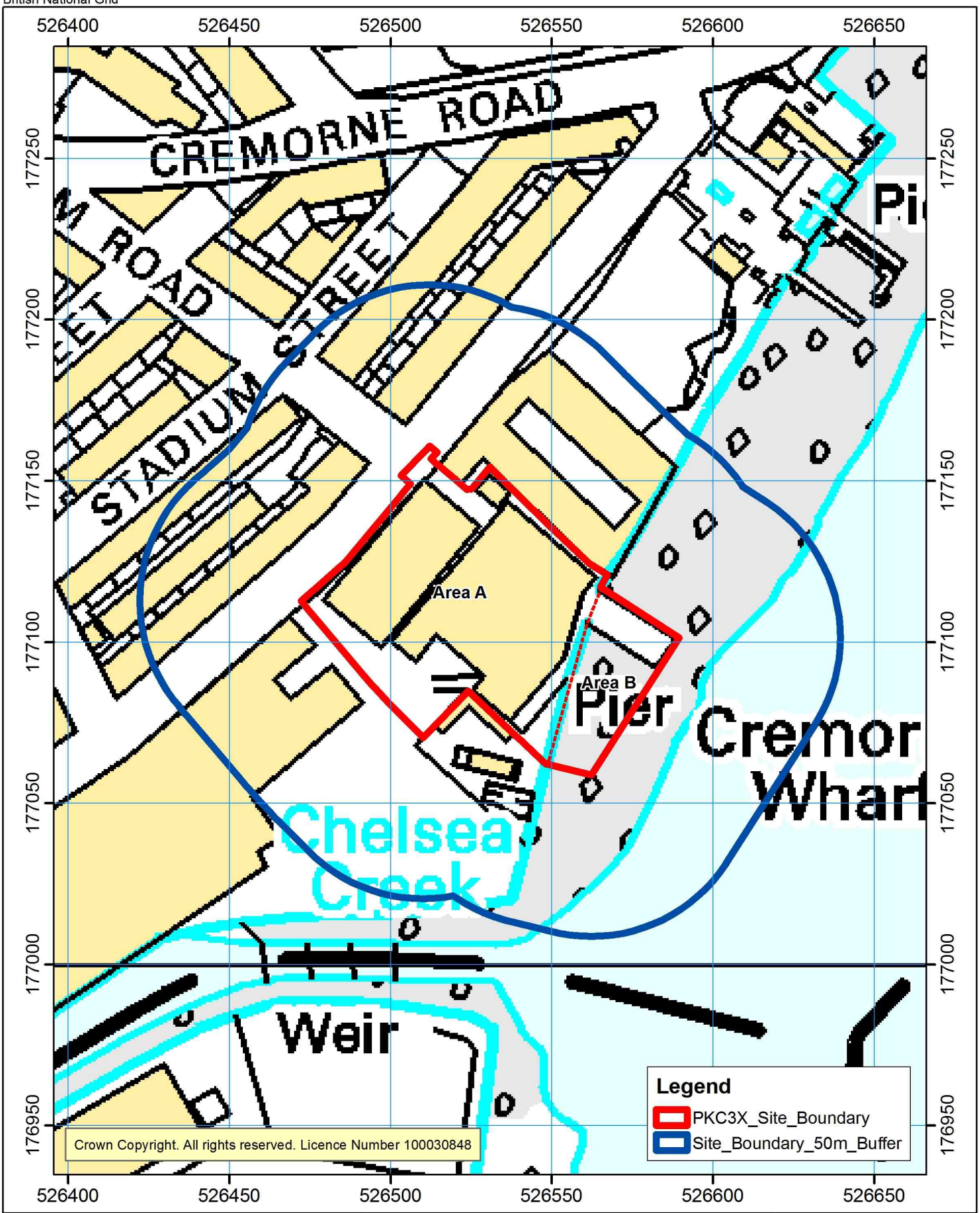

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Figure Three

Current Aerial Photography

Thames Tideway Tunnel - Work Area PKC3X
Current Aerial Photography

Figure 3

British National Grid

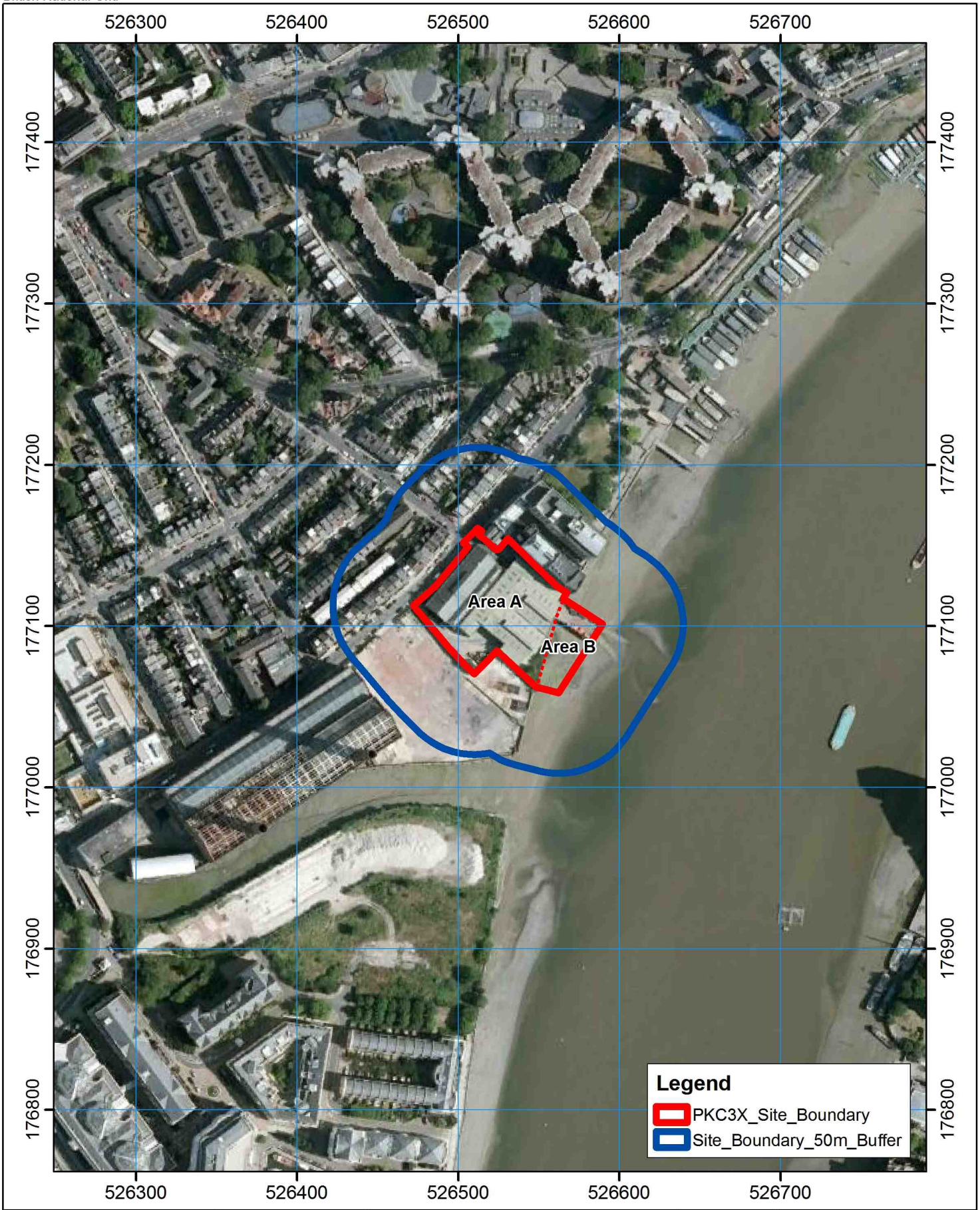

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Figure Four

1945 Aerial Photography

Thames Tideway Tunnel - Work Area PKC3X
1945 Aerial Photography

Figure 4

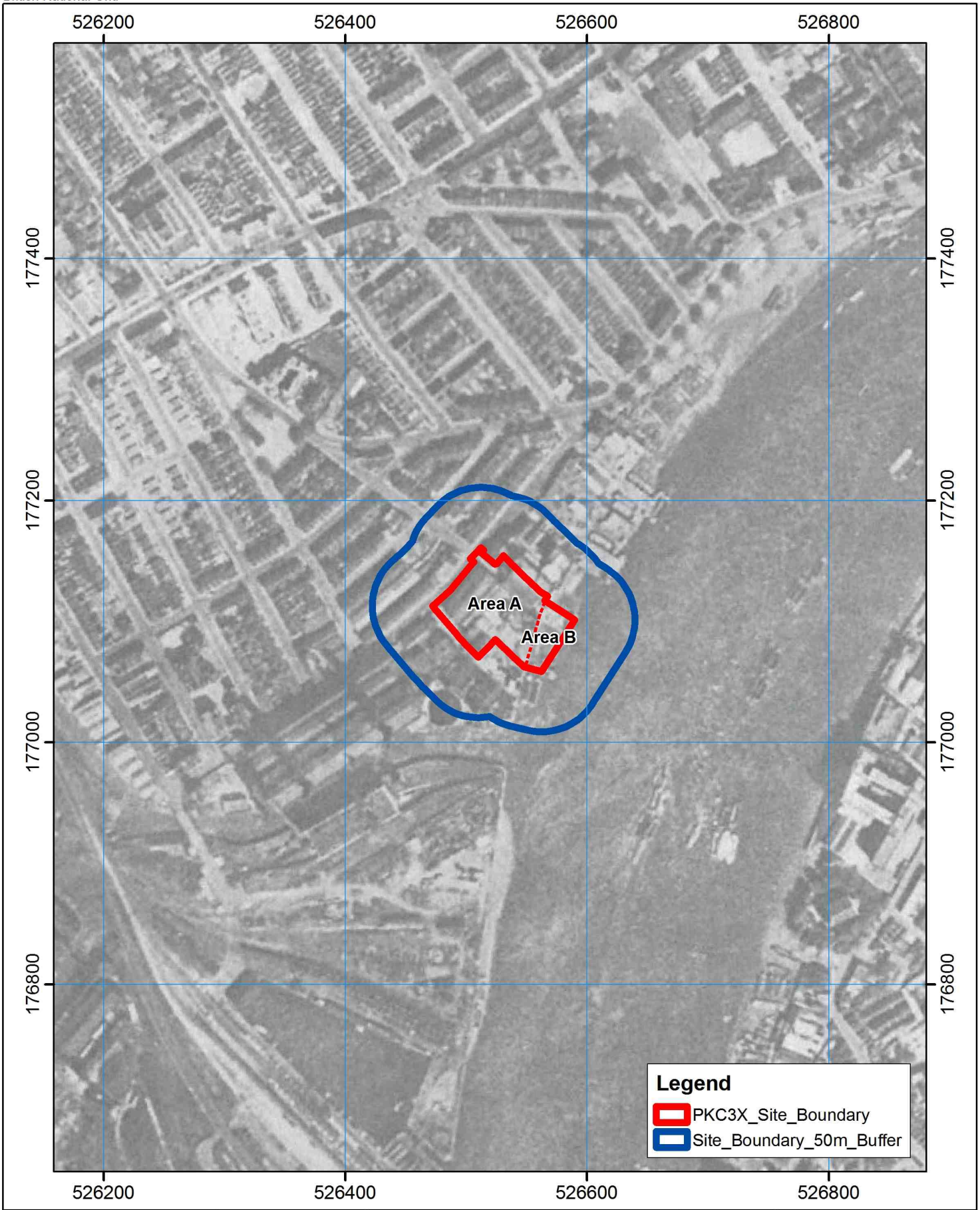

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Figure Five

WWII Luftwaffe Bombing Targets

Thames Tideway Tunnel - Work Area PKC3X
WWII Luftwaffe Bombing Targets

Figure 5

British National Grid

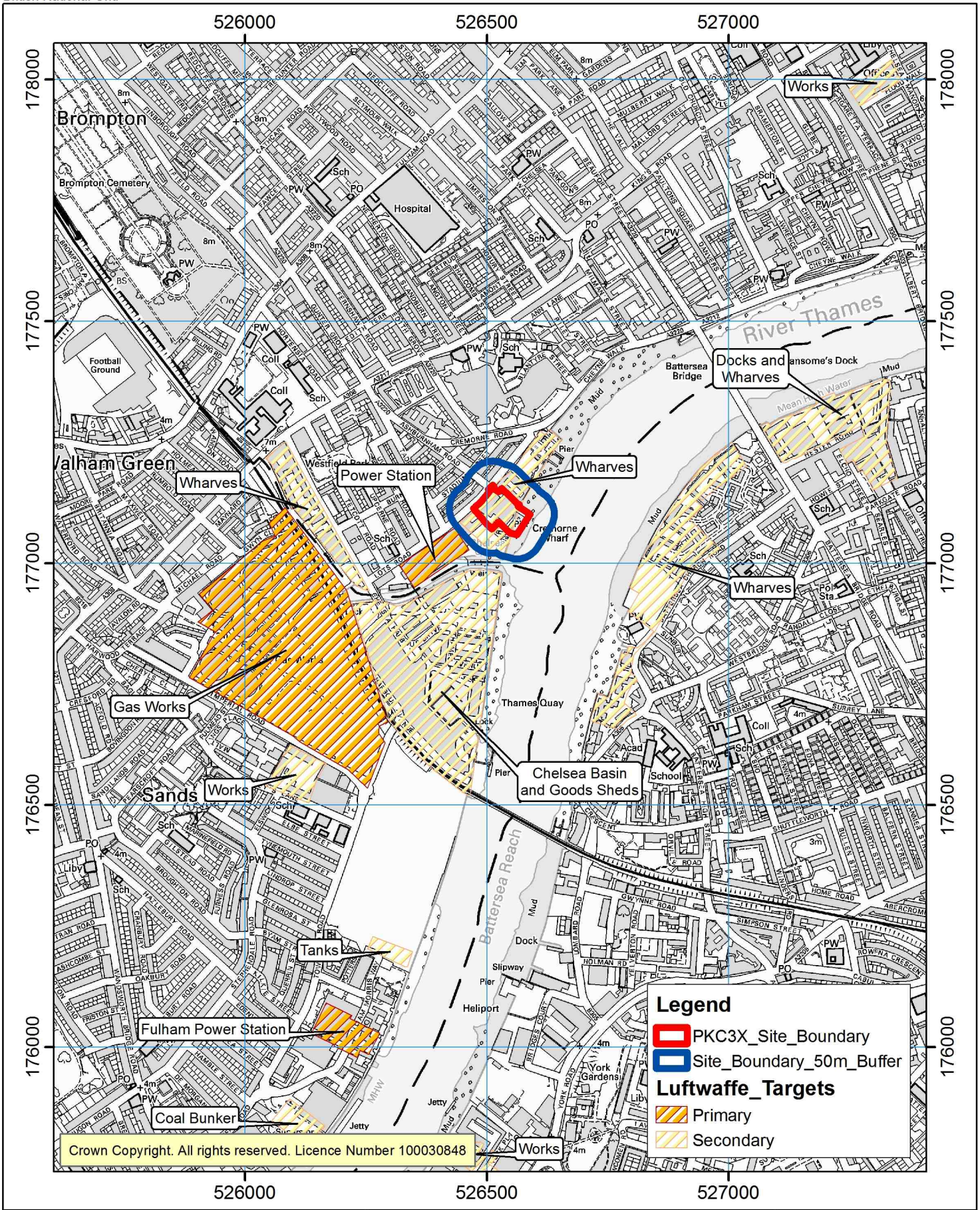

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Figure Six

WWII High Explosive Bomb Strikes

Thames Tideway Tunnel - Work Area PKC3X
WWII High Explosive Bomb Strikes

Figure 6

British National Grid

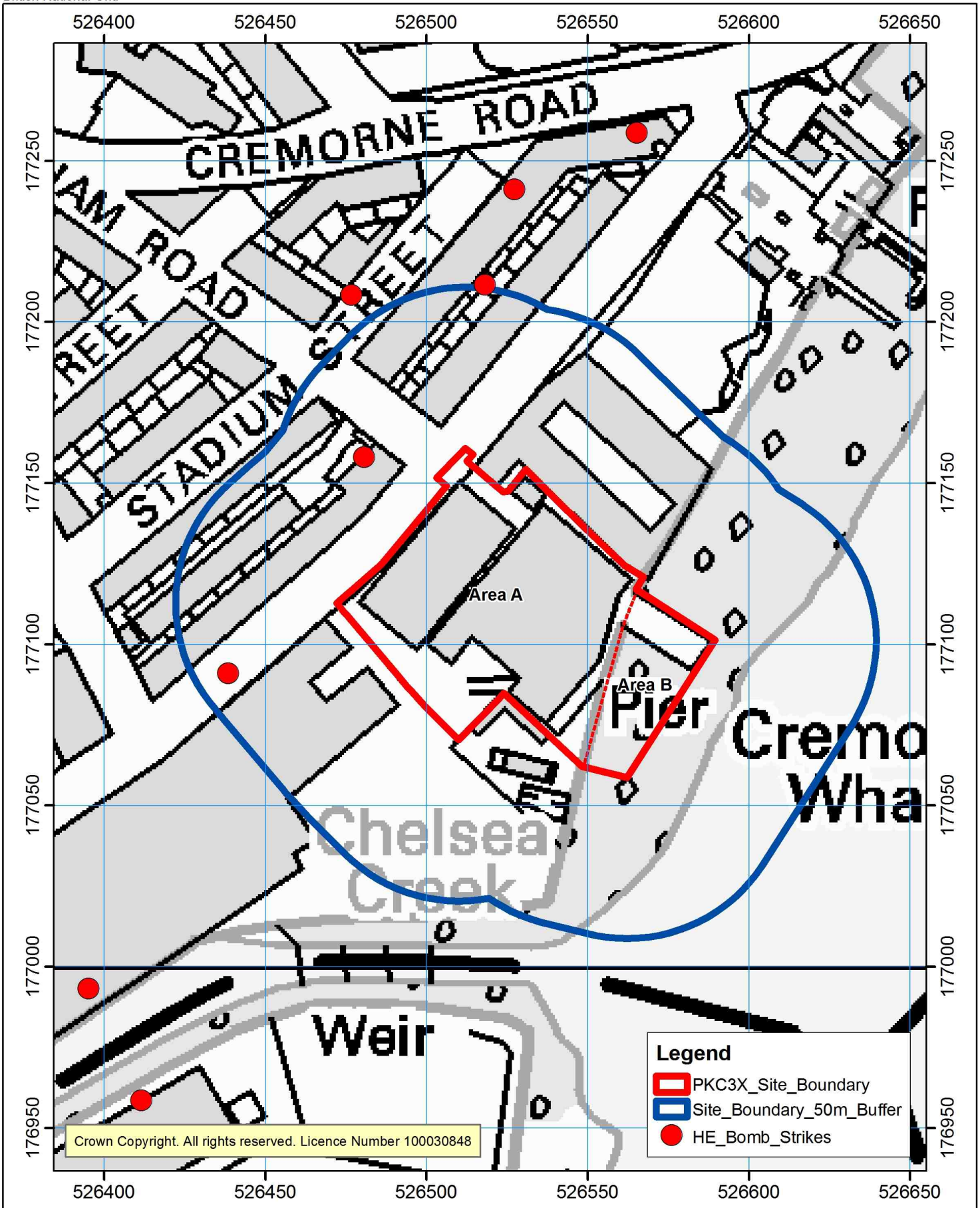

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Figure Seven

London County Council Bomb Damage Mapping

Thames Tideway Tunnel - Work Area PKC3X
London County Council Bomb Damage Map

Figure 7

British National Grid

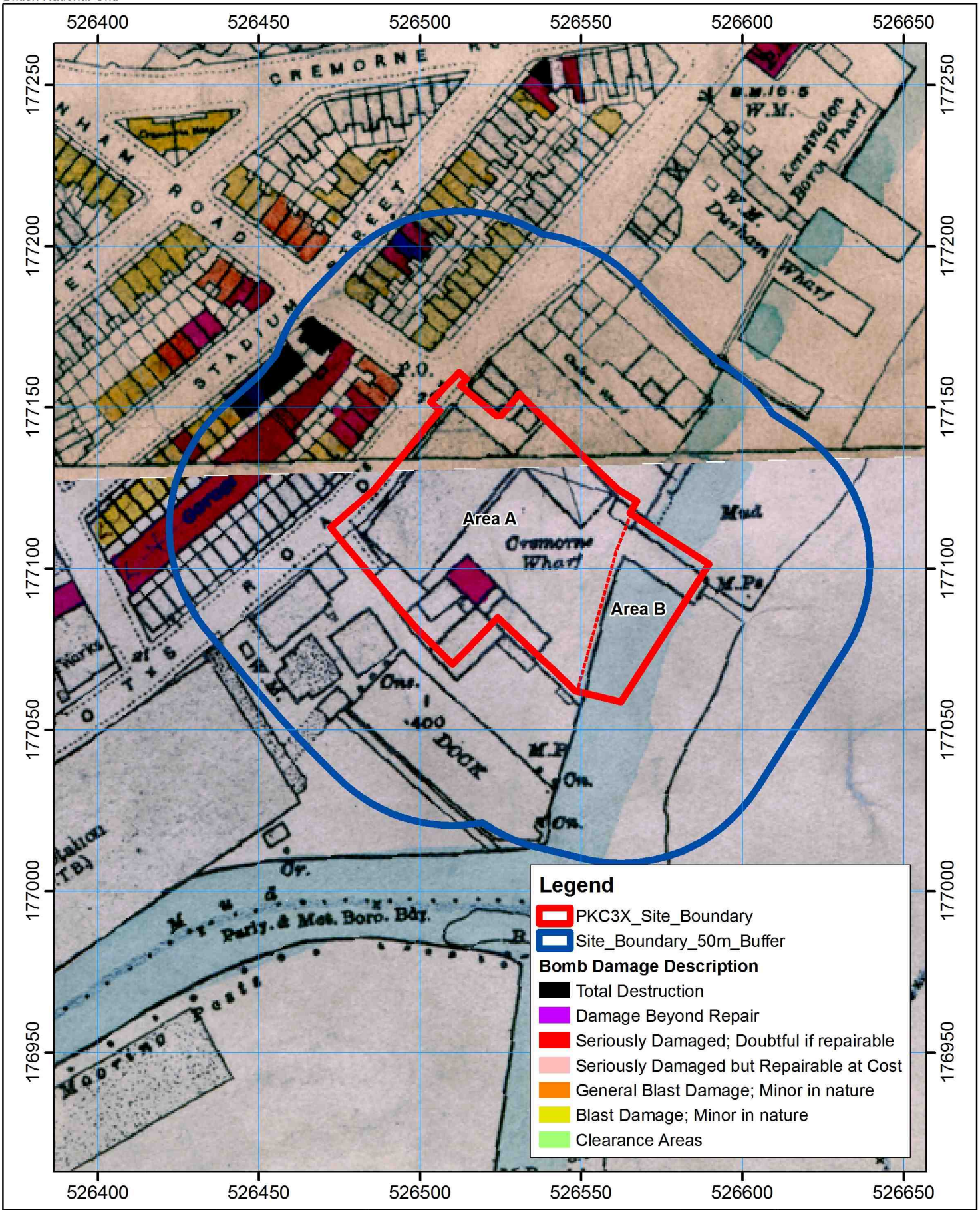

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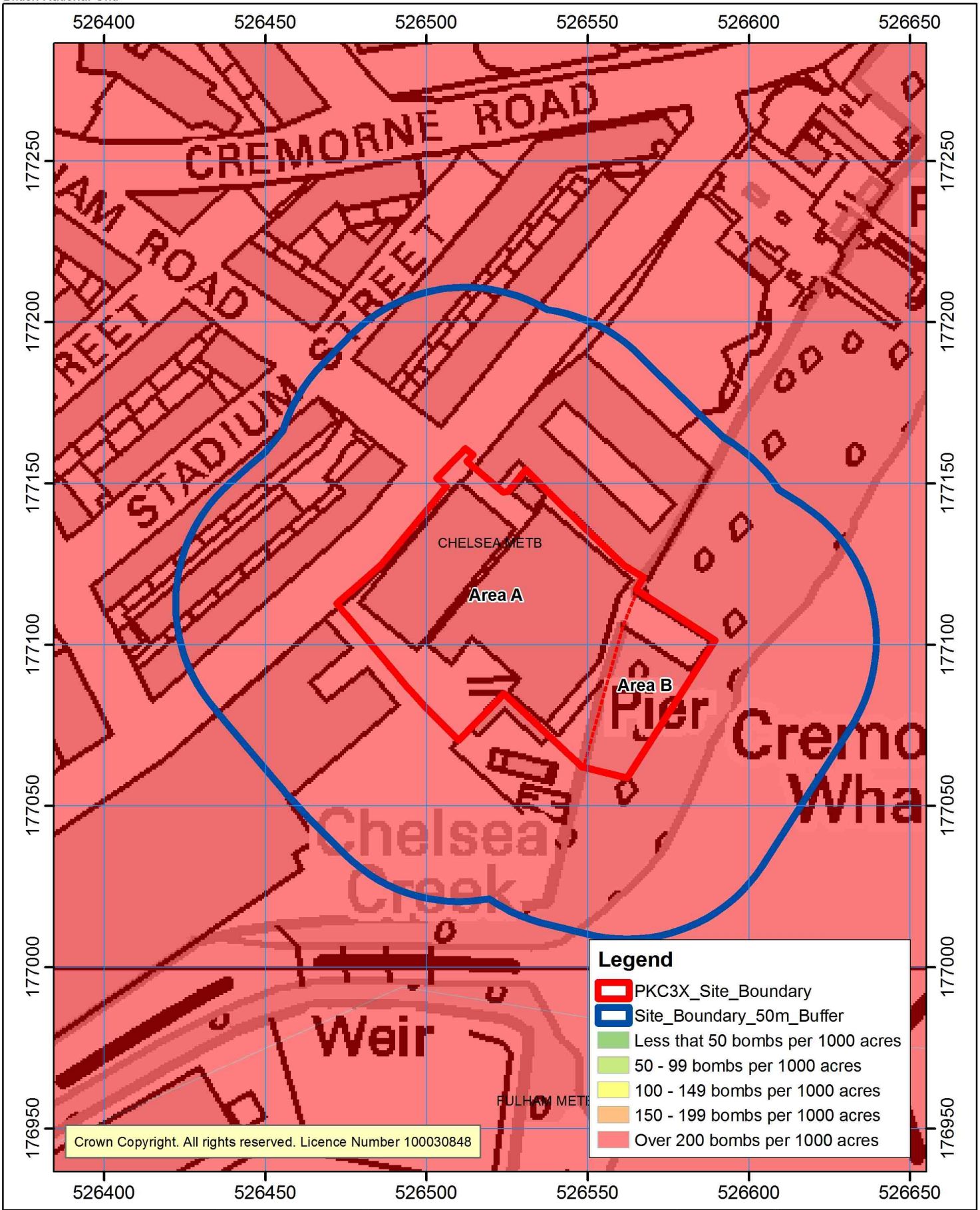
Figure Eight

WWII High Explosive Bomb Density

Thames Tideway Tunnel - Work Area PKC3X
WWII High Explosive Bomb Density

Figure 8

British National Grid



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

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.12**

Volume 12: Cremorne Wharf Depot appendices

Appendix G: Noise and vibration

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

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January 2013

Thames Tideway Tunnel

Creating a cleaner, healthier River Thames

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Thames Tideway Tunnel

Environmental Statement

Volume 12 Cremorne Wharf Depot appendices

Appendix G: Noise and vibration

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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 receptors to Cremorne Wharf are the dwellings close to the site, the offices at Chelsea Wharf and Cremorne Gardens, a public recreation space.

Survey methodology

G.1.3 The Royal Borough (RB) of Kensington & Chelsea has been consulted regarding the noise assessment and monitoring locations, prior to completing the surveys.

G.1.4 An initial baseline noise survey was completed on 30 June 2011 and additional data was collected between 15 and 17 January 2012. The initial survey comprised short-term attended measurements during the daytime and evening, at all measurement locations. The additional data collection comprised further short-term attended measurements during the daytime and night-time, and also included continuous overnight unattended monitoring.

G.1.5 During the initial baseline survey 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, so that the baseline data is representative of the quieter periods where any disturbance from construction would be most noticeable.

G.1.6 For the additional baseline survey, further short-term attended noise monitoring was completed at three locations (CWD01, CWD03 and CWD04) and representative overnight continuous unattended monitoring data was collected at one location (CWD02). Measurements were undertaken during the interpeak periods of 00:00-04:00 on a typical weekday, and 14:00-18:00 and 00:00-04:00 on a typical weekend day.

G.1.7 Vol 12 Table G.1 describes the survey equipment that was used to collect the baseline data at the site.

Vol 12 Table G.1 Noise – survey equipment

Item	Type	Manufacturer	Serial number(s)	Laboratory calibration date
Initial baseline survey: 30 June 2011				
Hand-Held Analyzer(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: 15 - 17 January 2012				
Hand-Held Analyzer(s)	2250	Brüel & Kjær	2659069 2506360	11/03/2011** 24/11/2011**
½" Microphone(s)	4189	Brüel & Kjær	2650595 2566383	10/03/2011** 24/11/2011**
B&K Sound Calibrator(s)	4231	Brüel & Kjær	2052513	09/11/2011**

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

G.1.8 Prior to and on completion of the survey, 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.1.9 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.1.10 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 to prevent birds from perching on the equipment.

G.1.11 The prevailing weather conditions observed for both baseline surveys are described in Vol 12 Table G.2.

Vol 12 Table G.2 Noise – weather conditions during baseline noise surveys

Wind Speed (ms^{-1})	Wind Direction	Temperature (°C)	Precipitation	Description
Initial baseline durvey – 30 June 2011 (daytime, 10:00-12:00; 14:00-16:00)				
Maximum: 1.4-4.5 Average: 0.4-1.7	NW; W	17-22	Yes - light drizzle observed during last afternoon measurement (15:53)	Started sunny but became cloudy, mainly dry, warm and breezy.
Initial baseline survey – 30 June 2011 (evening, 20:00-22:00)				
Maximum: 1.5-4.0 Average: 0.4-1.6	NW	17-19	No	Cloudy, warm, dry, breezy
Additional baseline survey – 15 January 2012 (daytime, 14:00-18:00)				
Maximum: 0.9-4.5 Average: 0.5-1.6	E	4-7	No	Cloudy, dry, cool and breezy
Additional baseline survey – 16 January 2012 (night-time, 00:00-04:00)				
Maximum: 0.9-4.4 Average: 0-1.1	E; NE	2-3	No	Clear, dry, cold and breezy
Additional baseline survey – 17 January, 2012 (night-time, 00:00-04:00)				
Maximum: 0-1.5 Average: 0-0.5	E; NE	1-3	No	Clear, dry, cold, light breeze

Measurement locations

G.1.12 Vol 12 Table G.3 details the measurement locations which are also presented in Vol 17 Figure G.1 Noise – measurement locations (see separate volume of figures), and shown in Vol 12 Plate G.1 to Vol 12 Plate G.4.

Vol 12 Table G.3 Noise – measurement locations

Measurement Location Number	Description	Co-ordinates	
		X	Y
CWD01	Public footpath adjacent to Lots Road	526494	177155
CWD02	Within Cremorne Gardens	526574	177190
CWD03	End of Chelsea Wharf	526576	177135
CWD04	Thames Path, in front of residential dwellings near to Whistlers Avenue	526835	177031

Results

G.1.13 The range of values for each of the parameters collected during the baseline surveys are summarised in Vol 12 Table G.4 to Vol 12 Table G.9.

Vol 12 Table G.4 Noise – sampled noise survey results – CWD01

Location Detail: CWD01, on public footpath alongside Lots Road, by the intersection with Ashburnham Road, in front of vacant commercial building						
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	54	65 - 70	64*	67	65
Evening (20.00-22.00)	84	53	65 - 66	63*	66	65
Night (00.00-04.00)	81	42	52 - 59	54*	57	55
Weekend day (14.00-18.00)	83	51	64 - 66	62*	65	65
Weekend night (00.00-04.00)	83	43	49 - 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 12 Table G.5 Noise – sampled noise survey results – CWD02

Location Detail: CWD02, within Cremorne Gardens						
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)	86	51	59 - 65	63	66*	65
Evening (20.00-22.00)	83	52	61 - 64	63	66*	65

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

Vol 12 Table G.6 Noise – sampled noise survey results – CWD03

Location Detail: CWD03, at the end of Chelsea Wharf, within the private courtyard of Chelsea Wharf Apartments						
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)	87	50	57 - 66	62	65*	65
Evening (20.00-22.00)	80	49	59 - 61	60	63*	65
Night (00.00-04.00)	71	44	45 - 48	46	49*	50
Weekend day (14.00-18.00)	72	49	53 - 54	53	56*	55
Weekend night (00.00-04.00)	60	44	46 - 48	47	50*	50

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

Vol 12 Table G.7 Noise – sampled noise survey results – CWD04

Location Detail: CWD04, on Thames Path, in front of residential dwellings near to Whistlers Avenue						
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)	82	50	58 - 63	57*	60	60
Evening (20.00-22.00)	82	49	58 - 60	56*	59	60
Night (00.00-04.00)	56	39	43 - 45	41*	44	45
Weekend day (14.00-18.00)	81	46	57 - 65	59*	62	60
Weekend night (00.00-04.00)	61	37	40 - 42	38*	41	40

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

Vol 12 Table G.8 Noise – continuously logged noise survey results – CWD02

Location Detail: CWD02, within Cremorne Gardens							
Day	**Period**	**Period noise level (dB(A) free-field)**			**Period noise level (dB(A) façade)**		
		L_{AFmax}	**L_{A90}**	**L_{Aeq}**	**L_{AFmax}**	**L_{A90}**	**L_{Aeq}**
Weekday	07.00-08.00	71	53	58	74	56	61
	08.00-18.00*	76	52	58	79	55	61
	18.00-19.00	86	51	64	89	54	67
	19.00-22.00	76	50	55	79	53	58
	22.00-07.00	75	42	53	78	45	56
Sunday	07.00-21.00*	85	51	56	88	54	59
	21.00-07.00	70	44	52	73	47	55

**The data presented in this row is deemed to be representative of the reference period. The continuous monitors only started collecting data from 5PM once the park was closed to the public and the equipment was secure.*

Vol 12 Table G.9 Noise – measurements near embankment (for river-based traffic assessment)

Sensitive receptor locations	Measurement location	Measurement period	Noise level (dBL_{Aeq}, facade)
Cremorne Wharf (all embankment locations)	CWD03	Day/evening (07.00-23.00)	63
		Night (23.00 – 07.00)	49

Baseline survey photographs

G.1.14 The following plates (Vol 12 Plate G.1 to Vol 12 Plate G.4) illustrate the noise measurement locations.

Vol 12 Plate G.1 Noise measurement location CWD01

Note: On public footpath on the corner of Lots Road and Ashburnham Road, looking east (façade measurement)

Vol 12 Plate G.2 Noise measurement location CWD02

Note: Within Cremorne Gardens, looking northwest towards Lots Road

Vol 12 Plate G.3 Noise measurement location CWD03

Note: At the end of Chelsea Wharf, looking southeast towards River Thames

Vol 12 Plate G.4 Noise measurement location CWD04

Note: On Thames Path, looking north towards Battersea Bridge (façade measurement)

G.2 Construction noise prediction results

G.2.1 The construction noise prediction methodology follows the methodology provided in Vol 2.

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 12 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 12 Plate G.5 to Vol 12 Plate G.15.

Vol 12 Table G.10 Vol 12 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	30	BS5228-1[1]: 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	15	BS5228-1: Table C.1, Item 6	Hand-held pneumatic breaker,
	Compressor 250cfm	1	93	30	BS5228-1: Table C.5, Item 5	Compressor for hand-held pneumatic breaker, 1 t
	Generator 35kVA	1	94	100	BS5228-1: Table C.4, Item 78	Diesel generator,
	Circular saw cutting timber	1	107	10	BS5228-1: Table D.7, Item 72	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	Oxyaceteline cutting equipment	1	93	10	BS5228-1: Table C.3, Item 35	Hand-held gas cutter, 230 bar

Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
site	Compressor 250cfm	1	93	50	BS5228-1: Table D.5, Item 5	Compressor for hand-held pneumatic breaker
	Generator200 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,
	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 also applicable during this phase	22T Excavator c/w hydraulic hammer	1	118	30	BS5228-1: Table C.1, Item 9	Tracked excavator fitted with breaker, 200 kg·m
	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	112	80	BS5228-1: Table C.1, Item 15	Tracked crusher,
	Vibrating rollers	2	101	50	BS5228-1: Table C.2, Item 38	Roller, 18 t
Piling for shaft/culvert support General site equipment also applicable during this phase	100t 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 phase	Concrete deliveries (agitating)	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
	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,
	Sump pump	4	96	100	BS5228-1: Table C.4, Item 88	Water pump (diesel), 100 kg
	400 cfm compressor	1	93	50	BS5228-1: Table D.5, Item 5	Compressor for hand-held pneumatic breaker
	25t excavator	1	105	50	BS5228-1: Table C.2, Item 19	Tracked excavator, 25 t
	12t excavator	1	97	80	BS5228-1: Table C.2, Item 25	Tracked excavator, 15 t
Connection tunnel drive General site equipment also applicable during this phase	Concrete deliveries (agitating)	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),
	400 cfm compressor	1	93	50	BS5228-1: Table D.5, Item 5	Compressor for hand-held pneumatic breaker
	100t crawler crane	1	103	50	BS5228-1: Table C.4,	Tracked mobile crane,

Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
					Item 52	105 t
	25t mobile crane	1	98	25	BS5228-1: Table C.4, Item 43	Wheeled mobile crane, 35 t
	25t excavator	1	105	50	BS5228-1: Table C.2, Item 19	Tracked excavator, 25 t
	Waste collection via skip or tipper lorry	1	106	10	BS5228-1: Table C.8, Item 21	Skip wagon
	Tunnel ventilation fans	1	100	100	Measured	Ventilation fans,
Shaft secondary lining General site equipment also applicable during this phase	100t 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 (discharging)	1	103	20	BS5228-1: Table C.4, Item 18	Cement mixer truck (discharging),
	Concrete pump	2	95	20	BS5228-1: Table C.4, Item 24	Concrete pump + cement mixer truck (discharging), 8 t / 350 bar
	Fixed and portable concrete vibrators	4	106	20	BS5228-1: Table C.4, Item 33	Poker vibrator,
	Hand tools (e.g. drills and wrenches)	4	95	80	Estimated	Impact wrench and compressor

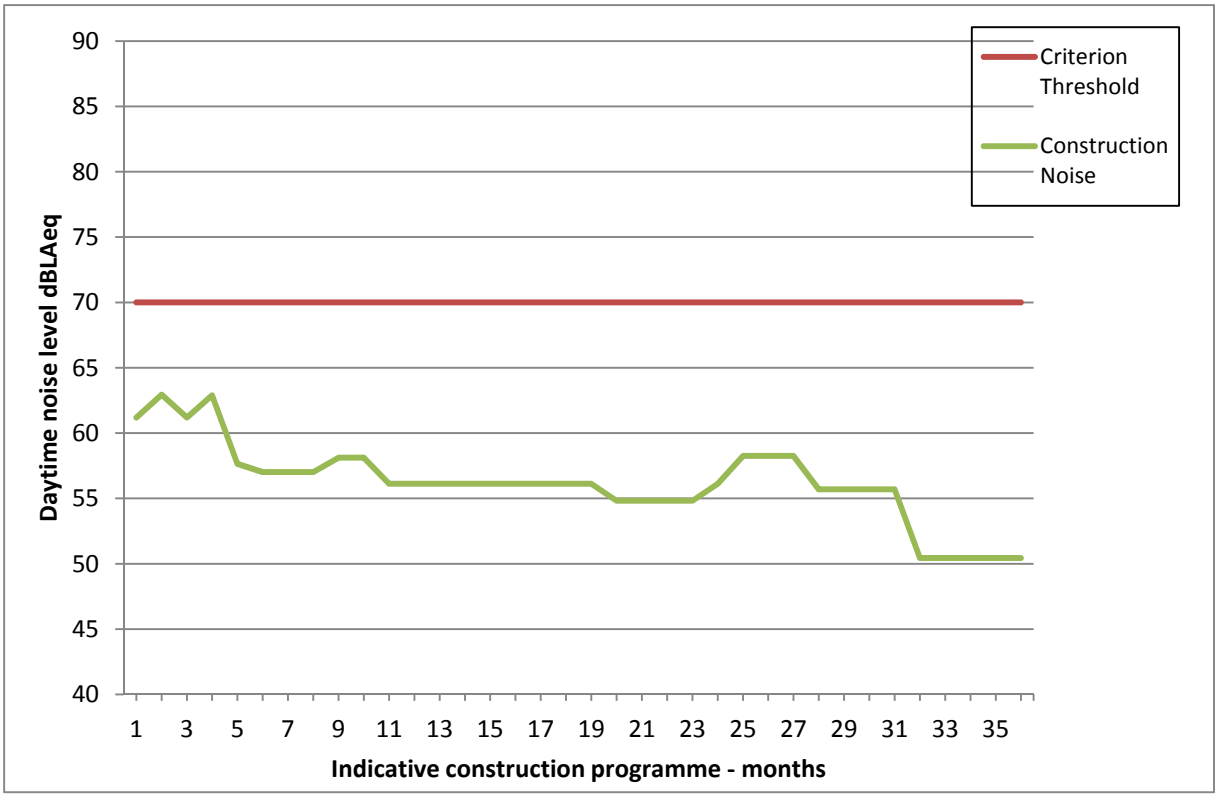
Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
Culvert and chamber works General site equipment also applicable during this phase	Service crane100T mobile crane	1	95	50	BS5228-1: Table C.4, Item 14	Wheeled backhoe loader, 9 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 General site equipment NOT applicable during this phase	25t excavator	1	105	50	BS5228-1: Table C.2, Item 25	Tracked excavator, 14 t
	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

Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
	Compressor for hand-held breaker	1	93	10	BS5228-1: Table C.5, Item 5	Compressor for hand-held pneumatic breaker, 1 t
	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

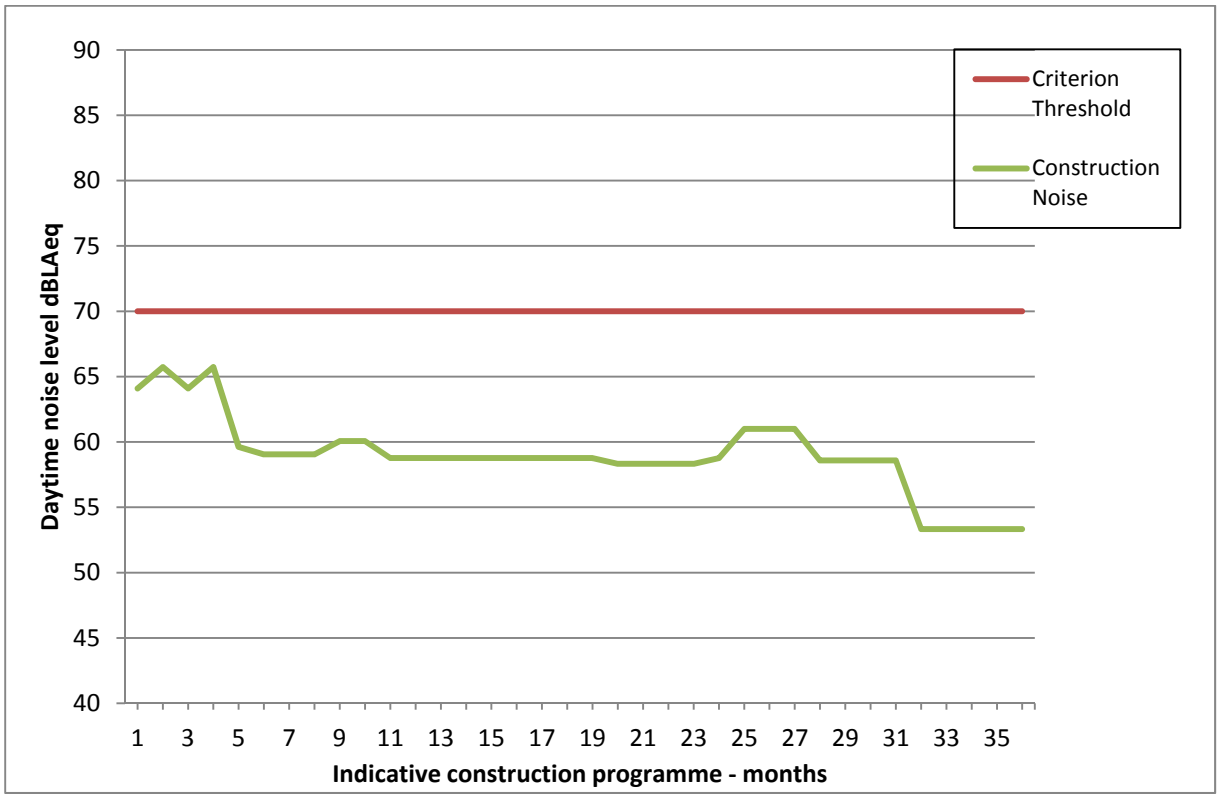
Note: This schedule provides an illustration of typical plant that could be used in the construction of the Thames Tideway Tunnel at this site. The appointed Contractor must comply with section 6 of the CoCP but may vary the method and plant to be used. This schedule therefore represents the most reasonable 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 plates below. It should be noted that these representations are for the worst-case scenarios for noise exposure at the upper floors. For comparison with the construction noise, the plates also show either the potential significance criterion threshold for residential receptors, or the ambient noise level for non-residential receptors. This comparison is discussed in the main assessment text. The night time noise levels have also been assessed for the short period of night time works, these results are described in the main assessment text and not presented here.

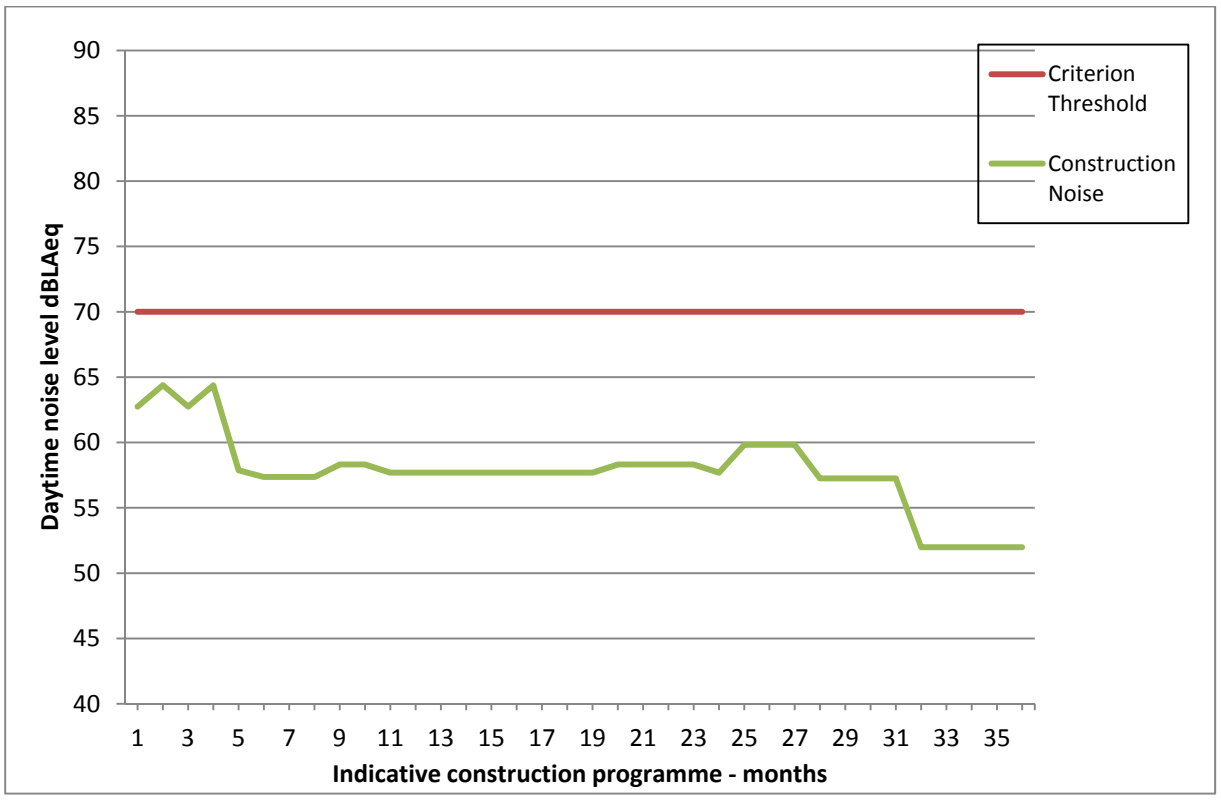
Vol 12 Plate G.5 Average monthly daytime noise level over duration of construction – 64-78 Lots Road (CD1)



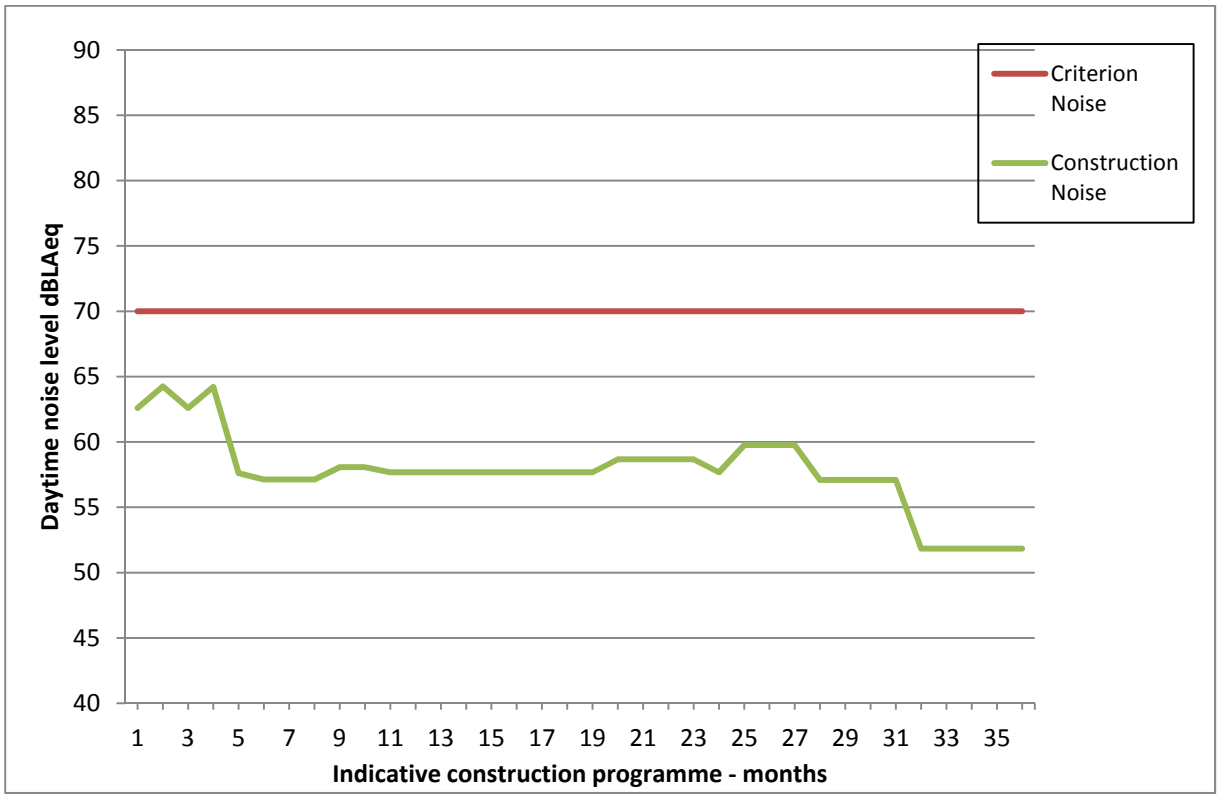
Vol 12 Plate G.6 Average monthly daytime noise level over duration of construction – 54-62 Lots Road (CD2)



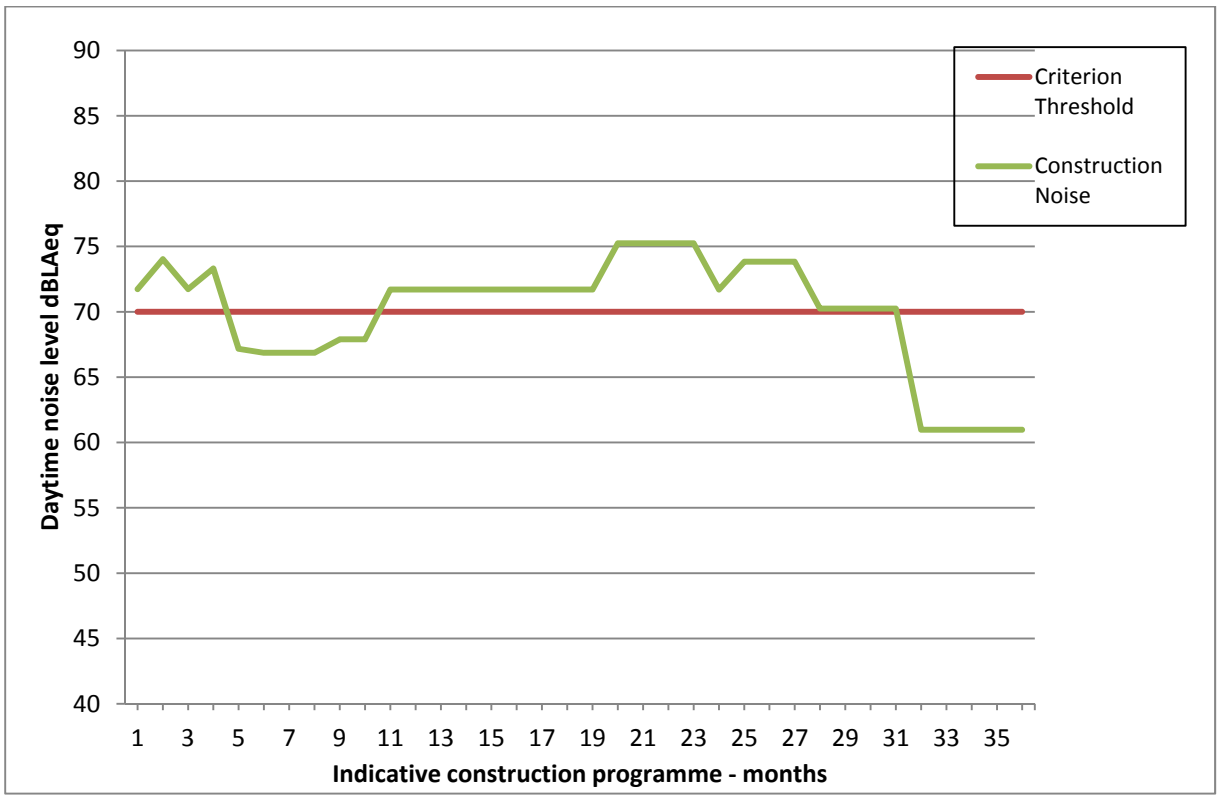
Vol 12 Plate G.7 Average monthly daytime noise level over duration of construction - 48-52 Lots Road (CD3)



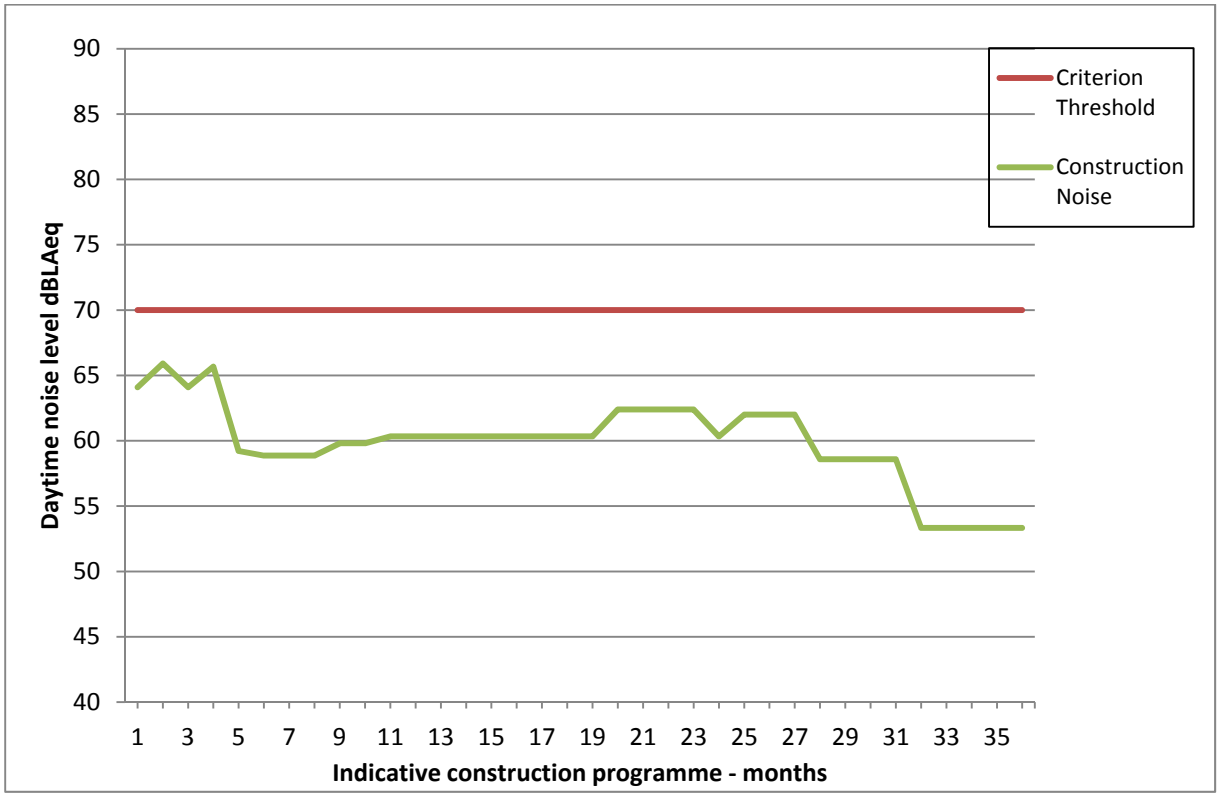
Vol 12 Plate G.8 Average monthly daytime noise level over duration of construction - 40-46 Lots Road (CD4)



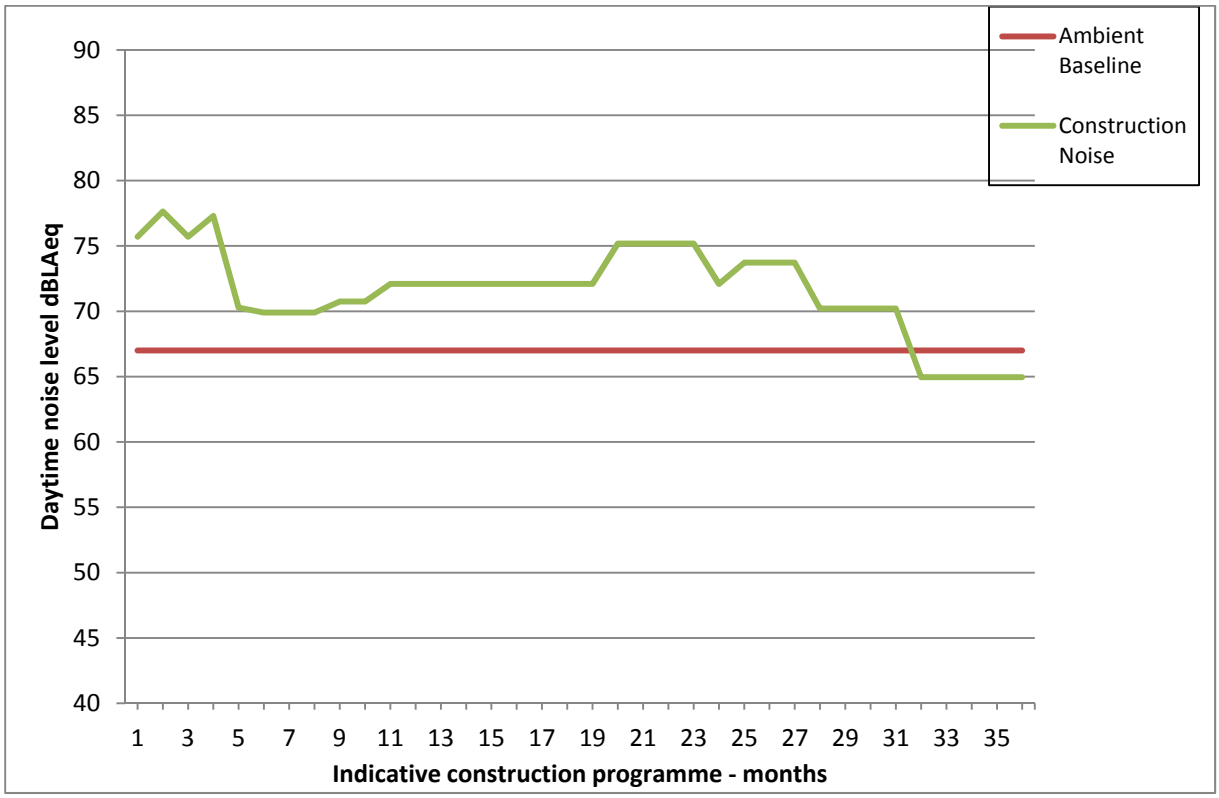
Vol 12 Plate G.9 Average monthly daytime noise level over duration of construction – Station House (CD5)



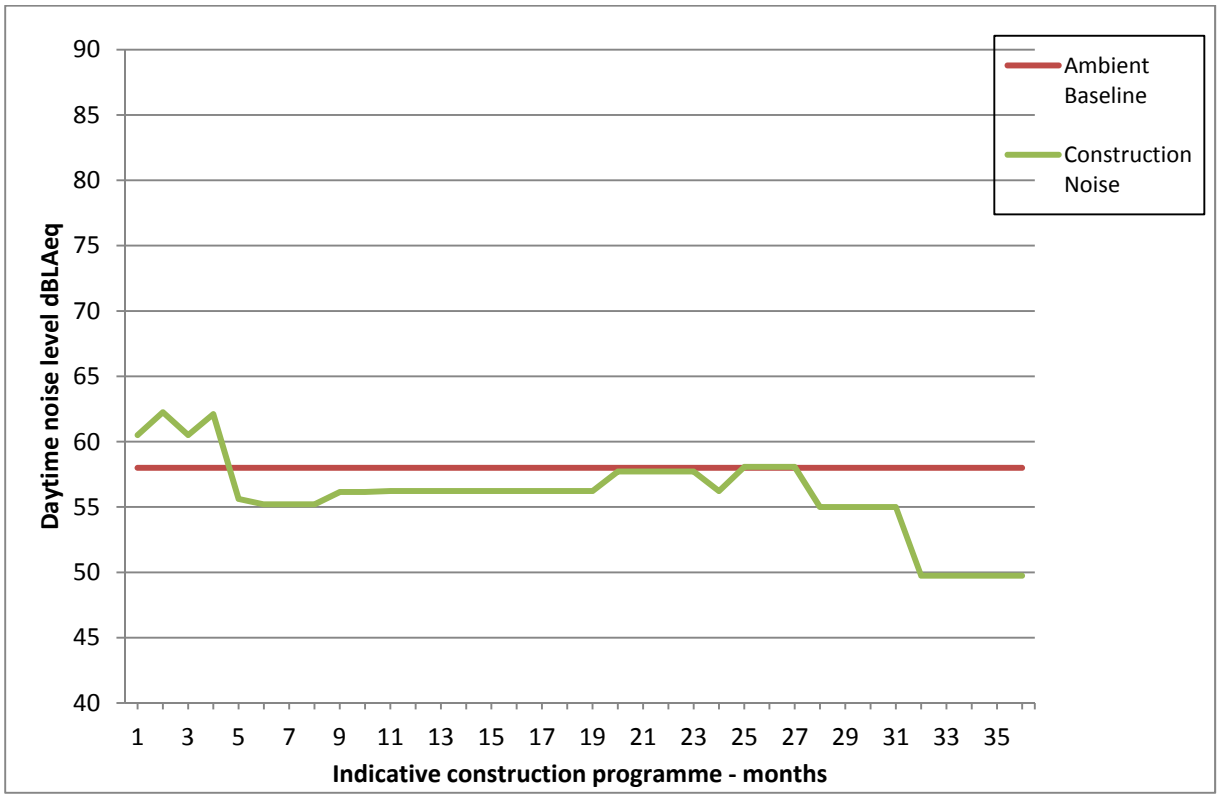
Vol 12 Plate G.10 Average monthly daytime noise level over duration of construction – 15 Lots Road Chelsea Wharf Apartments (CD6)



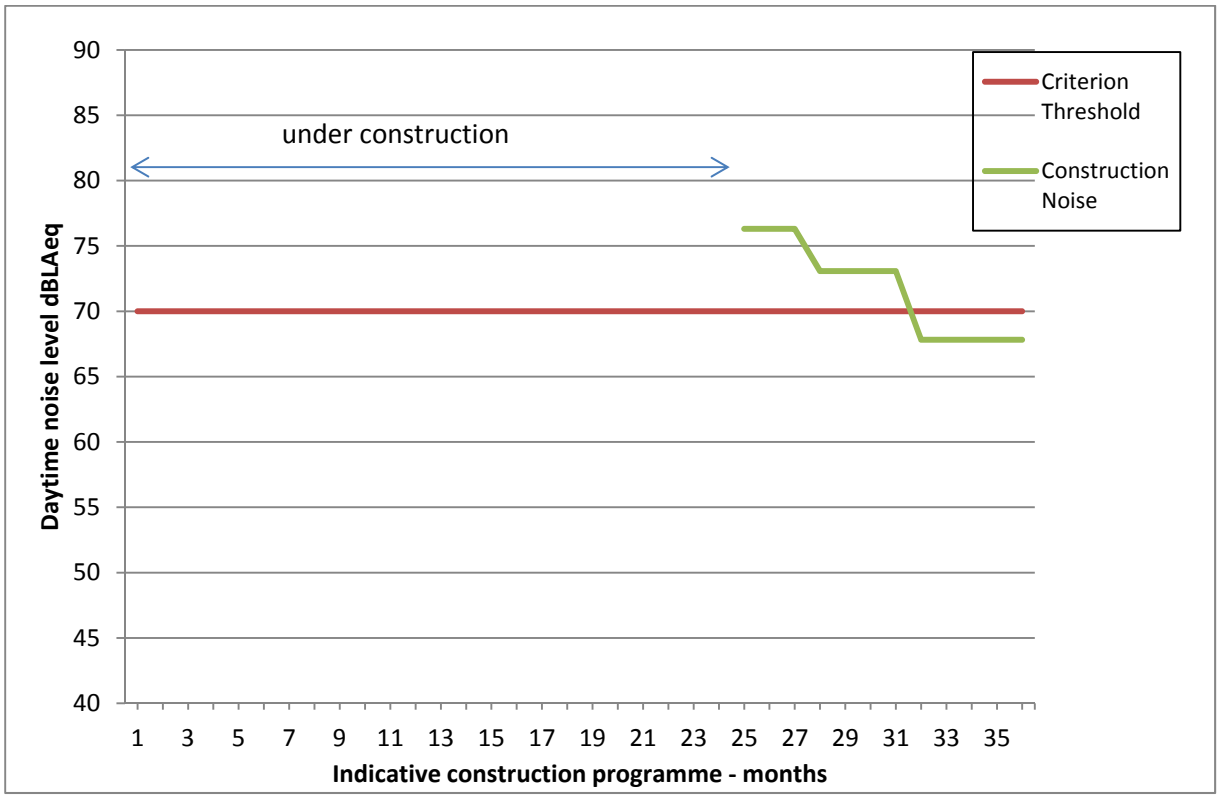
Vol 12 Plate G.11 Average monthly daytime noise level over duration of construction – Chelsea Wharf Offices (CD7)



Vol 12 Plate G.12 Average monthly daytime noise level over duration of construction – Cremorne Gardens (CD8)

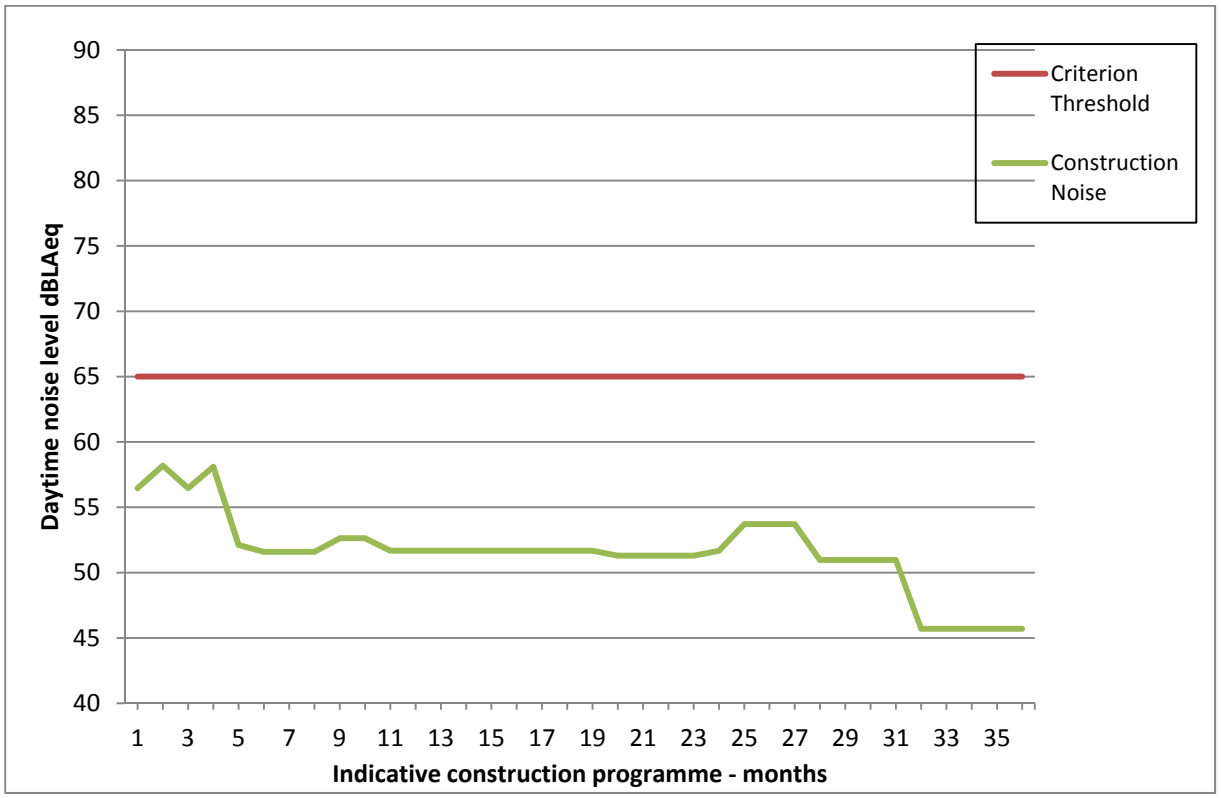


Vol 12 Plate G.13 Average monthly daytime noise level over duration of construction –Lots Road Power Station (mid-rise building) (CD9)



Vol 12 Plate G.14 Average monthly daytime noise level over duration of construction - Lots Road Power Station (high-rise tower) (CD10)

Vol 12 Plate G.15 Average monthly daytime noise level over duration of construction – Whistlers Avenue (CD11)



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

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

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Volume 12: Cremorne Wharf Depot appendices

Appendix H: Socio-economics

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Appendix H: Socio-economics

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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 in this socio-economic assessment, the community profile examines the 'immediate area' surrounding the construction site (ie, within an assessment area of 250m), a 'wider local area' (ie, within an assessment area of 1km) and the overall borough level (which in this case is the RB of Kensington and Chelsea).

H.1.3 The main protected characteristic groups concentrated[iii] within 250m of the site are:

a. persons of Black and Minority Ethnic (BME) groups

b. persons suffering from income and overall deprivation.

H.1.4 The main protected characteristic group concentrated within 1km of the site is persons suffering from income and overall deprivation.

H.1.5 Further detail on the socio-economic profile of the local community is provided below.

Resident population

H.1.6 The resident population was approximately 3,825 within 250m of the site and 37,025 within 1km at the time of the last census.

Gender and age

H.1.7 Of the total population within 250m of the site 51.3% residents are female. Females are also slightly more predominant than males within 1km (52.6%) and the RB of Kensington and Chelsea (52.2%), in line with the Greater London level (51.6%).

H.1.8 Vol 12 Table H.1 outlines age breakdown by assessment area, it illustrates that the proportion of under 16 year olds within 250m (19.2%) is

[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] 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.

broadly in line with Greater London levels (20.2%). Within 1km (15.2%) and at a borough wide level (15.6%), the proportions of under 16 year olds are somewhat lower.

H.1.9 The proportion of over 65 year olds within 250m (9.9%) is slightly lower than within 1km (11.9%), at the borough wide level (12.2%) and at the Greater London level (12.4%) as outlined in Vol 12 Table H.1.

Vol 12 Table H.1 Socio-economics – age breakdown by assessment area

Age group	Assessment area			
	Immediate area (250m)	Wider local area (1km)	Borough wide (RB of Kensington and Chelsea)	Greater London
Under 16 years old	19.2%	15.2%	15.6%	20.2%
Over 65 years old	9.9%	11.9%	12.2%	12.4%

Ethnicity

H.1.10 Vol 12 Table H.2 outlines ethnicity by assessment area, showing that within 250m of the site, White residents make up over two thirds of the population (70.5%) with BME groups comprising the remaining 29.5%. The proportion of White residents within 250m is broadly in line with the Greater London level (71.2%). Within 1km (81.0%) and at a borough level (78.6%) the proportion of White residents is somewhat higher than within 250m and at the Greater London level.

H.1.11 The proportion of Black residents within 250m (9.5%) is slightly higher than within 1km (8.4%) and at a borough wide level (7.0%), but slightly lower than the Greater London average (10.9%) as shown in Vol 12 Table H.2.

Vol 12 Table H.2 Socio-economics – ethnicity by assessment area

Ethnicity	Assessment area			
	Immediate area (250m)	Wider local area (1km)	Borough wide (RB of Kensington and Chelsea)	Greater London
White	70.5%	81.0%	78.6%	71.2%
BME	29.5%	19.0%	21.4%	28.8%
Asian	7.6%	3.7%	4.9%	12.1%
Black	9.5%	8.4%	7.0%	10.9%
Other	6.5%	3.5%	5.4%	2.7%
Mixed	5.8%	3.4%	4.1%	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 Christians are the predominant religious group within 250m of the site (54.9%) and 1km (65.1%), as well as within the RB of Kensington and Chelsea (62.0%). Muslims are the second most predominant religious group within 250m (14.5%), considerably higher than the proportion within 1km (5.7%), the wider borough (8.4%) and Greater London (8.5%).

Health indicators

H.1.13 Vol 12 Table H.3 outlines health indicators by assessment area, noting that the proportion of residents suffering from a long term limiting illness within 250m of the site (17.9%) is somewhat higher than at within 1km (14.4%) and at a borough wide level (13.6%). The proportion of residents claiming disability living allowance is highest within 250m (6.4%); almost twice as high as it is at a borough wide level (3.4%). The proportion within 1km (4.2%) is moderately lower than within 250m and broadly in line with that for Greater London (4.5%). See Vol 12 Table H.3 below.

Vol 12 Table H.3 Socio-economics – health indicators by assessment area

Health indicator	Assessment area			
	Immediate area (250m)	Wider local area (1km)	Borough wide (RB of Kensington and Chelsea)	Greater London
Long term limiting sick	17.9%	14.4%	13.6%	15.5%
Disability living allowance	6.4%	4.2%	3.4%	4.5%

H.1.14 In the Middle Layer Super Output Area (MSOA)[iv](Office of National Statistics, 2012)[5] which the construction site falls within, levels of adult obesity are in the second lowest quintile (ie, the lowest being the best) relative to Greater London. For the local borough overall, rates of obesity in children fall within the second highest quintile (ie, the highest being the worst) relative to other Greater London boroughs.

H.1.15 The borough ranks in the highest quintile (ie, the highest being the best) of all Greater London boroughs for both physically active adults and physically active children.

H.1.16 In the MSOA which the construction site falls within, the death rate by heart disease, strokes and circulatory disease within the MSOA fall within the lowest quintile (ie, the lowest being the best) relative to Greater

[iv] 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.

London; however cancer mortality rates are slightly higher and fall within the second lowest quintile.

H.1.17 Male and female life expectancy in the local MSOA is in the highest quintile relative to Greater London (ie, the highest being the best) with average life expectancy of both male and female residents being 84.9 to 93.1 years old.

Lifestyle and deprivation indicators

H.1.18 Vol 12 Table H.4 outlines lifestyle and income deprivation indicators by assessment area, showing that a reasonably high proportion of households within 250m of the site do not own cars (56.2%), moderately higher than within 1km (46.7%) and considerably higher than across Greater London overall (37.5%).

H.1.19 The incidence of deprivation within 250m, as measured by both income deprivation (59.9%) and overall deprivation (52.6%)[v], are considerably higher than that within 1km (27.1% and 15.9% respectively), within the RB of Kensington and Chelsea (20.8% and 22.9% respectively), and within Greater London (21.5% and 18.3% respectively), as shown in Vol 12 Table H.4

Vol 12 Table H.4 Socio-economics – lifestyle and income deprivation levels by area

Indicator	Assessment area			
	Immediate area (250m)	Wider local area (1km)	Borough wide (RB of Kensington and Chelsea)	Greater London
No car households	56.2%	46.7%	50.4%	37.5%
Income deprivation	59.9%	27.1%	20.8%	21.5%
Overall deprivation	52.6%	15.9%	22.9%	18.3%

[v] 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.

H.2 Baseline economic profile

H.2.1 This section presents a profile of the economy local to the proposed construction site at Cremorne Wharf Depot.

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 Royal Borough [RB] of Kensington and Chelsea) 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[vi].

Employment and businesses

H.2.4 Within approximately 250m of the site there are approximately 1,800 jobs.[vii] Vol 12 Table H.5[viii] illustrates the breakdown of employment by sector based on the UK Standard Industrial Classification (SIC) 2007[7]. 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 18% of employment within 250m, slightly less than within the RB of Kensington and Chelsea (20%), and slightly more than within Greater London (16%).

b. Real Estate Activities account for 17% of employment within 250m, more than double that within the RB of Kensington and Chelsea (7%) and over five times that within Greater London (3%).

c. Administrative and Support Service Activities account for 14% of employment within 250m, considerably more than within the RB of Kensington and Chelsea (6%) and Greater London (8%).

d. Professional, Scientific and Technical Activities account for 14% employment within 250m, double that within the RB of Kensington and Chelsea (7%) and somewhat more than within Greater London (11%).

e. Information and Communication accounts for 4% to 7% of employment at all three geographical levels.

f. Manufacturing account for 5% of employment within 250m, somewhat more than at the other two geographical levels (both 3%).

[vi] 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.

[vii] 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.

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

Vol 12 Table H.5 Socio-economics – employment by top six sectors (2012)

	Assessment area		
Sector (Standard Industrial Code 2007)	**Immediate area (250m)**	**Borough wide (RB of Kensington and Chelsea)**	**Greater London**
Wholesale and Retail Trade / Repair of Motor Vehicles and Motorcycles	18%	20%	16%
Real Estate Activities	17%	7%	3%
Administrative and Support Service Activities	14%	6%	8%
Professional, Scientific and Technical Activities	14%	7%	11%
Information and Communication	6%	4%	7%
Manufacturing	5%	3%	3%
Other (including unclassified)	27%	52%	51%

H.2.5 Within approximately 250m of the site there are approximately 330 businesses (defined here as business locations[ix]). The split of businesses by sector within 250m generally reflects the breakdown of employment by sector set out in Vol 12 Table H.5, with a relatively high number of businesses engaged in Professional, Scientific and Technical Activities (17%), Administrative and Support Service Activities (16%), Wholesale and Retail Trade / Repair of Motor Vehicles and Motorcycles (14%) and Information and Communication (7%). However, Real Estate Activities only account for 5% of businesses, despite generating 17% of employment.

H.2.6 Vol 12 Table H.6 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. Within approximately 250m of the site 92% of businesses employ one to nine employees, somewhat more than within both the RB of Kensington and Chelsea (85%) and Greater London (88%). Business units employing ten to 24 employees account for 6% of the total, slightly less than within the RB of Kensington and Chelsea (10%) and Greater London (8%).

H.2.7 For the sectors accounting for the greatest proportion of jobs and businesses within approximately 250m, the size banding profile of businesses is fairly similar, with businesses employing one to nine people accounting for between 86% and 92% of firms within each sector. This is

[ix] 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.

compared to an average across all sectors of 92%. In the Professional, Scientific and Technical Services and Wholesale and Retail Trade sectors, 8% to 9% of businesses employ ten to 24 employees, slightly more than the average across all sectors within 250m (6%), but comparable to levels within the RB of Kensington and Chelsea (10%) and Greater London (8%).

H.2.8 Within the Administrative and Support Service Activities sector 92% of businesses employ one to nine employees, greater than within the RB of Kensington and Chelsea (85%) and Greater London (88%). Conversely the Real Estate Activities sector has a lower than average proportion of businesses employing one to nine employees (86%) but a considerably greater proportion of businesses employing more than 250 employees (7%), compared to the average across all sectors and within both the RB of Kensington and Chelsea and Greater London (all 0%).

Vol 12 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)	92%	6%	2%	0%	0%	0%
Professional, Scientific and Technical Activities	89%	9%	2%	0%	0%	0%
Administrative and Support Service Activities	92%	4%	4%	0%	0%	0%
Wholesale and Retail Trade / Repair of Motor Vehicles and Motorcycles	88%	8%	2%	0%	2%	0%
- *Real Estate Activities*	86%	7%	0%	0%	0%	7%
Borough wide (RB of Kensington & Chelsea)	85%	10%	3%	1%	0%	0%
Greater London	88%	8%	2%	1%	1%	0%

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[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/

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[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.

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[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: **6.2.12**

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Appendix I: Townscape and visual

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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 Water Utilities Limited

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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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Appendix K: Water resources - groundwater

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Appendix K: Water resources – groundwater

K.1 Geology

K.1.1 A summary of the anticipated geological succession at the Cremorne Wharf Depot is shown in Vol 12 Table K.1.

Vol 12 Table K.1 Groundwater – anticipated geological succession

Period	Series	Group	Formation
Quaternary	Holocene	Superficial deposits	Made ground
			Alluvium
			Langley Silt
	Pleistocene		River Terrace Deposits
Palaeogene	Eocene	Thames	London Clay Formation

K.1.2 The superficial and solid geology in the vicinity of the site, as published by the British Geological Survey (BGS) (February 2009)[1], is shown in Vol 12 Figure 13.4.1 and Vol 12 Figure 13.4.2 respectively (see separate volume of figures).

K.1.3 The ground investigation undertaken for the Thames 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. The depths and thicknesses of geological layers are based on ground investigation boreholes drilled on site or in close proximity to the site; these are boreholes SA1098 (on site), SA1097 (approximately 67m to the north) and SR2075, SR2076 and SR2077 (overwater boreholes). The locations of boreholes around the site are shown in Vol 12 Figure 13.4.1 (see separate volume of figures). The depths and thicknesses of geological layers encountered are summarised in Vol 12 Table K.2.

Vol 12 Table K.2 Groundwater – anticipated ground conditions

Formation	Top elevation* mATD**	Depth below river bed (m)	Thickness (m)
RTD	100.0	0.0	2.0
London Clay			
B	98.0	2.0	13.5
A3ii	84.5	15.5	12.0
A3i	72.5	27.5	2.5
A2	70.0	30.0	10.0

Formation	Top elevation* mATD**	Depth below river bed (m)	Thickness (m)
Harwich	60.0	40.0	0.1
Lambeth Group			
USB	59.9	40.1	1.5
UMB	58.4	41.6	4.7
LtB/LSB	53.7	46.3	2.3
LMB	51.4	48.6	7.6
UPN (Gv)	43.4	56.2	2.4
UPN	41.0	58.6	1.4
Thanet Sand	40.0	60.0	10.5
Seaford Chalk	29.5	70.5	Not proven

** Top elevation of over-water boreholes is approximately 4m below assumed ground level.*
*** mATD = metres above tunnel datum. A commonly used term for sub-surface construction projects, which defines height above a datum set at -100mAOD (above Ordnance Datum).*

K.1.4 The combined sewer overflow (CSO) drop shaft and base slab at the Cremorne Wharf Depot site would extend down to approximately 62.96mATD and 60.96mATD respectively and would pass through the River Terrace Deposits, London Clay Formation, units B, A3ii and A3i and into the London Clay Formation, units A2.

K.1.5 The Lots Road connection tunnel would be constructed within the London Clay Formation, unit A2.

K.1.6 The interception chamber and culvert approximately 11.98m deep, as assumed for the purpose of this assessment, would extend down to 93.4mATD and into the London Clay Formation, unit B.

K.1.7 The borehole log from SA1098 (taken on land) indicates that Made Ground, containing concrete, brick, flint and tile, may be up to 7.15m thick at the Cremorne Wharf Depot site.

K.1.8 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 2.0m thick at the Cremorne Wharf Depot site.

K.1.9 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 A2, A3i-iii, B in decreasing age order. The London Clay Formation is expected to be 38m thick at the Cremorne Wharf Depot site.

K.1.10 The Harwich Formation comprises fine-grained glauconitic sand and rounded black flinty pebble beds, commonly deposited in a series of

superimposed channels. The thickness of Harwich formation is 0.1m at the site.

K.1.11 The Lambeth Group is made up of Upper Shelly Beds (1.5m thickness), Upper Mottled Beds (4.7m), Laminated Beds and Lower Shelly (combined 2.3m). The Upnor Formation is made up of the Upnor Gravels and Upnor at 2.4m and 1.4m thickness respectively.

K.1.12 The Thanet Sand and White Chalk (Seaford Chalk) lie below the Lambeth Group. The Thanet Sand is approximately 10.5m thickness and the Chalk is unproven.

K.2 Hydrogeology

K.2.1 A summary of the anticipated hydrogeological conditions at the Cremorne Wharf Depot is shown in Vol 12 Table K.3.

Vol 12 Table K.3 Groundwater – anticipated hydrogeological units

Group	Formation	Hydrogeology
Superficial deposits	River Terrace Deposits	Upper aquifer
Thames	London Clay	Aquiclude[i] (United States Geological Survey , August 1989)[2]
	Harwich	Aquitard[ii] ".(EA, Accessed April 2012)[3] / aquifer

K.2.2 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)[4]

K.2.3 The lower aquifer, comprising of the Upnor Formation, the Thanet Sands and the Chalk, is not expected to be encountered by the Thames Tunnel project at the Cremorne Wharf Depot site.

K.2.4 The CSO drop 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, the exception being unit A3ii which is regarded as the most porous section of this formation. It is anticipated that below the River Terrace Deposits the drop 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.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

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

[ii] *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).*

boreholes, mainly within the lower aquifer, across London which records are available dating back over 50 years.

K.3.2 Information on groundwater levels for this assessment was collected from an on site borehole (SA1098). This borehole has a response zone[iii] (EA, 2006)[5] and monitors groundwater levels in the Made Ground (absent in overwater boreholes but present in on land boreholes such as SA1098) and the River Terrace Deposits. . The response zone depth, the monitored strata and the frequency of monitoring are detailed in Vol 12 Table K.4. The manual dip data collected from this monitoring borehole is shown in Vol 12 Table K.5.

Vol 12 Table K.4 Groundwater – monitoring borehole

Borehole	Response zone depths mATD	Strata	Monitoring
SA1098	104.33 – 96.63	Made Ground/ River Terrace Deposits	Sporadic dips

Vol 12 Table K.5 Groundwater – summary level data

Borehole	Period of record	Maximum Month Year		Minimum Month Year		Average over period of record	
		mbgl	mATD	mbgl	mATD	mbgl	mATD
SA1098	21/10/09 – 12/07/2012	2.32 (October 2010)	103.01 (October 2010)	5.97 (October 2011)	99.36 (October 2011)	4.59	100.74

K.3.3 The recorded water levels in the River Terrace Deposits at SA1098 range from 99.36mATD to 103.01mATD. These water levels fluctuate above and below the top of the River Terrace Deposits at 100mATD. The ground investigation boreholes indicate that the Made Ground was drilled dry and that the River Terrace Deposits are not consistently fully saturated at this location; however the low permeability Made Ground and Alluvium may confine these deposits in places.

K.3.4 A plot of the groundwater levels within the River Terrace Deposits in the vicinity of the site is shown in Vol 12 Figure 13.4.3 (see separate volume of figures). In the absence of further monitoring boreholes within the upper aquifer at the site, 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 east towards the River Thames in these shallow deposits.

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

K.3.5 The EA network does not include any monitoring boreholes sufficiently close to the Cremorne Wharf Foreshore site to provide representative water level in the upper aquifer.

K.4 Groundwater abstractions and protected rights

Groundwater licensing policy

K.4.1 The London Catchment Abstraction Management Strategy (CAMS), (EA, 2006)[6] 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 Cremorne Wharf Depot site.

K.4.3 No dewatering of the upper or lower aquifers is anticipated at the Cremorne Wharf 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 of the site have been identified.

K.4.5 There are no licensed or unlicensed abstractions from the upper aquifer within 1km radius of the 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.5 Groundwater source protection zones

K.5.1 The EA defines Source Protection Zones (SPZ) around all major public water supply abstractions sources and large licensed private abstractions in order to safeguard groundwater resources from potentially polluting activities.

K.5.2 The site is not within any public water supply SPZ. The nearest SPZ to the site is 2km to the east.

K.6 Environmental designations

K.6.1 There are no environmental designations relevant to groundwater such as SSSI, SAC or SNCIs within 1km of the site.

K.7 Groundwater quality and land quality assessment

K.7.1 The Cremorne Wharf Depot site is an existing waste management depot, which is considered a potential contaminative onsite land use (Vol 12 Section 8). Land quality may impact on groundwater quality through the

creation or promotion of preferential pathways for existing contamination during construction of the proposed development.

K.7.2 The groundwater quality data presented in Vol 12 Table K.6 has been sourced from the ground investigation and monitoring works undertaken as part of the Thames Tunnel project and includes data from one monitoring borehole located on site (SA1098),these locations are shown in Vol 12 Figure 13.4.1 (see separate volume of figures). Any exceedances of the UK drinking water standards (2000)[7] or relevant Environmental Quality Standards (EQS) (Defra , 2010)[8] are shaded in blue in this table.

K.7.3 The data shows only one exceedance of the relevant standards for polycyclic aromatic hydrocarbons (PAH's) at SA1098. PAH's may be formed during a range of human activities, including incomplete combustion of carbon-based fuels and other industrial processes (EA, October 2010)[9]. In addition, PAH's are considered to be Priority Hazardous Substances under the Water Framework Directive (Commission of the European Communities, 2009)[10].

K.7.4 The EA monitors groundwater quality at a number of points across London, mainly within the Chalk and Lower London Tertiaries (Lambeth Group) (EA, 2006). The groundwater quality information provided from this network is not relevant to the site, where construction would take place entirely with the London Clay.

K.7.5 The land quality data from the ground investigation boreholes used in the groundwater quality assessment show exceedances of the human health screening values(EA, 2009)[11] (soil guideline values designed to be protective of human health) with respect to hydrocarbons within the River Terrace Deposits. . Further detail is provided in the land quality assessment (see Vol 12 Appendix F).

Vol 12 Table K.6 Groundwater – groundwater quality results

Source of data*				SI
Name				SA1098
Hydrogeological unit**				RTD
Distance from shaft	**EQS Criteria**			28m
Chemical	**Value**	**Units**	**Source**	2009
1,1,1 - Trichloroethane	100	ug/l	SW Regs 98	-
1,1,2 - Trichloroethane	400	ug/l	SW Regs 98	-
1,2 - Dichloroethane {Ethylene Dichloride}	3	ug/l	WS Regs 20	-
2,4 - Dichlorophenol	20	ug/l	WFD 2010	<0.4
2,4 - Dimethylphenol {2,4-Xylenol}	-	ug/l	-	<0.4
2,4,6 - Trichlorophenol	-	ug/l	-	<0.4
2,6 - Dichlorophenol	-	ug/l	-	<0.4
4 - Chloro - 3- Methylphenol {P-Chloro-M-Cresol}	40	ug/l	WFD 2010	<0.4
Acenaphthene	-	ug/l	-	<0.01
Acenaphthylene	-	ug/l	-	<0.01
Aliphatics >C10-C12	-	ug/l	-	7
Aliphatics >C12-C16 (Aqueous)	-	ug/l	-	6
Aliphatics >C16-C21 (Aqueous)	-	ug/l	-	7
Aliphatics >C21-C35 (Aqueous)	-	ug/l	-	11
Aliphatics >C6-C8	-	ug/l	-	<0.1
Aliphatics >C8-C10	-	ug/l	-	<0.1
Aliphatics C5-C6	-	ug/l	-	<0.1
Alkalinity (Carbonate)	-	mg/l as CaCO3	-	-
Alkalinity Ph 4.5 - As CaCO3	-	mg/l as CaCO3	-	380
Aluminium Total	200	ug/l as Al	DWS 2010	-
Ammonia - As N	0.39	mg/l as N	WS Regs 20	-
Ammoniacal nitrogen	-	mg/l	-	1.9
Anthracene	0.1	ug/l	SW WFD	<0.01
Aromatics >C7-C8	50	ug/l	WFD 2010	<0.1

Source of data*				SI
Name				SA1098
Hydrogeological unit**				RTD
Distance from shaft	**EQS Criteria**			28m
Chemical	**Value**	**Units**	**Source**	2009
Aromatics >EC10-EC12	-	ug/l	-	9
Aromatics >EC12-EC16 (Aqueous)	-	ug/l	-	10
Aromatics >EC16-EC21 (Aqueous)	-	ug/l	-	15
Aromatics >EC21-EC35 (Aqueous)	-	ug/l	-	23
Aromatics >EC8-EC10	-	ug/l	-	<0.1
Aromatics C6-C7	1	ug/l	DWS 2010	<0.1
Arsenic Total	10	ug/l as As	DWS 2010	<1
Atrazine { }	0.1	ug/l	DWS 2010	-
Bentazone	0.1	ug/l	DWS 2010	-
Benzene	1	ug/l	DWS 2010	<1
Benzo (a) anthracene	-	ug/l	-	<0.01
Benzo[a]Pyrene	0.01	ug/l	DWS 2010	<0.01
Benzo[b]Fluoranthene	0.03	ug/l	WFD D 10	<0.01
Benzo[g,h,i]Perylene	0.002	ug/l	WFD D 10	<0.01
Benzo[k]Fluoranthene	0.03	ug/l	WFD D 10	<0.01
Boron Total	1000	ug/l as B	DWS 2010	<100
Bromate	10	ug/l as BrO3	DWS 2010	-
Cadmium Total	5	ug/l as Cd	DWS 2010	<2
Calcium Total	250	mg/l as Ca	DWS 2010	-
Carbendazim / Benomyl	0.1	ug/l	FW List II	-
Carbetamide	-	ug/l	-	-
Carbon tetrachloride	3	ug/l	DWS 2010	-
Chlorfenvinphos	0.1	ug/l	DWS 2010	-
Chloride	250	mg/l as Cl	DWS 2010	250
Chloroform	100	ug/l	WS Regs 20	-
Chlortoluron	2	ug/l	FW List II	-
Chromium Total	50	ug/l as Cr	DWS 2010	<5
Chrysene	-	ug/l	-	<0.01
Clopyralid	-	ug/l	-	-

Source of data*				SI
Name				SA1098
Hydrogeological unit**				RTD
Distance from shaft	**EQS Criteria**			28m
Chemical	**Value**	**Units**	**Source**	2009
Conductivity @ 20°C	2500	uS/cm	WS Regs 20	1350
Copper Total	2000	ug/l as Cu	DWS 2010	<2
Cresols	-	ug/l	-	<0.4
Cyanazine	0.1	ug/l	DWS 2010	-
Cyanide (Free)	50	ug/l as CN	DWS 2010	<20
Cyanide (Total)	50	ug/l as CN	DWS 2010	<40
Cypermethrin	0.0001	ug/l	WFD 2010	-
Dalapon	-	ug/l	-	-
Diazinon	0.1	ug/l	DWS 2010	-
Dibenz-[A,H]-Anthracene	-	ug/l	-	<0.01
Dichloromethane	20	ug/l	WFD 2010	-
Dichlorprop	0.1	ug/l	DWS 2010	-
Diuron	0.1	ug/l	DWS 2010	-
Ethylbenzene	-	ug/l	-	<1
Fluoranthene	0.2	ug/l	EEC MAC	0.03
Fluorene	-	ug/l	-	0.01
Fluoride	1.5	mg/l as F	DWS 2010	-
Glyphosate	-	ug/l	-	-
Indeno-[1,2,3-Cd]-Pyrene	0.002	ug/l	WFD D 10	<0.01
Isoproturon (Diip1,3Dithiolan-2-Ylidenemalonate)	0.1	ug/l	DWS 2010	-
Lead Total	10	ug/l	WS Regs 20	<4
Magnesium Total	50	mg/l as Mg	EEC MAC	14
MCPA {2-methyl-4-chlorophenoxyacetic acid}	0.1	ug/l	DWS 2010	-
Mecoprop { }	0.1	ug/l	DWS 2010	-
Mercury Total	1	ug/l Hg	WS Regs 20	<0.05
Metazachlor	-	ug/l	-	-
MTBE {Methyl Tert-Butyl Ether}	-	ug/l	-	<1
Multi Residual Scan	-	ug/l	-	-

Source of data*				SI
Name				SA1098
Hydrogeological unit**				RTD
Distance from shaft	**EQS Criteria**			28m
Chemical	**Value**	**Units**	**Source**	2009
Naphthalene	1.2	ug/l	WFD D 10	<0.01
Nickel Total	20	ug/l as Ni	DWS 2010	<10
Nitrate - N	11.3	mg/l as N	WS Regs 20	<0.1
Permethrin (Cis + Trans)	0.01	ug/l	WFD D 10	-
pH	10	pH units	DWS 2010	7.1
Phenanthrene	-	ug/l	-	0.04
Phenol	0.5	ug/l	EEC MAC	<0.4
Phenol (Pentachlorophenol [PCP])	-	ug/l	-	-
Phenols Total For SWAD (7 Compounds)	-	ug/l	-	-
Polynuclear Aromatic Hydrocarbons (Total)	0.1	ug/l	DWS 2010	0.28
Potassium Total	-	mg/l as K	-	-
Propazine	0.1	ug/l	DWS 2010	-
Propetamphos	0.1	ug/l	DWS 2010	-
Pyrene	-	ug/l	-	0.2
Selenium	10	ug/l as Se	DWS 2010	<3
Simazine	0.1	ug/l	DWS 2010	-
Sodium Total	200	mg/l as Na	DWS 2010	120
Sulphate	250	mg/l as SO4	DWS 2010	51
Sulphide	-	ug/l	-	<10
Terbutryn	0.1	ug/l	DWS 2010	-
Tetrachloroethylene	-	ug/l	-	-
Toluene (Methylbenzene)	50	ug/l	WFD 2010	<1
Total Aliphatic TPH	-	ug/l	-	31
Total Aromatic TPH	-	ug/l	-	56
Total Chemical Oxygen Demand	-	mg/l	-	48
Trichloroethene (Trichloroethylene)	10	ug/l	DWS 2010	-
Trietazine	-	ug/l	-	-
Trifluralin	0.1	ug/l	DWS 2010	-
Turbidity	1	FTU	WS Regs 20	-

Source of data*				SI
Name				SA1098
Hydrogeological unit**				RTD
Distance from shaft	**EQS Criteria**			28m
Chemical	**Value**	**Units**	**Source**	2009
Xylene (Meta & Para){1,3+1,4-Dimethylbenzene}	30	ug/l	WFD 2010	<1
Zinc Total	50	ug/l as Zn	DWS 2010	5
Notes:				
xx	GAC1 exceedance			
' - '	Not tested			
' < '	Less than MDL			

** Origin of data: SI – Groundwater quality data collected during site investigation works by Thames Tunnel project (2009-2011), TT – Groundwater quality data collected during ongoing monitoring works by Thames Tunnel project (2009-2012)*

*** Hydrogeological unit: LCK – Lewes Nodular Chalk, CK – Chalk, SCK – Seaford Chalk, RTD – RTD, ALV - Alluvium*

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)[12] shows no groundwater body designation for either the upper or lower aquifers within the area in which the Cremorne Wharf Foreshore site 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 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 Cremorne Wharf Depot assessment is given in Vol 12 Table K.7.

Vol 12 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)

Source	Data	Date received	Notes
LB's*	Unlicensed groundwater abstraction boreholes and their details	June 2009	Contacted 14 London Boroughs 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 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] United States Geological Survey (USGS) Office of Water Data Coordination. *Glossary of Hydrologic Terms in the Federal Glossary of Selected Terms: Subsurface-Water Flow and Solute Transport*, (August 1989).

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

[4] Environment Agency. See citation above.

[5] 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.

[6] 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.

[7] *The Water Supply (Water Quality) Regulations*, (2000). Available at: http://www.legislation.gov.uk/uksi/2000/3184/contents/made.

[8] Defra. *River Basin Districts Typology, Standards and Groundwater Threshold Values* (Water Framework Directive) (England and Wales) Direction (2010). Available at: http://www.defra.gov.uk/environment/quality/water/legislation/water-framework-directive/.

[9] Environment Agency. *REACH Annex XVII Restrictions Polycyclic-aromatic Hydrocarbons (PAHs) Guidance Note Part 1* (October 2010). Available at: http://www.environment-agency.gov.uk/static/documents/Business/Part_1_PAH_Guidance_Note.pdf.

[10] Commission of the European Communities. *Directive of the European Parliament and of the Council on environmental quality standards in the field of water policy and amending Directive 2000/60/EC*. (2009). Available at: http://ec.europa.eu/environment/water/water-dangersub/pdf/com_2006_397_en.pdf?lang=_e.

[11] Environment Agency. *Soil Guideline Value Reports* (2009). Available at: http://www.environment-agency.gov.uk/research/planning/64015.aspx.

[12] 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.

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.12**

Volume 12: Cremorne Wharf Depot appendices

Appendix L: Water resources - surface water

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

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Appendix L: Water resources – surface water

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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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Appendix M: Water resources - flood risk

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Appendix M: Water resources – flood risk

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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 Cremorne Wharf Depot is provided below.

Local policy

Strategic Flood Risk Assessment

M.1.4 The site lies within the Royal Borough (RB) of Kensington and Chelsea. The borough produced a Strategic Flood Risk Assessment (SFRA) (JBA and Entec, 2009)[2], which outlines the main flood sources to the borough. 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 River 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 Thames to less than 0.1%. The risk of flooding is therefore a residual risk associated with a breach or overtopping of 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 11-25' 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) and carries a low residual risk from both breaching and overtopping.

d. The existing flood defence near the site is in fair condition and is identified as a likely breach location in the SFRA.

e. The site is situated within an area identified as having increased risk of surface water flooding, with records of properties flooding nearby in 2007.

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.

Surface Water Management Plan

M.1.8 The RB of Kensington and Chelsea, in partnership with the Greater London Authority (GLA), Thames Water and the EA has produced a Surface Water Management Plan (SWMP) (GLA, 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 According to the SWMP:

a. The site does not lie within a Critical Drainage Area (CDA)i

b. The site lies along an identified flow path for the 1% AEP + 30% climate change rainfall event.

Regional policy

Thames Estuary 2100

M.1.10 The site lies on the edge of the Hammersmith Policy Unit which has been assigned flood risk management policy 'P5' within Thames Estuary 2100 (TE2100) Plan (EA, 2012)[4], meaning that further action will be taken to reduce flood risk beyond that required to mitigate the impact of with climate change.

M.1.11 The TE2100 Plan outlines that the local sources of flood risk (relative to Cremorne Wharf Depot) as including:

a. tidal from the River Thames

b. heavy rainfall and urban drainage sources

c. a risk of groundwater flooding from superficial strata which is possibly connected to high water levels in the 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 to 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 vision to increase flood risk awareness within the area.

M.1.14 Adjacent to the Hammersmith Policy Unit is the London City Policy Unit. Within this policy unit it is acknowledged that there are long lengths of eroding foreshore at Chelsea and that it may be necessary to set the defences back to avoid erosion damage.

[i] Area susceptible to surface water flooding

London Regional Flood Risk Appraisal (RFRA)

M.1.15 For the reach between Hammersmith Bridge and the Thames Barrier (City Reach) the London Regional Flood Risk Appraisal (RFRA) (GLA, 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 acceptable and cost effective way. Development should be designed in such a way as to take opportunities to reduce flood risk and include resilience.

M.1.16 There is particular concern surrounding confluences of tributaries into the tidal River Thames 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.1.17 The RFRA indicates that 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. *Royal Borough of Kensington and Chelsea Strategic Flood Risk Assessment Final Report*. (Aug 2009).

[3] Greater London Authority. *Royal Borough of Kensington and Chelsea 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.* (Oct 2009).

Thames Tideway Tunnel
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Volume 12: Cremorne Wharf Depot appendices

Appendix N: Development schedule

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Appendix N: Development schedule

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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 12 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 12 Table N.1 Development schedule for Cremorne Wharf Depot

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		2018 (Site Year 1 of construction and peak construction traffic year)	2023 (Year 1 of operation)		
Cremorne Wharf	On site	PP/12/02224	RBKC Corporate Property Department	Following demolition of existing buildings, construction of a 9 storey building (including 2 basement levels) and a stand-alone two storey building to provide 1543sqm of B1 accommodation for small and medium sized enterprises, 48 C3 class (residential) units, including affordable housing, with associated parking, access landscaping and site works (major development)	C	Not started	Under construction	RBKC have signed an exclusivity agreement to work with Thames Water on this site. The pending application will not commence until after Thames Tideway Tunnel works are completed at Cremorne Wharf Depot.	**2018:** Neither (construction not started) **2023:** Cumulative
Lots Road Power Station	Adjacent	PP/02/01324 (RBKC portion), 2002/03132/FUL (LBHF portion)	Circadian Ltd (part of Hutchison Whampoa)	**RBKC part:** Conversion of Power Station to provide a mix of residential, retail, office, business and restaurant uses, together with erection of a 30 storey residential tower with ground floor gym, a 3-8 storey building incorporating commercial and residential uses, a 7 storey residential building, associated parking, servicing and landscaping, and works to Chelsea Creek, including three pedestrian bridges. **LBHF part:** Demolition of buildings ancillary to the Lots Road Power Station and redevelopment of all unbuilt land to provide 395 units of residential accommodation (comprising 100 one bedroom units, 157 two bedroom units, 113 three bedroom units and 21 four bedroom units 2 five bedroom units and 2 six bedroom units) together with 267 car parking spaces, a gymnasium (823 sq.m) and associated works to Chelsea Creek and Chelsea Basin, including the construction of three bridges over the creek.	A	Under construction	100% complete & operational	Meeting with Hutchison Whampoa in December 2011. Development expected to be mostly complete in 2019.	**2018:** No base case Cumulative = whole development **2023:** Base case = whole development No cumulative

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		2018 (Site Year 1 of construction and peak construction traffic year)	2023 (Year 1 of operation)		
Chelsea Creek (land bounded by Imperial Road and Fulham Gasworks and Railway Line and Imperial Wharf J2)	Approx 300m southwest	2011/01472/COMB	St George West London Ltd	Hybrid Planning Application (part outline/part detailed) for the mixed use development of the site following demolition of existing office building, comprising 489 residential units (including 147 affordable residential units), 1,190 sq. m of commercial floorspace (Use Class A1-A5), 8,896 sq. m of office floorspace (Use Class B1), within seven buildings ranging from six to eight storeys in height, and a 25 storey building; formation of water basin, two canals and navigable lock to replace existing Chelsea Creek barrier gates; provision of public and private open space; cycle and 402 car parking spaces at basement level. Approval sought for Access, Layout and Scale, with matters of Landscaping and Appearance reserved for later determination.	B	Blocks C, D & E complete & operational Blocks A, B, F & G under construction	100% complete & operational	Environmental Statement. NTS and section 6 on construction programme. The construction programme will span approximately nine years (from 2012 to 2021) for the construction of Blocks A-G. Construction will be broken into phases and it is currently envisaged that the development will be commenced from the Imperial Road side with Blocks C, D and E being built out first. On this basis it is assumed that this will be built out by 2018 with remaining blocks still under construction. The whole development will be built out by 2021.	**2018**: Base case = Blocks C, D & E Cumulative = Blocks A, B, F & G **2023**: Base case (all blocks)
Imperial Wharf	Approx 500m south	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	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 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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