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

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Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.10**

Volume 10: Carnwath Road Riverside site assessment

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

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January 2013

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Volume 10: Carnwath Road Riverside site assessment

Section 1: Introduction

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1 Introduction

1.1.1 This volume of the Environmental Statement of the Thames Tideway Tunnel project presents the results of the environmental impact assessment (EIA) of the proposed development at the Carnwath Road Riverside site.

1.1.2 The proposal at this site is to drive the tunnel boring machine (TBM) to Acton Storm Tanks. The TBM used to excavate the main tunnel driven from Kirtling Street would be removed at Carnwath Road Riverside. In addition, there would be a connection tunnel driven from Dormay Street to Carnwath Road Riverside. There would be no combined sewer overflow (CSO) interception at this site.

1.1.3 The site and environmental context are described in Section 2. The proposed development, comprising both the construction and operational phases, is described in Section 3. Those elements of the proposal for which development consent is sought are described followed by a description of the assumptions applied to the assessment of construction and operational effects. Finally in Section 3.6, the main alternatives which have been considered for this site are presented.

1.1.4 Sections 4 to 15 present the environmental assessments for each topic, which are presented alphabetically. The order of these topics and the structure of each assessment remains the same across different sites.

1.1.5 Figures and appendices for this site are appended separately (Vol 10 Carnwath Road Riverside figures and Vol 10 Carnwath Road Riverside appendices). In addition, there is a separate glossary and abbreviations document which explains technical terms used within this assessment.

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Volume 10: Carnwath Road Riverside site assessment

Section 2: Site context

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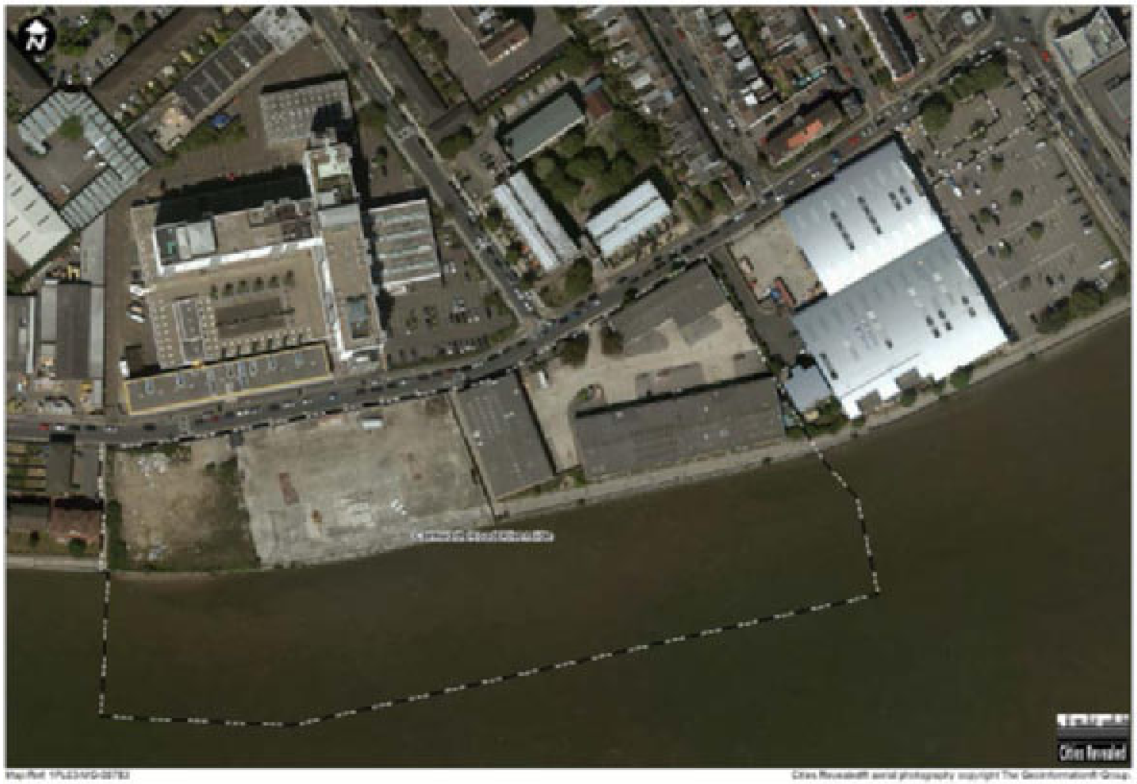
2 Site context

2.1.1 The proposed development site is located in the London Borough (LB) of Hammersmith and Fulham. It comprises two parts: a main site which from west to east includes Whiffin Wharf (which is not a safeguarded wharf), Hurlingham Wharf which is a safeguarded wharf under the *London Plan* and Carnwath Road Industrial Estate. The main site also extends into the River Thames.

2.1.2 The second, smaller part of the proposed development site is the Carnwath Road Riverside highway works site located at the junction of Carnwath Road and Wandsworth Bridge Road. The main site and highway works site are defined by the limits of land to be acquired or used (LLAU) and cover areas of 3.49 hectares and 0.12 hectares respectively. The site context and location is indicated in Vol 10 Figure 2.1.1 (see separate volume of figures). All references to the site in this assessment are to the main site unless otherwise indicated.

2.1.3 The main site is bounded to the north by Carnwath Road, to the east by a residential block at 5 Carnwath Road, to the south by the River Thames and to the west by residential dwellings with the nearest block at 89-101 Carnwath Road. The small highway works site is located at the junction of Wandsworth Bridge Road and Carnwath Road encompassing the northeast corner of a superstore car park. Vol 10 Plate 2.1.1 below provides an aerial view of the site.

Vol 10 Plate 2.1.1 Carnwath Road Riverside site – aerial photograph



2.1.4 Existing access to the site is via Carnwath Road. The closest train station is Putney Bridge Underground approximately 1.1km to the west of the site. The Thames Path public rights of way (PRoW) runs along the western and northern boundary of the site then extends southwards through the site and follows the River Thames along the frontage of the Carnwath Road Industrial Estate.

2.1.5 Within the site there are commercial buildings and hard standing. Whiffin Wharf and Hurlingham Wharf have not been used as wharfs for more than ten years. The general pattern of existing land uses within and around the site is shown in Vol 10 Figure 2.1.2 (see separate volume of figures).

2.1.6 Photographs of the site and surrounding area are presented below in Vol 10 Plate 2.1.2 to Vol 10 Plate 2.1.5.

Vol 10 Plate 2.1.2 Carnwath Road Riverside – view north from river towards site

Vol 10 Plate 2.1.3 Carnwath Road Riverside – Thames River Path looking east towards site with 89-101 Carnwath Road to the north (left)

Vol 10 Plate 2.1.4 Carnwath Road Riverside – view north towards 1-5 Carnwath Road residential units adjacent to eastern boundary of site

Vol 10 Plate 2.1.5 Carnwath Road Riverside – Riverside Quarter and transfer station opposite the Carnwath Road Riverside site within the London Borough of Wandsworth

2.1.7 There are a number of receptors in proximity to the site and these include residential, educational, commercial and recreational receptors as follows (approximate closest distance to the proposed main site hoarding is given):

a. residential

   i 5 Carnwath Road adjacent to the east of the site Carnwath Road and 89 -1-1 Carnwath Road to the west of the site

b. Educational

   i Thomas' London Day School 105m north of site hoarding

c. commercial

   i B1 Offices/studios (50 Carnwath Road) 10m to the north

d. Recreational

i Thames Path located adjacent and within the site.

2.1.8 Environmental designations for the site and immediate surrounds are shown in Vol 10 Figure 2.1.3 (see separate volume of figures).

2.1.9 The site is within the LB of Hammersmith and Fulham air quality management area (AQMA) declared for nitrogen dioxide (NO_2) and particulate matter (PM_{10}).

2.1.10 There are no designated statutory nature conservation sites within the local area although the foreshore area falls within the River Thames and Tidal Tributaries Site of Importance for Nature Conservation (SINC) (Metropolitan level).

2.1.11 The site does not contain any nationally designated heritage assets. There are no listed buildings within or adjacent to the site. There is a modernist mural painted on The Piper Building on the opposite side of Carnwath Road are locally listed.

2.1.12 The site lies within the Sands End Conservation Area. It is not within an Archaeological Priority Area.

2.1.13 There are no tree preservation orders (TPOs) within or adjacent to the site.

2.1.14 There is potential for contamination of the site to have occurred from several previous land uses. These uses include: wharf operations, tanks, electrical substations, garage services, and printers. The local geology comprises made ground, river terrace gravel and London clay.

2.1.15 The Carnwath Road Riverside site is partially in the River Channel which lies within Flood Zone 3b, functional flood plain. The area of the site which lies behind the flood defences is classified as Flood Zone 3 and defended to the 1 in 1000 year flood level.

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Volume 10: Carnwath Road Riverside site assessment

Section 3: Proposed development

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3 Proposed development

3.1 Overview

3.1.1 The Carnwath Road Riverside site is a main tunnel drive and reception site.

3.1.2 The proposed development includes driving the tunnel boring machine from this site westwards to Acton Storm Tanks. In addition, the tunnel boring machine, used to excavate the main tunnel driven from Kirtling Street, would be removed at Carnwath Road Riverside. It would also receive the Frogmore connection tunnel boring machine. There would be no CSO interception at this site. A shaft would be constructed and the tunnel boring machine would be launched through the base of the shaft and driven west to Acton Storm Tanks.

3.1.3 The geographic extent of the proposals for which development consent is sought is defined by the limits of land to be acquired or used (LLAU).

3.1.4 This section of the assessment provides a description of the proposed development. The defined project for which consent is sought is described in Section 3.2. In Section 3.3, assumptions are presented on how the development at this site is likely to be constructed and includes the assumed programme and typical construction activities. Section 3.4 sets out operational assumptions in terms of operational structures and typical maintenance regime. These construction and operational assumptions underpin the assessment.

3.1.5 Other developments may become operational in advance of or during the Thames Tideway Tunnel project thereby changing the baseline conditions. In order to undertake an accurate assessment it is necessary to compare the predicted situation with the Thames Tideway Tunnel project in place with this future baseline conditions ('base case') (rather than comparing it with the current conditions). In addition, other developments may be under construction at the same time as construction or operation of the Thames Tideway Tunnel project and this could lead to cumulative effects. Information regarding schemes included in the base case and in the cumulative assessment is summarised in Section 3.5 with details included in Vol 10 Appendix N. The methodology for identifying these schemes is explained in Volume 2 Section 3.8. Finally, Section 3.6 describes any on-site alternatives considered.

3.2 Defined project

3.2.1 This section identifies the proposals for which consent is sought and so those which can be regarded, subject to approval, as being 'certain' or nearly so (eg, indicative locations).

3.2.2 Vol 10 Table 3.2.1 below lists the plans and documents for which consent is sought and which have been assessed.

Vol 10 Table 3.2.1 Carnwath Road Riverside – plans and documents defining the proposed development

Document/plan title	Status	Location
Proposed schedule of works	For approval	Schedule 1 of *The Draft Thames Water Utilities Limited (Thames Tideway Tunnel) Development Consent Order 201[ ] (Draft DCO)* (and extracts below)
Site works parameter plan	For approval	Vol 10 Carnwath Road Riverside figures – Section 1
Demolition and site clearance plan	For approval	Vol 10 Carnwath Road Riverside figures – Section 1
Access plan	For approval	Vol 10 Carnwath Road Riverside figures – Section 1
Proposed landscape plan	Indicative	Vol 10 Carnwath Road Riverside figures – Section 1
Ventilation building design intent plan	Indicative	Vol 10 Carnwath Road Riverside figures – Section 1
Ventilation column design intent plan	Indicative	Vol 10 Carnwath Road Riverside figures – Section 1
Design Principles – Generic	For approval	*Design Principles* report Section 3 (see Vol 1 Appendix B)
Design Principles – Site-specific (Carnwath Road Riverside)	For approval	*Design Principles* report Section 4.7 (see Vol 1 Appendix B)
Code of Construction Practice (CoCP) Part A: General Requirements	For approval	*CoCP* Part A (see Vol 1 Appendix A)
Code of Construction Practice (CoCP)	For approval	*CoCP* Part B Carnwath Road Riverside (see Vol 1 Appendix A)

Document/plan title	Status	Location
Part B – Site Specific Requirements (Carnwath Road Riverside)		

Description of the proposed works

3.2.3 Schedule 1 to the *Draft DCO* describes the proposed works for which development consent is sought. The schedule describes the main tunnel, connection tunnels and also the works which would be required at each of the proposed sites within the project. This includes the works comprising the nationally significant infrastructure project (NSIP) and associated development (which are described in Part 1 of Schedule 1) and ancillary works (which are described in Part 2 of Schedule 1).

3.2.4 The following sections provide a description of the proposed works at this site under three headings: Nationally significant infrastructure project, Associated development and Ancillary works. The description of the proposed works has been taken from Schedule 1 to the *Draft DCO* and the codes given for the works are those given within that schedule.

3.2.5 In accordance with the *Draft DCO*, all distances, directions and lengths referred to are approximate. All distances for scheduled linear works referred to are measured along the centre line of the limit of deviation for that work. Internal diameters for tunnels and shafts are the approximate internal dimensions after the construction of a tunnel lining. Unless otherwise stated, depths are specified to invert level and are measured from the proposed final ground level.

Nationally significant infrastructure project

3.2.6 The proposed structures and works required at this site which comprise the nationally significant infrastructure project are as follows:

a. **Work No. 6a**: Carnwath Road Riverside main tunnel shaft - A shaft with an internal diameter of 25 metres and a depth (to invert level) of 42 metres.

Associated development

3.2.7 The proposed structures and works required at this site which comprise the associated development are as follows:

a. **Work No. 6b**: Carnwath Road Riverside associated development – Works to establish a tunnel drive and reception site for use in constructing, connecting and operating the main tunnel (west) (Work No. 1a) and the main tunnel (west central) (Work No. 1b), and the Frogmore connection tunnel (Work No. 7), including the following above and below ground works and structures:

   i demolition of existing buildings and ground preparation works including land remediation ii demolition of existing boundary wall to Carnwath Road on Whiffin and Hurlingham Wharves and demolition of boundary wall between Hurlingham Wharf and Carnwath Road Industrial Estate and partial rebuilding of wall for Whiffin Wharf and reinstatement around Hurlingham Wharf

iii strengthening and alteration of existing river wall to the south of Whiffin Wharf, and strengthening or replacing the existing river wall to the south of Hurlingham Wharf and Carnwath Road Industrial Estate

iv dredging and construction of a temporary jetty with campshed and/or campsheds adjacent to the river wall

v provision of areas for [assembly of plant and machinery], storage of construction materials and excavated materials including temporary enclosures and workshops, concrete batching plant, fixed and mobile craneage, plant and equipment for ground treatment and dewatering and facilities and equipment for the processing of excavated materials from shaft and tunnel excavation including silos, tanks and conveyors (with and without noise enclosures), provision of power supplies (including substations) and other utilities including temporary buildings and other means of enclosure, office and welfare facilities and installations and equipment for monitoring the construction activity

vi construction of a noise enclosure building(s) over Work No 6a for use in association with the construction of Work No. 1a

vii construction of pits, chambers, ducts and pipes for cables, hydraulic pipelines, utility connections, utility diversions and drainage, including facilities for drainage attenuation

viii construction of a ventilation building to accommodate air management plant and equipment including filters and fans and construction of ventilation columns and acoustic attenuation chambers and associated below ground ducts and chambers

ix modifications to the Carnwath Road/Wandsworth Bridge Road junction

x provision of construction accesses to Whiffin Wharf, Hurlingham Wharf, and highway works site adjacent to Wandsworth Bridge Road

xi construction of permanent access off Carnwath Road

xii construction of boundary wall between Hurlingham Wharf and Whiffin Wharf.

3.2.8 The maximum heights of above-ground structures, which are for approval, and shown on the Site works parameter plan (see separate volume of figures – Section 1) are as follows:

a. ventilation column(s) serving the main tunnel shaft - 15m

b. ventilation building - 5.5m

3.2.9 In addition, further works are required at this site that constitute associated development within the meaning of section 115(2) of the Planning Act 2008. These comprise:

a. establishment of temporary construction areas at each works site to include, as necessary, site hoardings/means of enclosure, demolition (including of existing walls, fences, planters, and other buildings and other above and below ground structures), provision of services, including telecommunications, water and power supplies (including substations) including means of enclosure, and ground preparation works including land remediation and groundwater de-watering

b. provision of welfare/office accommodation, workshops and stores, storage and handling areas, facilities for and equipment for processing of excavated materials, treatment enclosures and other temporary facilities, plant, cranes, machinery, temporary bridges and accesses, and any other temporary works required

c. in connection with Work Nos. 5, 6, [8] , 11, 12, 13, 14, 15, 16, 17, 19, [23], 24 [and 26] the provision of temporary moorings (including dolphins) and other equipment and facilities for temporary use by barges, pontoons and other floating structures and apparatus (including as necessary piling for support of such structures) for use in construction of those works, and works for the strengthening of river walls and other flood protection defences

d. temporary removal of coach and car parking bays and creation of temporary replacement coach and car-parking as required and temporary footpath diversions

e. restoration of temporary construction areas, works to restore and make safe temporary work sites and work areas, including (as necessary) removal of hardstanding areas, temporary structures and other temporary works and works to re-establish original ground levels

f. works to trees

g. works to create temporary or permanent landscaping, including drainage and flood compensation, means of enclosure, and reinstatement / replacement of, or construction of, boundary walls and fences including gates

h. formation of construction vehicle accesses and provision of temporary gated or other site accesses and other works to streets

i. diversions (both temporary and permanent) of existing traffic and pedestrian access routes and subsequent reinstatement of existing routes, and works to create permissive rights of way

j. modifications of existing accesses, railings and pedestrian accesses

k. provision of construction traffic signage

l. relocation of existing bus stops and provision of temporary bus lay-bys

m. construction of new permanent moorings and piers, including access brows, bank seats, gangways and means of access

n. permanent and temporary works for the benefit or protection of land or structures affected by the authorised project (including protective works to buildings and other structures, and works for the monitoring of buildings and structures)

o. temporary landing places, moorings or other means of accommodating vessels in the construction and/or maintenance of the authorised project

p. provision of buoys, beacons, fenders and other navigational warning or ship impact protection works

q. such other works as may be necessary or expedient for the purposes of or in connection with the construction of the authorised project which do not give rise to any materially new or materially different environmental effects from those assessed in the Environmental Statement

3.2.10 The works defined by bullet k (in the list above) are not considered likely to be applicable to the works proposed at this site

Ancillary works

3.2.11 These works are not “development” as defined in section 32 of the Planning Act 2008, they do however form part of the Thames Tideway Tunnel project for which development consent will be sought and are included within Schedule 1 to the *Draft DCO*.

3.2.12 The following ancillary works are set out in Schedule 1 to the *Draft DCO*:

a. works within the existing sewers, chambers and culverts and other structures that comprise the existing sewerage network for the purposes of enabling the authorised project, including reconfiguring, modifying, altering, repairing, strengthening or reinstating the existing network

b. works within existing pumping stations including structural alterations to the interior fabric of the pumping station(s), works to reconfigure existing pipework, provision of new pipework, new penstock valves and associated equipment, modification of existing electrical, mechanical and control equipment, and installation or provision of new electrical, mechanical and control equipment

c. installation of electrical, mechanical and control equipment in other buildings and kiosks and modification to existing electrical, mechanical and control equipment in such buildings and kiosks

d. installation of pumps in chambers and buildings

e. works to trees and landscaping works not comprising development

f. works associated with monitoring of buildings and structures

g. provision of construction traffic signage

h. the relocation of boats/vessels

Design principles

3.2.13 The design principles for the project have been developed with stakeholders and set the parameters that must be met in the final detailed design of the above-ground structures and spaces associated with the project. The principles apply only to the operational phase of the project (ie, the permanent structures).

3.2.14 The generic principles include principles for the integration of functional components and also principles for heritage, river structures, landscape, lighting and site drainage.

3.2.15 The design principles form an integral part of the project and are assumed to be implemented within the design of the operational development. Where individual principles are relevant to a particular topic, this is indicated within the relevant assessments.

3.2.16 The *Design Principles* report is provided in Vol 1 Appendix B

Site features and landscaping

3.2.17 The proposed development at this site includes a Proposed landscape plan which takes account of the design principles (see separate volume of figures – Section 1).

3.2.18 The Ventilation building design intent (see separate volume of figures – Section 1) shows a structure of up to 5.5m in height located within a defined parameter zone located towards the northern section of Whiffin Wharf (see Site work parameter plan in separate volume of figures – Section 1). This would include a planted brown roof to promote biodiversity. Towards the river frontage approximately in line with the ventilation building, would be a 15m high ventilation column.

3.2.19 The proposal includes an area of landscaped open space within Whiffin Wharf to be publically accessible with tree planting, provision of benches and a brown roof on the proposed building to house air management plant (see Proposed landscape plan in separate volume of figures – Section 1). A feature wall of between 2.5m and 5.5m high would separate the landscaped area from the safeguarded Hurlingham Wharf to the east. An area of land immediately west of the landscaped area and extending from Carnwath Road towards the river frontage would be reinstated but not landscaped to facilitate future development. The Thames River Path would be reinstated to the current layout. Access to the river frontage would be available from the area of landscaped public realm.

3.2.20 Lighting for the public realm would comply with the design principles.

Code of Construction Practice

3.2.21 All works would be undertaken in accordance with the *Code of Construction Practice* (*CoCP*). The *CoCP* sets out a series of measures to protect the environment and limit disturbance from construction activities as far as reasonably practicable. These measures would be applied throughout the construction process at this site, and would be the responsibility of the contractor to implement. The *CoCP* is provided in Vol 1 Appendix A and comprises two parts, Part A and Part B. Part A presents measures which are applicable at all sites across the project and Part B defines measures which are only applicable at individual sites.

3.2.22 The *CoCP* forms an integral part of the project and all of the measures contained therein are assumed to be in place during the construction process described in Section 3.3 below. The measures are not described within Section 3.3 although further details on the measures within the *CoCP Part B* at Carnwath Road Riverside are given within the relevant assessments.

3.3 Construction assumptions

3.3.1 This section describes the approach to construction which has been assumed for the purposes of the EIA. The construction programme, layouts and working methods are illustrative and do not form part of the project for which consent is sought.

3.3.2 Although the programme, layouts and working methods described are illustrative, they represent what is considered to be the likely approach, given the existing site constraints, the adjacent land uses and the construction requirements. This section describes the main activities with the focus on those that are relevant for the assessment of environmental effects.

3.3.3 The assumed construction programme is described first, followed by a description of typical construction activities.

3.3.4 It is also assumed that, where the appropriate powers do not form part of the Development Consent Order, further consents may be required before certain construction activities are progressed. These could include various consents issued by the Environment Agency (EA) (including flood defence consents, abstraction licenses and discharge consents) and the Port of London Authority (PLA) (including river works licenses) as appropriate.

Assumed construction programme and working hours

3.3.5 Construction at this site would be likely to commence in 2016 (Site Year 1) and would be completed by 2021 (Site Year 6). The site would be operational in 2023 when the Thames Tideway Tunnel as a whole becomes operational.

3.3.6 Construction at Carnwath Road Riverside would be anticipated to take approximately six years and would involve the following steps (with some overlaps):

a. Site Year 1 - Site setup (approximately eight months)

b. Site Year 1 to 2 - Shaft construction (approximately 14 months)

c. Site Year 2 to 4 - Tunnelling (approximately 22 months)

d. Site Year 4 - Secondary lining (approximately seven months)

e. Site Year 4 to 5 - Construction of other structures (approximately 12 months)

f. Site Year 5 to 6 - Completion of works and site restoration (approximately 13 months)

3.3.7 This site would operate to the standard, extended and continuous working hours for various phases and activities as set out in the *CoCP* Part A and B (Section 4). Standard working hours would be applied to all of the above phases of construction work apart from elements of tunnelling and secondary lining as described below.

3.3.8 It has been assumed that extended working hours would be required once a month during major concrete pours.

3.3.9 It has been assumed that ccontinuous hours would be required for approximately 29 months during tunnelling (approximately 22 months), and during secondary lining of the tunnel (approximately seven months) but these activities are generally underground. However, it is noted that there would be periods of activity within this phase where continuous 24 hour working would not be required, including during TBM assembly, maintenance and dismantling.

3.3.10 During these periods only those activities directly connected with the task would be permitted within the varied hours.

Typical construction activities

3.3.11 Vol 10 Table 3.3.1 identifies the construction phasing plans used for the assessment of construction effects. These plans have been prepared to illustrate possible site layouts for the principle construction phases.

Vol 10 Table 3.3.1 Carnwath Road Riverside – construction phase plans

Plan title	Activities	Status	Location
Construction phase 1 plan	Site set up and shaft construction	Illustrative	Vol 10 Carnwath Road Riverside figures – Section 1
Construction phase 2 plan	Tunnelling	Illustrative	Vol 10 Carnwath Road Riverside figures – Section 1
Construction phase 3 plan	Secondary lining and other structures	Illustrative	Vol 10 Carnwath Road Riverside figures – Section 1
Construction phase 4 plan	Site demobilisation	Illustrative	Vol 10 Carnwath Road Riverside figures – Section 1

3.3.1 The methods, order and timing of the construction work outlined herewith are illustrative-, but representative of a practical method to construct the works and suitable upon which to base the assessment

3.3.2 The following construction activities are described:

a. site set up

b. shaft construction
c. tunnel construction
d. secondary lining
e. construction of other structures
f. completion of works and site restoration
g. excavated materials and waste
h. access and movement

Site set up

3.3.3 Part of the proposed site is currently occupied by business premises. The buildings associated with these businesses would need to be removed.

3.3.4 A group of tree saplings along the Thames Path would require removal in advance of the works.

3.3.5 The extent of demolition and site clearance works are shown on the Demolition and site clearance drawing (see separate volume of figures – Section 1).

3.3.6 The alignment of the Thames Path would require temporary amendment.

3.3.7 Prior to any works commencing the site boundary would be established and secured. The boundary would be built to an appropriate height and form for the site. Welfare and office facilities would also be set up with utility and power connections installed.

3.3.8 A stretch of river wall, extending approximately 200m along Hurlingham Wharf and coinciding with the location of a construction campshed, would require rebuilding. Strengthening works to adjacent sections of river wall would also be required.

3.3.9 A solid concrete campshed would be installed against the new river wall to enable barge access. Perimeter sheet piles would be installed and material from within the shallow area required for the campshed would be removed and a geotextile membrane used to separate the underlying substrate from the imported concrete. The campshed would be in place for a total of six years. Periodic dredging of the navigational channel around the campshed would be necessary.

3.3.10 Reinstatement would involve the removal of concrete and the geotextile membrane and the placement of imported substrate in order to restore the area to a similar profile of the surrounding foreshore. The imported substrate material would replicate the existing foreshore particle size.

3.3.11 The campshed would be removed at the end of the construction phase including removal of the perimeter piling. The void left once the campshed has been removed would be filled with suitable material to seek to reinstate similar materials in place prior the placement of the campshed. Similarly, should a jetty be used during construction, this would be removed at the end of construction works.

3.3.12 As an alternative to the campshed against the river wall, a jetty has also been considered during the construction phase. This would also operate with a campshed.

3.3.13 Plant and material storage areas for shaft and tunnel works, waste skips, muck bin and delivery vehicle turning area would also be established on site. Craneage, compressors, air receivers, material silos, static concrete pump and all the facilities for barge operation would also be required on site.

3.3.14 Other site works would include the setting up of required site access along Carnwath Road and at the junction of Carnwath Road and Wandsworth Bridge Road and the introduction of traffic management activities. The highways works would involve setting back the kerb on the southern corner of Carnwath Road and Wandsworth Bridge Road in order to facilitate movement of HGVs. This would involve the removal of four trees.

Shaft construction

3.3.15 Once the site has been prepared as described above, plant and material storage areas for the shaft and the delivery vehicle turning area would be set up on site.

3.3.16 The following methodology assumes that the shaft would be constructed using sprayed concrete techniques with a cast *in situ* secondary lining.

3.3.17 A piling rig would initially drive sheet piles through the over lying permeable ground to cut off any potential ground water ingress. The shaft would be excavated using a small tracked excavator that would load excavated material into a shaft skip. The skips would then be hoisted by a crawler crane and excavated material deposited in the excavated materials handling area. The majority of the excavated material from the shaft would be removed by barges via a campshed or possibly a jetty. Typically a long reach excavator would load barges positioned by the river wall. Where required, a tracked excavator would load excavated material into rigid tipper lorries to transport material for disposal or re-use elsewhere in the project.

3.3.18 The shaft would be advanced in incremental cycles. After 1m has been excavated the primary sprayed concrete lining (SCL) would be constructed. It is assumed that the concrete would be batched on site. Alternatively, concrete may be delivered by ready mix concrete truck.

3.3.19 A steel bar reinforced portal would be incorporated within the shaft lining to accommodate construction of the tunnel portals where the tunnels connect to the shaft for the main tunnel drive and reception and the Frogmore connection tunnel reception.

3.3.20 A steel reinforced concrete base plug would be formed at the base of the shaft. Concrete would be delivered to site in ready mix concrete mixer trucks and discharged into a truck mounted concrete pump and pumped to the base plug.

3.3.21 The upper section of the shaft would be excavated through the London Clay formation and no dewatering is anticipated for this section. Any water entering the excavation from either the superficial deposits or from minor seepages through silt layers would be pumped to the sewer via appropriate settlement tanks. While dewatering of the upper section is not anticipated, for the lower section of the shaft dewatering is assumed as it is partly constructed in the Lambeth Beds. The dewatering would be required to depressurise the base to enable construction of the base slab.

Tunnelling

3.3.22 Approximately 6.9km of 6.5m internal diameter tunnel would be driven west by an earth pressure balance TBM to be received at Acton Storm Tanks.

3.3.23 Tunnel portals would be formed in the shaft lining. The portals would consist of cast in-situ reinforced concrete. After TBM assembly but prior to the start of tunnelling works, an enclosure would be installed over the shaft area to mitigate for potential noise effects.

3.3.24 Once launched the TBM would cut the ground by rotating the cutter head whilst hydraulic shove rams would propel it forward. The excavated material would be transported by conveyor to the surface. The TBM would move forward and a temporary railway built behind it.

3.3.25 Excavated material would be transported to awaiting barges that would be moored against the river wall or at a jetty (or to a temporary stockpile if the barge is unavailable) for onward disposal offsite.

3.3.26 The shaft would also be used to receive the main tunnel from Kirtling Street and the Frogmore connection tunnel from Dormay Street. For the reception of the Frogmore connection tunnel from Dormay Street, a reception cradle would be installed on a temporary mid-depth deck in the shaft. The TBM would be dismantled and removed from site. In order to facilitate the removal of the TBM from Kirtling Street, it is likely that part or all of the noise shed would be removed. Once the TBM had been removed, the noise shed would be re-erected prior to the commencement of secondary lining.

Secondary lining of tunnel and shaft

3.3.27 Secondary lining is an additional layer of concrete placed against the inside of a tunnel's primary concrete segmental lining for watertightness and to improve the overall structural durability. For the purposes of assessment, it has been assumed that the tunnels would have reinforced concrete secondary linings.

3.3.28 It has been assumed that on completion of the tunnelling phase, a batching plant would be mobilised to site. The plant would supply the secondary lining of the main tunnel. Concrete would be batched on surface and pumped or skipped to the tunnel. The underground railway would be used to transport the concrete and reinforcement to the area of the pour. The tunnel enclosure installed over the main tunnel shaft and gantry crane area during tunnelling would remain in situ during secondary lining.

3.3.29 The secondary lining of the main tunnel would be constructed by installing steel reinforcement, erecting a cylindrical shutter within a short length of tunnel and pumping concrete into the gap between the shutter and the primary lining. Once the concrete has hardened sufficiently, the shutters would be removed and erected in the next section of tunnel.

3.3.30 It is assumed that the lining of the main tunnel shaft would be made of reinforced concrete placed inside the shaft's primary support. The steel reinforcement would be assembled in sections and a shutter would be used to cast the concrete against. The shutter would be assembled at the bottom of the shaft and sections of reinforcement installed and lining cast progressively up the shaft.

3.3.31 Any reinforced concrete structures internal to the main tunnel shaft and the roof slab would be constructed in a similar manner progressively from the shaft bottom. In some cases precast concrete members may be used.

Construction of other structures

3.3.32 Below ground air ducts and air treatment chambers would be constructed between the shaft and the ventilation housing.

3.3.33 Sheet pile walls would be used to provide ground support within which the ducts and chambers would be constructed.

3.3.34 The base and walls of the ducts and chambers would be formed by *in situ* concrete techniques. Ready mixed concrete would be delivered to site from external suppliers and either pumped or skipped to the work site. Tops of ducts and chambers may be of in situ or precast construction.

3.3.35 The foundations of the ventilation housing would comprise shallow concrete pad spread footings or a piled raft depending on ground conditions.

3.3.36 Erection of the ventilation building to house air management plant and equipment ('the ventilation building') would follow. This would be a steel portal frame structure. The Ventilation building design intent plan (see separate volume of figures – Section 1) shows precast concrete cladding with a composite steel and concrete roof supporting a brown roof.

3.3.37 Extending directly from the southern end of the eastern elevation of the ventilation building would be a wall aligned along the boundary between and Whiffin and Hurlingham Wharves. The wall would have a height matching that of the ventilation housing. It may be of free standing design and construction or may use the shaft for support in places.

3.3.38 A precast concrete ventilation column, 15m high, would be constructed towards the river frontage.

Completion of works and site restoration

3.3.39 On completion of the construction works the permanent works area would be graded and a high grade capping concrete and paved surface constructed where required in accordance with the Proposed landscape plan (see separate volume of figures – Section 1).

Excavated materials and waste

3.3.40 The construction activities described above and in particular the construction of the main tunnel shaft and the subsequent tunnelling would generate a large volume of excavated material which would require removal. This is estimated at 785,500 tonnes, the main elements of which would comprise approximately 770,000 tonnes London clay and 14,700 tonnes of made ground.

3.3.41 150,000 tonnes of imported fill (which would require later removal), 20,000 tonnes of mixed materials from the diaphragm wall construction, 14,000 tonnes of made ground, 21,000 tonnes of Lambeth group, 16,000 tonnes of Thanet sands and 700,000 tonnes of chalk.

3.3.42 In addition, it is estimated that approximately 4,700 tonnes of construction waste would be generated including 3,300 tonnes of concrete.

3.3.43 Excavated materials and construction wastes would be exported from the site in accordance with the *Transport Strategy* which accompanies the application for development consent (the 'application') (see Access and movement below).

Access and movement

3.3.44 For the purposes of the assessment a single trip to or from the site is referred to as a 'movement', while two trips, one to and one from the site, are referred to as a 'lorry' or a 'barge'.

3.3.45 It is anticipated that the removal of 90% of all shaft and tunnel excavated material would be by barge. It is also anticipated that 90% of tunnel secondary lining aggregates would be brought to site by barge. The highest barge movements would occur during main tunnel construction. Peak daily barge numbers, averaged over a one month period, would be two barges per day, equivalent to four barge movements. It is estimated that total barge numbers for this site would be 1,067, equivalent to 2,134 barge movements.

3.3.46 Barge numbers are based upon an assessed barge size of 800T. Barges would sit on campsheds during periods of low tide. It is assumed for the purposes of the assessment that barges would be tugged. The tug dwell time for this site would be approximately 25 minutes for delivering empty barges and to pick up loaded barges.

3.3.47 Peak vehicle movements would be associated with specific site activities. The highest lorry movements at the site would occur during tunnel construction. The peak daily vehicle numbers at this time, averaged over a one month period, would be 45 HGV lorries, equivalent to 90 movements per day. It is estimated that total vehicle numbers for this site would be in the order of 25,900 HGV lorries, equivalent to 51,800 movements.

3.3.48 For materials not handled by river barge, construction lorries would take the route of minimum impact to/from the Transport for London Route Network (TLRN). It is envisaged that lorries would access and egress the site via two routes. From the south: via the A3 and A217 (Wandsworth Bridge Road) into Carnwath Road. From the North: Via the A3220 – Chelsea Embankment, A308 – Kings Road, A217 - Wandsworth Bridge Road, into Carnwath Road.

3.3.49 A *Traffic management plan* would be developed for the site, produced, coordinated and implemented by the contractor.

3.3.50 A *Draft Project Framework Travel Plan*, which accompanies the application, has been produced setting out the requirements and guidelines for the site-specific *Travel plans* to be developed by the contractor.

3.4 Operational assumptions

3.4.1 This section provides details of the assumptions which have been made for the operational phase for the purposes of the EIA. Unless otherwise also listed in Section 3.2, the details given are illustrative and do not form part of the project for which consent is sought.

3.4.2 The details given are considered to represent the likely approach, given the site constraints, the adjacent land uses and the operational requirements. This section describes only the main operational structures and activities with the focus on those that are relevant for the assessment of environmental effects.

3.4.3 The operational structures are described first, followed by the assumed maintenance regime and concluding with other assumptions associated with the operational phase.

3.4.4 The shaft at the Carnwath Road Riverside site would be situated over the main tunnel ('on line'). The shaft would receive the majority of current discharges from the Frogmore Storm Relief (SR) - Bell Lane Creek Combined Sewer Overflow (CSO) at Dormay Street and the Frogmore SR - Buckhold Road CSO at King George's Park, via the Frogmore connection tunnel. The discharges would be conveyed along the main tunnel for treatment at Beckton Sewage Treatment Works.

Operational structures

3.4.5 For the purposes of the application, each of the main operational structures is shown as being located within a defined zone, in which the structure would be located. The operational structures listed within Section 3.2 along with the relevant plans, form part of the proposed development for consent. The defined zones for the structures are shown on the Site works parameter plan (see separate volume of figures – Section 1).

3.4.6 The height of the ventilation building and ventilation column is defined and form part of the project for consent (see Section 3.2). The following text provides additional clarification on the assumed form, purpose, function and working of these structures where this is considered helpful to the reader.

3.4.7 The assessment for each of the environmental topics has been based on the most appropriate dimensions and siting of the structures to ensure the assessment is robust. For example, the lower height for the ventilation column would typically generate higher odour impacts than a higher height and so the lower height limit has been modelled in the assessment. For other topics such as townscape, the upper height may be more important and has been assessed. The approach that has been adopted in this regard is explained within each topic assessment section, where necessary.

3.4.8 The approximate dimensions provided for underground structures are internal dimensions which are determined by the hydraulic and access requirements at particular sites.

3.4.9 Once constructed and operational the structures listed in the following sections would remain on site.

Shaft

3.4.10 The location, diameter and depth of the main tunnel shaft are described in Section 3.2.

3.4.11 The shaft would be constructed at the intersection of the main tunnel and the Frogmore connection tunnel thus providing a drop shaft and access to both tunnels. The shaft would be located in a relatively narrowly defined zone towards the western section of the site, mainly within the non-safeguarded Whiffin Wharf.

3.4.12 Ground level access covers on the shaft would be used for access/egress by maintenance vehicles and personnel during planned inspections of the main tunnel and main tunnel shaft. Those access covers to the main tunnel shaft which are only used for the ten yearly inspections (see below) would be designed to blend in with landscape treatments.

Chambers and culverts

3.4.13 The chamber and related culverts are defined in Section 3.2 and would be required for the ventilation structures, and ducts would be required for cables and hydraulic pipelines. There would be covers on top of the chambers at ground level to allow access for inspection.

River wall

3.4.14 The location of the new river wall is defined in Section 3.2. It would be constructed along the line of the existing river wall and would run in front of the new main tunnel structures including the main tunnel shaft. It would be built to the required flood defence level and tied in with existing flood defences.

Air management structures

3.4.15 The heights and locations of above-ground air management structures are defined in Section 3.2. There would be no other small diameter vent columns at the site as there would be no interception chamber.

Air management structures

3.4.16 Air would be released through a 15m high ventilation column located within a defined zone towards the southern side of Whiffin Wharf. The column would be a twisted structure with and oval cross-section enclosing air release columns (see Ventilation column design intent plan – see separate volume of figures – Section 1).

3.4.17 The ventilation building would contain the fans and electrical control instruments. Below ground structures would contain passive filters and connect the ventilation column to the structures that they are ventilating.

These would have ground level covers to allow access and inspection.

3.4.18 Electrical plant would be accommodated within the building housing the ventilation and control equipment in the zone indicated on the Site works parameter plan (see separate volume of figures – Section 1).

Permanent restoration and landscaping

3.4.19 The indicative landscaping proposals are presented in the Proposed landscape plan in the separate volume of figures (Section 1) and described in para. 3.2.17.

Typical maintenance regime

3.4.20 A light commercial vehicle would undertake three to six monthly maintenance works. This would be carried out during normal working hours and would take approximately half a day. Additionally, once every ten years, more substantial maintenance work would be carried out. This would be carried out in normal working hours. Vehicular requirements for these visits would include two mobile cranes and associated support vehicles and equipment.

3.5 Base case and cumulative development

3.5.1 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, Greater London Authority and Transport for London have been consulted on the methodology (see Volume 2) and asked to assist in identifying and verifying the development projects included in the assessment. A schedule is provided in Vol 10 Appendix N 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.

3.5.2 The development projects which have been included under base case, cumulative or both for the assessment of the proposed development at Chambers Wharf are listed below. A map showing their location is included in Vol 10 Figure 3.5.1 (see separate volume of figures):

a. Wandsworth Riverside Quarter, Point Pleasant/Osiers Road

b. Jetty adjacent to 51 Townmead Road

c. Townmead Road

d. Western Riverside Transfer Station

e. Units 1 -20 Enterprise Way

f. Osiers Road

g. Battersea Reach

h. Southside Shopping Centre, Garratt Lane

i. Cockpen House, Buckhold Road

j. Imperial Wharf

k. The Business Village, Broomhill Road

3.6 On-site alternatives

3.6.1 Project-wide and site selection alternatives are addressed in Volume 1 Section 3. This section describes on-site alternatives that have been considered and provides the main reasons why these alternatives (to the proposed approach) have not been adopted.

3.6.2 Vol 10 Table 3.6.1 below identifies those items for which alternatives have been considered, the alternatives and provides the main reasons why the alternatives were not taken forward.

Vol 10 Table 3.6.1 Carnwath Road Riverside – on-site alternatives

Item	Alternatives considered	Main reasons that the alternative (given left) was not progressed
River wall	Strengthen river wall only	
Ventilation building and structure	Locate ventilation building and column towards the central position of Whiffin Wharf.	Location towards the eastern section of Whiffin Wharf is nearer to the safeguarded Hurlingham Wharf and further from reinstated land on the western section of Whiffin Wharf for future development and from existing residential dwellings on Carnwath Road.
	Ventilation building up to approximately 9.5metres high.	Through design development, smaller scale building less visually intrusive proposed.
	No highway improvements to Wandsworth Bridge Road and Carnwath Road.	Provision of highway and junction improvements at the junction of Wandsworth Bridge Road and Carnwath Road included facilitating construction access.

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.10**

Volume 10: Carnwath Road Riverside site assessment

Section 4: Air quality and odour

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Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

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Thames Tideway Tunnel

Environmental Statement

Volume 10: Carnwath Road Riverside site assessment

Section 4: Air quality and odour

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4 Air quality and odour

4.1 Introduction

4.1.1 This section presents the findings of the assessment of the likely significant air quality and odour effects of the proposed development at the Carnwath Road Riverside site. The assessment covers the effects associated with both the main site and highway works site and the results presented apply to both site options (campshed or jetty with associated campshed). The project-wide air quality effects are described in Volume 3 Project-wide effects assessment.

4.1.2 The proposed development has the potential to affect air quality and odour due to:

a. construction traffic on the roads leading to an increase in vehicle emissions (air quality)

b. temporary closure of lanes during construction, which can lead to an increase in vehicle emissions through worsened congestion or through vehicles being routed onto other roads (air quality)

c. emissions from tugs pulling river barges (air quality)

d. emissions from construction plant (air quality)

e. construction-generated dust (air quality)

f. operation of the tunnel, resulting in air emissions (odour).

4.1.3 Each of these impacts is considered within the assessment. As a result the construction assessment for Carnwath Road Riverside site comprises four separate components: effects on local air quality from construction road traffic; effects on local air quality from tugs (for river barges); effects on local air quality from construction plant; and effects from construction dust. The effects on local air quality from construction road traffic, tugs (for river barges) and construction plant are assessed together (within the same model) while construction dust is assessed separately. The operational assessment considers the potential for nuisance odour emissions from the operation of the tunnel. As set out in the *Scoping Report*, local air quality effects are not assessed during operation on the basis that the only relevant operational source of air pollutants would be from the infrequent visits of maintenance vehicles which would not result in a significant effect.

4.1.4 The assessment of air quality and odour presented in this section has considered the requirements of the National Policy Statement for Waste Water Sections 4.3 (odour), 4.11 (air quality and emissions) and 4.12 (dust). Further details of these requirements can be found in Volume 2 Environmental assessment methodology Section 4.3.

4.1.5 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Volume 10

Carnwath Road Riverside Figures). Appendices supporting this site assessment are contained in Vol 10 Appendix B.

4.2 Proposed development relevant to air quality and odour

4.2.1 The proposed development is described in Section 3 of this volume. The elements of the proposed development relevant to air quality and odour are set out below.

Construction

Construction road traffic

4.2.2 During the proposed construction period there would be construction traffic movements[i] in and out of the site.

4.2.3 The highest number of lorry movements in any one year at the Carnwath Road Riverside site would occur during the tunnel drive works (Site Year 2 of construction). The average daily number of vehicle movements during the peak month would be approximately 90 movements per day.

4.2.4 The construction traffic routes, traffic management and access to the site are detailed in Section 12 of this volume.

4.2.5 Construction traffic is likely to affect local air quality as a result of increasing traffic and therefore from emissions on the road network.

Tugs for river barges

4.2.6 River barges may affect local air quality through direct emissions from the tugs pulling them.

4.2.7 The peak number of barge movements would be four barge movements a day averaged over a one month period in Site Year 2 of construction. The emissions associated with the tugs are presented in Vol 10 Appendix B.3.

Construction plant

4.2.8 Construction plant is likely to affect local air quality from direct exhaust emissions associated with the use and movement of the plant around the site.

4.2.9 There are a number of items of plant to be used on site that may produce emissions that could affect local air quality. Examples of such plant are excavators, generators and dumper trucks.

4.2.10 Typical construction plant which would be used at the Carnwath Road Riverside site in the peak construction year and associated emissions data are presented in Vol 10 Appendix B.4.

Construction dust

4.2.11 Activities with the potential to give rise to dust emissions from the proposed development during construction are as follows:

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[i] A movement is a construction vehicle moving either to or from the site.

a. site preparation and establishment
b. demolition of existing infrastructure and buildings
c. materials handling and earthworks
d. construction traffic – from moving over unpaved ground and then tracking out mud and dirt onto the public highway (termed 'trackout' hereafter).

4.2.12 At the Carnwath Road Riverside site there would be approximately 9,000m^3 of demolition material generated while the amount of amount of material moved during the earthworks would be approximately 785,500 tonnes. The volume of building material used during construction would be approximately 81,000m^3.

Code of Construction Practice

4.2.13 Appropriate dust and emission control measures are included in the *Code of Construction Practice* (*CoCP*)[ii] (Section 7) in accordance with the London Councils *Best Practice Guidance* (GLA and London Councils, 2006)[1]. Measures incorporated into the *CoCP* (Section 7) to reduce air quality impacts include measures in relation to vehicle and plant emissions, measures to reduce dust formation and re-suspension, measures to control dust present and measures to reduce particulate emissions. These would be observed across all construction and demolition activities at the Carnwath Road Riverside site.

4.2.14 There are no site-specific air quality measures contained in the *CoCP* (Section 7).

4.2.15 The effective implementation of the *CoCP* (Section 7) measures is assumed within the assessment.

Operation

4.2.16 A ventilation column would treat air released from the tunnel. The air would be treated by an active ventilation plant consisting of below ground air treatment chambers each with fans within an above ground housing directing treated air to the ventilation column. The combined capacity of the odour control units would be 20m^3/s.

4.2.17 Treated air would be released from the ventilation column for 99% of the time during a typical year. The capacity of the odour control units would occasionally be exceeded when air flows exceed 20m^3/s, as could occur during a heavy storm resulting in rapid filling of the tunnel system. This is expected to occur for about 35 hours in a typical year when the excess air would bypass the air treatment chamber and be released through a separate vent within the ventilation column. This release is at the top of the column where better dispersion can occur.

[ii] *CoCP* is provided in Vol 1 Appendix A. It contains general requirements (Part A), and site specific requirements for this site (Part B).

Environmental design measures

4.2.18 An active ventilation and air treatment plant would be included as part of the design and construction. The air treatment units would remove the majority of odours emanating from the tunnel except during heavy storms when the capacity could be exceeded, as discussed above. Full details of the Thames Tideway Tunnel project ventilation system can be found in the *Air Management Plan*.

4.3 Assessment methodology

Engagement

4.3.1 Vol 2 Section 4.2 documents the overall engagement which has been undertaken in preparing the *Environmental Statement*. Specific comments relevant to this site for the assessment of air quality and odour are presented here (Vol 10 Table 4.3.1).

4.3.2 The *Scoping Report* was prepared before Carnwath Road Riverside had been identified as a preferred site. The scope for the assessment of air quality and odour at this site has therefore drawn on the scoping responses and is based on professional judgement as well as experience of similar sites.

Vol 10 Table 4.3.1 Air quality and odour - stakeholder engagement

Organisation	Comment	Response
London Borough (LB) of Hammersmith and Fulham (May 2011)	Agree monitoring locations with LB of Hammersmith and Fulham	Locations agreed with LB of Hammersmith and Fulham Senior Environmental Policy and Projects Officer.
LB of Hammersmith and Fulham (July 2012)	Odour complaints in the area should be considered	No odour complaints around the site - confirmed by LB of Hammersmith and Fulham Environmental Protection Manager.
LB of Hammersmith and Fulham, Section 48 Response, November 2012	The Section 48 publicity includes, by the Acton and Carnwath Road sites, uniquely ‘active’ ventilation shafts expelling foul gases from the tunnel all year round. We further note that there will be times when these gases will not be treated, arising from such instances as excessive pressure in the tunnel or from mechanical	The odour benchmark is $1.5ou_E/m^3$ for the 98^{th} percentile of hourly values. Dispersion modelling has been carried out to assess the impact. The maximum number of hours in a year with odour above $1.5ou_E/m^3$ near Carnwath Road Riverside site is 75 either at a building or at ground level (see Section

Organisation	Comment	Response
	breakdown. The expelling of any untreated gases within such heavily residential areas is unacceptable. Consideration should be given in the strategy to utilise these vents away from residential areas ideally at the eastern end of the tunnel.	4.6) so is well within the benchmark which permits 175 hours above this value. The impact is therefore well within the Environment Agency's odour benchmark which is widely used across the country.

Baseline

4.3.3 The baseline methodology follows the methodology described in Vol 2 Section 4. There are no site specific variations for identifying baseline conditions for this site.

Construction

4.3.4 The assessment methodology for the construction phase follows that described in Vol 2 Section 4. There are no site specific variations for undertaking the construction assessment of this site.

4.3.5 Section 4.5 details the likely significant effects arising from the construction at the Carnwath Road Riverside site. There are no other Thames Tideway Tunnel project sites which could elevate construction dust nuisance effects within the assessment area (see para. 4.3.6 below). Also, it is noted that when assessing construction dust at the Carnwath Road Riverside site, the effect of the two parts of the site (the main site and the highway works site) have been considered in combination to ensure a robust assessment. With regard to local air quality, the effect of all relevant traffic associated with Thames Tideway Tunnel project sites using the highway network in the vicinity of the Carnwath Road Riverside site is taken into account in the assessment as traffic data used for the assessment includes traffic associated with all Thames Tideway Tunnel project sites.

Construction assessment area

4.3.6 The assessment area for the local air quality assessment during construction covers a square area of 600m by 600m centred on the Carnwath Road Riverside main site. This assessment area has been used for the assessment of road transport, tugs for river barges, construction plant and construction dust and has been selected on the basis of professional judgement to ensure that the effects of the Carnwath Road Riverside site are fully assessed. A distance of 200m sufficient (Highways Agency, 2007)[2] is generally considered sufficient to ensure that any significant effects are considered. The selected assessment area exceeds this considerably.

Construction assessment year

4.3.7 The peak construction year in terms of construction traffic movements (Site Year 2 of construction) has been used as the year of assessment for construction effects (construction road traffic, tugs for barges, construction plant and construction dust) in which the development case (with Thames Tideway Tunnel project) has been assessed against the base case (without Thames Tideway Tunnel project) to identify likely significant effects of the Thames Tideway Tunnel project.

4.3.8 The assessment of construction effects also considers the extent to which the effects on local air quality would be likely to be materially different should the programme for the Thames Tideway Tunnel project be delayed by approximately one year.

Other developments

4.3.9 As indicated in the site development schedule (see Vol 10 Appendix N), there are three other relevant developments (Townmead Road, Western Riverside Transfer Station and Wandsworth Riverside Quarter) identified within the local air quality construction assessment area. Townmead Road, Western Riverside Transfer Station and part of Wandsworth Riverside Quarter (Phase A) would be complete and operational by Site Year 2 of construction and therefore are considered as part of the base case. Part of the Wandsworth Riverside Quarter development (Phase B) would still be under construction in Site Year 2 of construction and therefore this is considered in the cumulative effects assessment. Trips associated with the other developments are taken into account in the traffic data used for the air quality assessment. No additional receptors are required to be included as all three developments are further from the Carnwath Road Riverside site than existing sensitive receptors.

Operation

4.3.10 The odour assessment methodology for the operational phase follows that described in Vol 2 Section 4. There are no site specific variations for undertaking the operational assessment of this site.

4.3.11 Section 4.6 details the likely significant effects arising from the operation at the Carnwath Road Riverside site. There are no other Thames Tideway Tunnel project sites that could give rise to additional effects on odour within the assessment area for this site and therefore no other Thames Tideway Tunnel project sites are considered in this assessment

Operational assessment area

4.3.12 Odour dispersion modelling has been carried out over an area of 700m by 550m centred on the Carnwath Road Riverside main site (which includes the redevelopment of the Cemex site). The assessment area has been selected on professional judgement on the basis of it being considered the potential maximum extent of the impact area.

Operational assessment year

4.3.13 The assessment undertaken for a typical use year (as described in Vol 2 Section 4) applies equally to all operational years. Therefore no specific year of operation has been assessed.

Other developments

4.3.14 Regarding other new developments, the three developments identified as relevant to the construction assessment (see para. 4.3.9) are also relevant to the operational assessment. All would be complete and operational by Year 1 of operation and therefore are considered as part of the base case with no cumulative assessment required. No additional receptors are required as the developments are further from the Carnwath Road Riverside site than existing sensitive receptors.

Assumptions and limitations

Assumptions

4.3.15 The general assumptions associated with this assessment are presented in Vol 2 Section 4.

Construction

4.3.16 The site specific assumptions in terms of model inputs for the local air quality dispersion modelling are set out in Vol 10 Appendix B.1.

Operation

4.3.17 The site specific assumptions in terms of the assumed capacity of the carbon filter and air release rate used for the odour dispersion modelling are described in paras. 4.2.16-4.2.18.

4.3.18 Odour dispersion modelling only includes emissions from the ventilation structure and does not take account of background concentrations due to other sources. Background odour concentrations in the area are assumed to be low as there have been no complaints in the surrounding area over recent years (see para. 4.4.12) and seasonal spot measurements of hydrogen sulphide (H_2S) carried out in 2011/12 indicate that concentrations are generally typical of urban areas (Michigan Environmental Science Board, 2000)[3].

4.3.19 The ventilation structures were located for the dispersion modelling in a position that was expected to result in the highest concentrations at buildings and so represent a worst-case scenario. This location would be within the area marked on the Site parameter plan (see separate volume of figures – Section 1). It is therefore likely that the actual concentrations would be lower than those reported in this assessment.

Limitations

4.3.20 The general limitations associated with this assessment are presented in Vol 2 Section 4.

Construction

4.3.21 As there are no PM_{10} monitoring sites located within the vicinity of the Carnwath Road Riverside site, it has not been possible to verify PM_{10}

modelling results[iii]. The adjustment factor derived for NO_x (from a comparison of modelled and monitored NO_x data) has therefore been applied to the PM_{10} modelling results.

Operation

4.3.22 There are no limitations specific to the odour assessment of this site.

4.4 Baseline conditions

4.4.1 The following section sets out the baseline conditions for air quality and odour within and around the site. Future baseline conditions (base case) are also described.

Current baseline

Local air quality

4.4.2 The current conditions with regard to local air quality are best established through long-term air quality monitoring.

4.4.3 As part of their duties under Part IV of the Environment Act 1995 (UK Government, 1995)[4], local authorities, especially in urban areas where air quality is a significant issue, undertake long-term air quality monitoring within their administrative areas.

4.4.4 While there are no continuous monitoring stations in the vicinity of the site, there is one diffusion tube site operated by LB of Hammersmith and Fulham which collects data pertinent to the Carnwath Road Riverside site and associated construction traffic routes which monitors NO_2. The location of this site on Daisy Lane is shown in Vol 10 Figure 4.4.1 (see separate volume of figures). Monitoring data for the local authority monitoring site for 2007 and 2008 are contained in Vol 10 Table 4.4.1. It is noted that monitoring at this site ceased in 2009; the reason for this is unknown. Hourly concentrations are not recorded at diffusion tube sites.

4.4.5 There are no PM_{10} monitoring sites within 1km of the Carnwath Road Riverside site.

Vol 10 Table 4.4.1 Air quality - measured NO_2 concentrations

Monitoring site	Site type	Annual mean ($\mu g/m^3$)				
		2011	2010	2009	2008	2007
Diffusion tube monitoring site						
Daisy Lane (HF67)	Urban background	NM	NM	NM	31	33

Note: NM indicates not measured. Codes in brackets represent monitoring site identifiers used in Vol 10 Figure 4.4.1 (see separate volume of figures).

[iii] Model verification refers to checks that are carried out on model performance at a local level. This involves the comparison of predicted (modelled) versus measured concentrations. Where there is a disparity between the predicted and the measured concentrations, the first step should always be to check the input data and model parameters in order to minimise the errors. If required, the second step would be to determine an appropriate adjustment factor that can be applied to the modelled traffic contribution.

4.4.6 The monitoring data show that the annual mean NO_2 standard ($40\mu g/m^3$) was met at the Daisy Lane monitoring site in 2007 and 2008.

4.4.7 The LB of Hammersmith and Fulham has declared the whole borough an Air Quality Management Area (AQMA) for both NO_2 and PM_{10}.

4.4.8 Diffusion tube monitoring has also been undertaken as part of the environmental impact assessment (EIA) to monitor NO_2 concentrations in the vicinity of the Carnwath Road Riverside site. This monitoring comprises ten diffusion tube sites at the locations identified in Vol 10 Table 4.4.2. The table shows a 2010 annual mean concentration (baseline year), which has been calculated from the measurements made between April 2011 and April 2012 at each of the sites. To calculate the 2010 annual mean NO_2 concentrations, the 2011/12 measurements are adjusted for bias using the co-located diffusion tubes and are then seasonally adjusted. Annual mean NO_2 concentrations, for the period covered by the diffusion tubes, and for the year 2010 have been collated from four nearby background continuous monitoring sites measuring NO_2 and with data capture rates greater than 90%. The average of the ratios between the period and annual means has been used to calculate the seasonal adjustment factor. To enable any bias to be corrected, a triplicate site (comprising three diffusion tubes) was established at a continuous monitoring site in Putney (site PEFM4 – see Vol 7); for additional precision, a triplicate site was established at one of the monitoring sites near the Carnwath Road Riverside site (CRRM3); otherwise all the monitoring locations have single tubes.

Vol 10 Table 4.4.2 Air quality - additional monitoring locations

Monitoring site	Grid reference	Site type	2010 NO_2 annual mean ($\mu g/m^3$)
Carnwath Road (CRRM1)	525485, 175583	Roadside	**44.5**
Carnwath Road (CRRM2)	525782, 175700	Kerbside	**57.5**
Wandsworth Bridge Triplicate (CRRM3)	525801, 175839	Kerbside	**63.7**
Townmead Road (CRRM4)	525932, 175806	Kerbside	**75.6**
Wandsworth Bridge (CRRM5)	525916, 175674	Roadside	**65.9**
Carnwath Road (CRRM6)	525635,175602	Roadside	**53.3**
A217 Swandon Way (DSTM5)	525897,175196	Roadside	**74.5**
Jews Row (DSTM6)	525979,175375	Urban Background	**58.4**

Monitoring site	Grid reference	Site type	2010 NO_2 annual mean ($\mu g/m^3$)
A214 Trinity Road (DSTM7)	526180,175159	Urban Background	**45.9**
A214 Trinity Road (DSTM8)	526232,175178	Roadside	**69.4**

Note: Emboldened figures indicate an exceedance of the objective / limit value which is 40µg/m³ for the annual mean.

4.4.9 All ten sites recorded concentrations above the NO_2 annual mean standard (40µg/m³). The concentrations recorded during the monitoring are similar to those recorded during local authority monitoring at roadside sites and are typical of the high levels in London.

4.4.10 This monitoring has been used in conjunction with existing LB of Hammersmith and Fulham monitoring to define the baseline situation and also to provide input to model verification.

4.4.11 In addition to monitoring data, an indication of baseline pollutant concentrations in the vicinity of the site has been obtained from the background data on the air quality section of the Defra website (Defra, 2012)[5]. Mapped background pollutant concentrations are available for each 1km by 1km grid square within every local authority's administrative area for the years 2008 and projected to 2020. The background data relating to the Carnwath Road Riverside site are given in Vol 10 Table 4.4.3 for 2010 (baseline year).

Vol 10 Table 4.4.3 Air quality – 2010 background pollutant concentrations

Pollutant*	2010
NO_2 ($\mu g/m^3$)	36.1
PM_{10} ($\mu g/m^3$)	20.6

** Annual mean for 1km grid square centred on 525500,175500*

Odour

4.4.12 The LB of Hammersmith and Fulham has not received any odour complaints for the local area over recent years (LB of Hammersmith and Fulham, 2012)[6]. Complaints in the Thames Water database were reviewed within an area of 500m radius of the zones identified for the proposed ventilation columns. Only two complaints were identified since 2005, one relating to odour from the general sewerage system in 2010 and the other in 2011, relating to the Swandon Way Pumping Station which is not in the vicinity of the Carnwath Road Riverside site.

4.4.13 Data gathering for the project included spot measurements of hydrogen sulphide (H_2S) made near the site the results of which are summarised in Vol 10 Table 4.4.4 and the monitoring locations shown in Vol 10 Figure 4.4.2 (see separate volume of figures). The highest concentrations, up to 37µg/m³, were measured on 1 December 2011 at two of five locations, possibly indicating a local source of H_2S on that day during westerly wind conditions. While the levels were raised on the 1 December 2011, on other days levels were typical of urban areas3 when a faint odour may be detectable on occasions (WHO, 2000)[7,iv].

Vol 10 Table 4.4.4 Odour - measured H_2S concentrations

Location	Grid reference	Date	Time	H_2S concentration (µg/m^3)
Piper Centre (CRRS1)	525510, 175592	28/08/11	12:00:51	0.0
		28/08/11	12:01:26	0.0
		30/10/11	11:17:59	5.5
		30/10/11	11:18:28	0.0
		01/12/11	15:40:01	6.4
		01/12/11	15:41:11	5.7
		26/02/12	08:15:12	6.2
		26/02/12	08:15:40	5.4
Piper Building, 50 Carnwath Road (CRRS2)	525612, 175611	28/08/11	11:58:21	0.0
		28/08/11	11:59:01	0.0
		30/10/11	11:16:20	5.3
		30/10/11	11:16:48	4.3
		01/12/11	15:36:43	35.3
		01/12/11	15:37:59	12.2
		26/02/12	08:13:04	6.9
		26/02/12	08:13:33	9.6
Philpot Square (CRRS3)	525696, 175647	28/08/11	12:06:32	4.3
		28/08/11	12:07:06	0.0
		01/12/11	15:46:39	4.9
		01/12/11	15:48:13	6.6
Residential property, Carnwath Road (CRRS4)	525740, 175663	28/08/11	12:08:25	0.0
		28/08/11	12:08:54	0.0
		01/12/11	15:59:14	36.9
		01/12/11	16:00:36	10.2
Thames Path	525657, 175556	28/08/11	12:12:50	0.0

[iv] The H_2S odour detection threshold is 7ug/m^3 which is the level at which 50% of the people on an odour panel who have been proven to have a good sense of smell can just detect the gas in laboratory controlled conditions.

Location	Grid reference	Date	Time	H_2S concentration ($\mu g/m^3$)
(CRRS5)		28/08/11	12:13:20	0.0
		30/10/11	11:22:40	0.0
		30/10/11	11:23:07	0.0
		01/12/11	16:01:55	7.8
		01/12/11	16:02:48	7.1
		26/02/12	08:21:44	5.7
		26/02/12	08:22:12	4.7
Petrolina Wharf (CRRS6)	525498, 175542	28/08/11	12:02:36	0.0
		28/08/11	12:03:06	0.0
		30/10/11	11:19:32	0.0
		30/10/11	11:20:00	0.0
		01/12/11	15:43:55	31.3
		01/12/11	15:45:09	10.0
		26/02/12	08:16:47	4.8
		26/02/12	08:17:17	4.6
Meteorological conditions: 28/08/11 SW wind up to 2 m/s, partially cloudy, few spots of rain. 30/10/11 SW wind at 0.5 m/s, cloudy, last rain on 27/10/11. 01/12/11 Wet, cloudy. 26/02/12 Last rain light 23/02/12, calm, occasional light wind from SW.				

Receptors

4.4.14 As set out in Section 4.1 and Vol 2, the air quality assessment involves the selection of appropriate receptors, which are shown in Vol 10 Figure 4.4.3 (see separate volume of figures) and detailed in the table below (Vol 10 Table 4.4.5) for the Carnwath Road Riverside site. All of these receptors are relevant, albeit with different levels of sensitivity to each of the elements of the air quality assessment. The sensitivity of identified receptors has been determined using the criteria detailed in Vol 2 Section 4.

Vol 10 Table 4.4.5 Air quality and odour - receptors

Receptors (relating to all identified emissions sources)	Approximate distance of modelled receptor from site boundary and direction from site	Receptor sensitivity		
		Air quality (construction traffic/plant and river tugs for barges)	Construction dust (on-site demolition and construction processes)	Odour (ventilation column)
Residential - 5 Carnwath Road (CRRR8)	Adjacent	High (exposure relevant to annual mean, daily mean and hourly mean standards).	Medium	High
Residential - 89-101 Carnwath Rd (CRRR1)	2.5m west	High (exposure relevant to annual mean, daily mean and hourly mean standards).	Medium	High
Residential - Philpot Square (CRRR3)	75m north	High (exposure relevant to annual mean, daily mean and hourly mean standards).	Medium	High
Residential - 358 Wandsworth Bridge Road (CRRR6)	180m northeast	High (exposure relevant to annual mean, daily mean and hourly mean standards).	Medium	High
Residential - Down House, Wandsworth Bridge Road (CRRR5)	220m northeast	High (exposure relevant to annual mean, daily mean and hourly mean standards).	Medium	High
Educational - Thomas' London Day School (building) (CRRR4)	105m north	High (exposure relevant to annual mean, daily mean and hourly mean standards).	Medium	High
Office/commercial – Piper Centre, 50 Carnwath Road	10m north	Low (exposure is relevant for the hourly mean standard only).	Medium	Medium

Receptors (relating to all identified emissions sources)	**Approximate distance of modelled receptor from site boundary and direction from site**	**Receptor sensitivity**		
		Air quality (construction traffic/plant and river tugs for barges)	**Construction dust (on-site demolition and construction processes)**	**Odour (ventilation column)**
(CRRR2)				
Commercial - Carnwath Road Retail Park (CRRR7)	110m west	Low (exposure is relevant for the hourly mean standard only).	Medium	Medium
Recreational - Thames Path (CRRR9)	Adjacent	Low (exposure is relevant for the hourly mean standard only)	Low	Low
Recreational - River Thames (CRRR10)	Adjacent	Low (exposure is relevant for the hourly mean standard only)	Low	Low

Construction base case

4.4.15 The base case conditions for the construction assessment year would be expected to change from the current baseline conditions due to modifications to the sources of the air pollution in the intervening period.

4.4.16 For road vehicles, there would be an increase in the penetration of new Euro emissions standards (Defra, 2012)[8] to the London vehicle fleet between the current situation and Site Year 2 of construction. Euro standards define the acceptable exhaust emission limits for new vehicles sold in the EU. These standards are defined through a series of European Union directives staging the progressive introduction of increasingly stringent standards over time. The uptake of newer vehicles with improved emission controls should lead to a reduction in NO_2 and PM_{10} concentrations over time. These changes in fleet composition and the emissions are covered in this assessment.

4.4.17 Other emissions sources should also reduce due to local and national policies. Therefore, the non-road sources of the background concentrations used in the modelling have been reduced in line with Defra guidance LAQM.TG (09) (Defra, 2012)[9]. Background pollutant concentrations for Site Year 2 of construction (peak construction year) that were used in the modelling are shown in Vol 10 Table 4.4.6.

4.4.18 The background concentrations have been taken from the Defra mapped background data5. The Defra maps have been used as there were no suitable background monitoring sites within the assessment area.

Vol 10 Table 4.4.6 Air quality – annual mean background pollutant concentrations

Pollutant	Baseline (2010)	Peak construction year (Site Year 2 of construction)
NO_2 (µg/m^3)*	33.9	25.9
PM_{10} (µg/m^3)*	20.4	18.6

** Taken from Defra mapped 1km grid square centred on 525500,175500. Adjusted to ensure local A roads are not double-counted.*

4.4.19 As described in Section 4.3, the base case in Site Year 2 of construction takes into account the three relevant developments (Townmead Road, Western Riverside Transfer Station and Wandsworth Riverside Quarter) with trips associated with the developments included in the traffic data used for the assessment.

Operational base case

4.4.20 Base case conditions have been assumed to be the same as baseline conditions with respect to background odour concentrations as no change in background odour concentrations is anticipated.

4.4.21 As for the construction base case, the three other developments identified as relevant to the air quality assessment are included in the base case for Year 1 of operation.

4.5 Construction effects assessment

Local air quality assessment

4.5.1 Construction effects on local air quality (comprising emissions from construction road traffic, tugs for river barges and construction plant) have been assessed following the modelling methodology set out in Vol 2 Section 4. This involves predicting NO_2 and PM_{10} concentrations in the baseline year (2010), and in the peak construction year (Site Year 2 of construction), without the proposed development (base case) and with the proposed development (development case). Predicted pollutant concentrations for the base case and development case can then be compared to determine the air quality impacts associated with the project and considering these in the context of statutory air quality objectives/limit values to determine the significance of effects at specified receptors (listed in Vol 10 Table 4.4.5).

4.5.2 The assessment has focussed on NO_2 and PM_{10} concentrations as these are the only pollutants whose air quality standards may be exceeded. From professional experience, emissions of other pollutants (eg, volatile organic compounds (VOCs)) are very unlikely to be significant and therefore do not need to be assessed.

4.5.3 A model verification exercise has been undertaken at the Carnwath Road Riverside site in line with the Defra guidance LAQM.TG(09)9. This checks the model performance against measured concentrations, using ten of the monitoring sites established for the air quality assessment (CRRM1-6 – see Vol 10 Table 4.4.2, DSTM5, DSTM7, DSTM8 and FPSM1). Further details regarding the verification process are included in Vol 10 Appendix B.1. The model adjustment factor derived from the verification process was applied to all model results (for both NO_2 and PM_{10}).

4.5.4 The model inputs for the local air quality assessment for the Carnwath Road Riverside site are also detailed in Vol 10 Appendix B (B.2, B.3 and B.4). This includes road traffic data (comprising annual average daily traffic flows, heavy good vehicle proportions and speeds for each road link) and data pertaining to the tugs for river barges and construction plant.

NO_2 concentrations

4.5.5 Predicted annual mean NO_2 concentrations for the modelled scenarios, are shown in Vol 10 Table 4.5.1. This table details the forecast NO_2 concentrations at specific sensitive receptors. Annual mean results are shown for all of the sensitive receptors but the receptors are divided into two groups depending on whether people could be exposed for a year at that location (which determines whether the annual mean objective/limit value applies or not). The annual mean criteria only apply at those receptors which could be occupied continually for a year (eg, residential properties). Exceedances of the hourly objective / limit value are inferred from the annual mean concentration. Additionally, contour plots are provided (Vol 10 Figure 4.5.1 to Vol 10 Figure 4.5.3, see separate volume of figures) showing modelled concentrations for the baseline, base case and development case scenarios over the construction assessment area. A plot showing the change in NO_2 annual mean concentrations between the base and development cases (in the peak construction year) is also presented at Vol 10 Figure 4.5.4 (see separate volume of figures).

4.5.6 The modelled concentrations in Vol 10 Table 4.5.1 show that annual mean NO_2 levels are predicted to decrease between 2010 and the peak construction year with or without the Thames Tideway Tunnel project. This decrease is due to predicted reductions in background concentrations and improved vehicle engine technology. The results for the development case show increases over the base case at all modelled receptors due to the construction works.

4.5.7 Exceedances of the annual mean objective / limit value (40µg/m^3) are predicted in the peak construction year for three receptors in the base case and in the development case although the objective / limit value only applies at three of these receptors. In line with LAQM.TG (09)9, sites with modelled concentrations in the peak construction year above 60µg/m^3 are considered likely to exceed the hourly NO_2 air quality objective / limit value. These include Down House (CRRR5) and 358 Wandsworth Bridge Road (CRRR6) in both the base and development cases.

Vol 10 Table 4.5.1 Air quality - predicted annual mean NO_2 concentrations

Receptor	**Predicted annual mean NO_2 concentration (µg/m^3)**			**Change between base and dev cases (µg/m^3)**	**Magnitude of impact**
	2010 baseline	**Peak construction year base case**	**Peak construction year dev case**		
Receptors where the annual mean objective / limit value applies					
5 Carnwath Road residential (CRRR8)	**45.1**	35.9	37.1	1.2	Small
89-101 Carnwath Road residential (CRRR1)	**41.4**	31.5	32.5	1.0	Small
Philpot Square residential (CRRR3)	**45.3**	35.6	36.4	0.7	Small
358 Wandsworth Bridge Road residential	**66.6**	**59.7**	**60.8**	1.1	Small

Receptor	Predicted annual mean NO_2 concentration ($\mu g/m^3$)			Change between base and dev cases ($\mu g/m^3$)	Magnitude of impact
	2010 baseline	Peak construction year base case	Peak construction year dev case		
(CRRR6)					
Down House residential (CRRR5)	**71.3**	**64.0**	**65.4**	1.4	Small
Thomas' London Day School (building) (CRRR4)	39.3	30.5	30.7	0.2	Negligible
Receptors where the annual mean objective / limit value does not apply					
Piper Centre, 50 Carnwath Road commercial (CRRR2)	**45.8**	35.1	35.9	0.8	Small
Carnwath Road Retail Park (CRRR7)	**58.0**	**49.2**	**49.5**	0.3	Negligible
Thames Path (CRRR9)	**44.2**	35.1	36.4	1.3	Small
River Thames (CRRR10)	39.1	30.2	31.0	0.8	Small

Note: Emboldened figures indicate an exceedance of the standard (objective/limit value) which is 40µg/m³ for the annual mean. Changes in concentration at each receptor have been rounded to one decimal place.

4.5.8 The highest predicted increase in annual mean concentration as a result of the construction works is predicted to occur at the residential property at Down House (CRRR5) with an increase of 1.4µg/m³. This increase is described as having small magnitude according to the criteria detailed in Vol 2 Section 4.

4.5.9 The significance of the effect at residential properties at 5 Carnwath Road (CRRR8), 89–101 Carnwath Road (CRRR1), Philpot Square (CRRR3), Down House (CRRR5) and Wandsworth Bridge Road (CRRR6), which have a high sensitivity to local air quality, is **minor adverse** (according to the criteria detailed in Vol 2 Section 4). At Thomas' London Day School (CRRR4), which also has a high sensitivity to local air quality, the significance of the impact is **negligible**. At the other receptors, which have a low sensitivity to local air quality, the significance of the effects is

negligible as only the hourly objective / limit value applies to these receptors (of which there are not any exceedances at these receptors).

PM_{10} concentrations

4.5.10 Predicted annual mean PM_{10} concentrations for the modelled scenarios, taking account of emissions from construction road traffic, tugs for river barges and construction plant, are shown in Vol 10 Table 4.5.2. This table details the forecast PM_{10} concentrations at specific sensitive receptors. Additionally, contour plots are provided in Vol 10 Figure 4.5.5 to Vol 10 Figure 4.5.7 (see separate volume of figures) showing modelled concentrations for the baseline, base case and development case scenarios over the construction assessment area. A plot showing the change in annual mean PM_{10} concentrations between the base and development cases (in the peak construction year) is also presented at Vol 10 Figure 4.5.8 (see separate volume of figures).

4.5.11 The modelled concentrations in Vol 10 Table 4.5.2 show that annual mean concentrations of PM_{10} are predicted to achieve the annual mean objective / limit value (40µg/m^3) and decrease between 2010 and the peak construction year with and without the Thames Tideway Tunnel project. This decrease is due to predicted reductions in background concentrations and improved vehicle engine technology.

Vol 10 Table 4.5.2 Air quality - predicted annual mean PM_{10} concentrations

Receptor	Predicted annual mean PM_{10} concentration (µg/m^3)			Change between base and dev cases (µg/m^3)	Magnitude of impact
	2010 baseline	Peak construction year base case	Peak construction year dev case		
Receptors where the annual mean objective / limit value applies					
5 Carnwath Road residential (CRRR8)	22.5	20.4	20.5	0.2	Negligible
89-101 Carnwath Road residential (CRRR1)	21.9	20.0	20.1	0.2	Negligible
Philpot Square residential (CRRR3)	22.6	20.5	20.5	0.1	Negligible
358 Wandsworth Bridge Road residential (CRRR6)	27.2	24.1	24.2	0.1	Negligible

Receptor	Predicted annual mean PM_{10} concentration ($\mu g/m^3$)			Change between base and dev cases ($\mu g/m^3$)	Magnitude of impact
	2010 baseline	Peak construction year base case	Peak construction year dev case		
Down House residential (CRRR5)	28.4	25.1	25.2	0.1	Negligible
Thomas' London Day School (building) (CRRR4)	21.4	19.5	19.5	0.0	Negligible
Receptors where the annual mean objective / limit value does not apply					
Piper Centre, 50 Carnwath Road commercial (CRRR2)	22.9	20.8	21.0	0.1	Negligible
Carnwath Road Retail Park (CRRR7)	25.4	22.7	22.8	0.1	Negligible
Thames Path (CRRR9)	22.3	20.2	20.4	0.2	Negligible
River Thames (CRRR10)	21.4	19.5	19.6	0.1	Negligible

Note: Emboldened figures indicate an exceedance of the standard (objective/limit value) which is 40µg/m³ for the annual mean. Changes in concentration at each receptor have been rounded to one decimal place.

4.5.12 The largest predicted increase in annual mean concentration as a result of construction at the Carnwath Road Riverside site is 0.2µg/m³, which is predicted to occur at 5 Carnwath Road (CRRR8) and 89-101 Carnwath Road (CRRR1), both of which are receptors of relevant exposure to the annual mean standard (40µg/m³). An increase of 0.2µg/m³ is also predicted at the recreational receptor at Thames Path (CRRR9) but the annual mean standard does not apply at this location. These changes are all described as negligible according to the criteria detailed in Vol 2 Section 4.

4.5.13 As predicted concentrations are well below the annual mean PM_{10} standard at all receptors, the significance of the effects at all receptors is **negligible**.

4.5.14 With regard to the daily mean PM_{10} concentrations, Vol 10 Table 4.5.3 shows the predicted number exceedances of the daily PM_{10} standard

($50 \mu g/m^3$) for each modelled scenario. The objective / limit value allows no more than 35 exceedances in a year.

Vol 10 Table 4.5.3 Air quality - predicted exceedances of the daily PM_{10} standard

Receptor	Predicted number of exceedances of the daily PM_{10} standard			Change between base and dev cases (days)	Magnitude of impact
	2010 baseline	Peak construction year base case	Peak construction year dev case		
Receptors where the daily mean objective / limit value applies					
5 Carnwath Road residential (CRRR8)	7	4	4	0	Negligible
89-101 Carnwath Road residential (CRRR1)	6	3	4	0	Negligible
Philpot Square residential (CRRR3)	7	4	4	0	Negligible
358 Wandsworth Bridge Road residential (CRRR6)	18	10	11	0	Negligible
Down House residential (CRRR5)	22	13	13	0	Negligible
Thomas' London Day School (building) (CRRR4)	5	3	3	0	Negligible
Receptors where the daily mean objective / limit value does not apply					
Piper Centre, 50 Carnwath Road commercial (CRRR2)	8	4	5	0	Negligible
Carnwath Road Retail Park (CRRR7)	13	8	8	0	Negligible

Receptor	Predicted number of exceedances of the daily PM_{10} standard			Change between base and dev cases (days)	Magnitude of impact
	2010 baseline	Peak construction year base case	Peak construction year dev case		
Thames Path (CRRR9)	7	4	4	0	Negligible
River Thames (CRRR10)	5	3	3	0	Negligible

Note: Changes at each receptor have been rounded to the nearest whole number.

4.5.15 The results in Vol 10 Table 4.5.3 show that the number of daily exceedances of PM_{10} is predicted to slightly decrease between 2010 and the peak construction year with and without the Thames Tideway Tunnel project. This decrease is due to predicted reductions in background concentrations and improved vehicle engine technology. The results for the development case show no increase in the number of days per year with concentrations above 50µg/m^3 compared with the base case at the modelled receptors due to construction works at the Carnwath Road Riverside site. This represents an impact of negligible magnitude according to the criteria in Vol 2 Section 4.

4.5.16 With no exceedances of the daily PM_{10} criteria in the development case, the significance of the effects would be **negligible** at all sensitive receptors.

Sensitivity test for programme delay

4.5.17 For the assessment of local air quality effects during construction, a delay to the Thames Tideway Tunnel project of approximately one year would not be likely to materially change the assessment findings reported above for the existing and proposed receptors. Based on the development schedule (Vol 10 Appendix N), it is possible that as a result of the one year delay, more of the Wandsworth Riverside Quarter development would be completed and occupied. However, it is not expected that these new receptors (Phase B) would experience any different effects to those identified in the assessment above, rather it would be a case of the potential for some additional receptors to experience the same (or lesser due to the distance of the development from the Carnwath Road Riverside site) effects as those that have already been identified.

Construction dust

4.5.18 Construction dust would be generated from both on-site activities and from road vehicles accessing and servicing the site.

4.5.19 Dust sensitive receptors have been identified in the vicinity of the Carnwath Road Riverside site in accordance with the criteria in Vol 2 Section 4, as described in Vol 10 Table 4.4.5. A summary of the approximate numbers of receptors in distance bands from the Carnwath Road Riverside site is detailed in Vol 10 Table 4.5.4.

Vol 10 Table 4.5.4 Air quality - numbers of dust sensitive receptors

Buffer distance (m)	Number of receptors*	Receptor type
<20	10-100	Residential, industrial and commercial
20-50	10-100	Residential, industrial and commercial
50-100	10-100	Residential and commercial
100-350	>500	Residential and commercial

** Buildings or locations that could be affected by nuisance dust.*

4.5.20 In line with the IAQM guidance (IAQM, 2012)[10], the site has been categorised using the criteria given in Vol 2 Section 4 to assess the likely impacts from demolition, earthworks, construction and trackout activities during construction and the likely effects of these activities on sensitive receptors close to the development.

4.5.21 The demolition for the Carnwath Road Riverside site is classified as a 'small' dust emission class. This classification is based on the small size of the demolition volume, which is less than 20,000m^3. As the nearest receptor is within 20m of the construction site, this makes the risk category for demolition activities medium risk.

4.5.22 The earthworks have been assessed to be a 'high' dust emission class as the size of the construction site is greater than 10,000m^2 and the total material to be moved is considerably more than 100,000 tonnes. With the nearest receptor within 20m, the site is assessed to be high risk for earthworks.

4.5.23 The construction proposed for the Carnwath Road Riverside site has a 'high' dust emission class. This classification is based on the large volume of concrete that would be batched on-site. The risk category for construction activities is therefore assessed to be high risk.

4.5.24 There would be 50-100m of unpaved haul roads on site, and the number of construction lorries per day would be 25-100, so the trackout dust emission class is classified as 'medium'. The closest receptor is within 20m of the affected roads. The risk category from trackout is therefore assessed to be medium risk.

4.5.25 The risk categories for the four activities are summarised in Vol 10 Table 4.5.5. This summary of these risks does not take into account the measures outlined in the *CoCP Part A* (Section 7).

Vol 10 Table 4.5.5 Air quality – summary of construction dust risks

Source	Dust soiling / PM_{10} effects
Demolition	Medium risk site
Earthworks	High risk site
Construction	High risk site
Trackout	Medium risk site

Note: without CoCP (Section 7) measures

4.5.26 On this basis, the development at the Carnwath Road Riverside site is classified as a high risk site overall.

4.5.27 Although the receptor sensitivity (with respect to construction dust nuisance) is identified as medium for all receptors apart from the Thames Path and River Thames (as identified in Vol 10 Table 4.4.5), due to the duration of the works and with receptors within 20m, the sensitivity of the area has been defined as 'high'.

4.5.28 With regard to the significance of effects, a high risk site with a high sensitivity of the area would result in a moderate adverse effect without control measures. When the measures outlined in the *CoCP Part A* (Section 7) are applied, the significance of the effect would be reduced to **minor adverse** (in accordance with IAQM guidance) for dust sensitive receptors within 20m of the site. At dust sensitive receptors beyond 20m the effect would be **negligible** with control measures in place. The significance of the effect for each receptor is summarised in Vol 10 Table 4.5.6.

Vol 10 Table 4.5.6 Air quality - significance of construction dust effects

Receptor	Significance of effect
5 Carnwath Road residential (CRRR8)	Minor adverse
89-101 Carnwath Road residential (CRRR1)	Minor adverse
Philpot Square residential (CRRR3)	Negligible
358 Wandsworth Bridge Road residential (CRRR6)	Negligible
Down House residential (CRRR5)	Negligible
Thomas' London Day School (building) (CRRR4)	Negligible
Piper Centre, 50 Carnwath Road commercial (CRRR2)	Minor adverse
Carnwath Road Retail Park (CRRR7)	Negligible
Thames Path (CRRR9)	Minor adverse
River Thames (CRRR10)	Minor adverse

4.6 Operational effects assessment

4.6.1 The operational assessment has been undertaken in accordance with the modelling methodology set out in Vol 2. Vol 10 Table 4.6.1 shows the predicted maximum ground level odour concentrations at the Carnwath Road Riverside site. These are the highest concentrations that could occur at the worst affected ground level receptor at or near the site in a typical year for the most unfavourable locations of the columns. In accordance with the odour benchmark set by the Environment Agency, results are presented for the 98th percentile of hourly average concentrations in the year (or the 176th highest hourly concentration in the year) and the number of hours in a year with concentrations above 1.5ou_E/m^3. Achieving the 98th percentile is considered to prevent nuisance and protect amenity. The number of hours with concentrations above 1.5ou_E/m^3 gives an indication of the number of hours in a year that an odour might be detectable at the worst affected receptor. The Environment Agency benchmark permits 175 hours above 1.5ou_E/m^3. The table also identifies the magnitude of the identified impacts in accordance with the criteria detailed in Vol 2 Section 4. Vol 10 Table 4.6.2 gives corresponding results for the predicted impacts at the worst affected buildings, where concentrations at ground level and at various heights have been considered.

Vol 10 Table 4.6.1 Odour - impacts and magnitude at ground level - operation

Year	Maximum at ground level locations		Impact magnitude and justification
Typical	98th percentile (ou_E/m^3)	0.4	Negligible 98th percentile concentration is less than 1ou_E/m^3
	No. of hours > 1.5ou_E/m^3	22	

Vol 10 Table 4.6.2 Odour - impacts and magnitude at buildings - operation

Year	Maximum at buildings		Impact magnitude and justification
Typical	98th percentile (ou_E/m^3)	0.8	Negligible 98th percentile concentration is less than1ou_E/m^3
	No. of hours > 1.5ou_E/m^3	75	

4.6.2 In the two tables above, the 98th percentile is shown as less than 1.5ou_E/m^3 at all locations so the odour benchmark would be achieved at all locations.

4.6.3 The highest 98th percentile concentration at ground level would occur on the Sullivan Enterprise Park, approximately 140m to the northwest of the ventilation column with 0.4ou_E/m^3. The highest 98th percentile concentration at a building would occur on the third floor of residential flats at 5 Carnwath Road to the west of the site with 0.8ou_E/m^3.

4.6.4 The most frequent occurrence of odour at ground level is predicted to occur approximately 50m to the northeast of the ventilation columns at the Piper Centre where there are predicted to be a maximum of 22 hours in a typical year when the odour threshold of $1.5ou_E/m^3$ would be exceeded. Odour could be detectable on an hourly basis at ground level for at least ten hours in a year out to a distance of 250m from the columns. The most frequent occurrence of odour at a building could occur on the third floor of residential flats in Carnwath Road to the west of the site with 75 hours in a typical year. With a frequent use year (ie, a more rainy year than average), the effects would be similar.

4.6.5 The significance of effects at ground level and building locations, given that the predicted odour concentrations at all locations and at buildings would not exceed the 98^{th} percentile benchmark of $1.5ou_E/m^3$ would be **negligible**. No significant effects are therefore predicted in relation to odour.

4.7 Cumulative effects assessment

Construction effects

4.7.1 As described in Section 4.3, only one development, Wandsworth Riverside Quarter, would be under construction during the peak construction year at the Carnwath Road Riverside site. It is expected that construction activities at the Wandsworth Riverside Quarter site could elevate dust, NO_2 and PM_{10} concentrations near that site and could also have an effect near the Carnwath Road Riverside site. However, this effect is likely to be small and not affect the significance of the impact due to construction activities at the Carnwath Road Riverside site due to the distance between the two sites (200m). Therefore the effects on air quality would remain as described in Section 4.5 above.

4.7.2 In the event that the programme for the Thames Tideway Tunnel project is delayed by approximately one year, a greater proportion of the Wandsworth Riverside Quarter development would be complete and occupied with a corresponding reduced level of cumulative activity. The effects on air quality would therefore continue to remain as described in Section 4.5.

Operational effects

4.7.3 As described in Section 4.3, there would not be any cumulative operational effects. Therefore the effects on odour would remain as described in Section 4.6 above.

4.8 Mitigation

Construction

4.8.1 Control measures of relevance to air quality are embedded in the *CoCP* (Section 7) as summarised in Section 4.2. No mitigation is required because effects are not significant.

Operation

4.8.2 Based on the assessment results (which includes the environmental design measures detailed in para. 4.2.18) indicating that all effects would be negligible, no mitigation is required.

Monitoring

4.8.3 It is envisaged that an appropriate particulate monitoring regime would be agreed with the LB of Hammersmith and Fulham prior to commencement of construction at the Carnwath Road Riverside site.

4.9 Residual effects assessment

Construction effects

4.9.1 As no mitigation measures are required, the residual construction effects remain as described in Section 4.5. All residual effects are presented in Section 4.10.

Operational effects

4.9.2 As no mitigation measures are required, the residual operational effects remain as described in Section 4.6. All residual effects are presented in Section 4.10.

4.10 Assessment summary

Vol 10 Table 4.10.1 Air quality - summary of construction assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Residential - 5 Carnwath Road (CRRR8)	Local air quality – effects from construction road traffic, tugs for river barges and plant emissions	Minor adverse	None	Minor adverse
	Effects from construction dust	Minor adverse	None	Minor adverse
Residential - 89-101 Carnwath Rd (CRRR1)	Local air quality – effects from construction road traffic, tugs for river barges and plant emissions	Minor adverse	None	Minor adverse
	Effects from construction dust	Minor adverse	None	Minor adverse
Residential - Philpot Square (CRRR3)	Local air quality – effects from construction road traffic, tugs for river barges and plant emissions	Minor adverse	None	Minor adverse
	Effects from construction dust	Negligible	None	Negligible
Residential - 358 Wandsworth Bridge Road (CRRR6)	Local air quality – effects from construction road traffic, tugs for river barges and plant emissions	Minor adverse	None	Minor adverse
	Effects from construction dust	Negligible	None	Negligible
Residential - Down House, Wandsworth Bridge Road (CRRR5)	Local air quality – effects from construction road traffic, tugs for river barges and plant emissions	Minor adverse	None	Minor adverse
	Effects from construction dust	Negligible	None	Negligible
Educational - Thomas’	Local air quality – effects from construction	Negligible	None	Negligible

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
London Day School (building) (CRRR4)	road traffic, tugs for river barges and plant emissions			
	Effects from construction dust	Negligible	None	Negligible
Office/commercial – Piper Centre, 50 Carnwath Road (CRRR2)	Local air quality – effects from construction road traffic, tugs for river barges and plant emissions	Negligible	None	Negligible
	Effects from construction dust	Minor adverse	None	Minor adverse
Commercial - Carnwath Road Retail Park (CRRR7)	Local air quality – effects from construction road traffic, tugs for river barges and plant emissions	Negligible	None	Negligible
	Effects from construction dust	Negligible	None	Negligible
Recreational - Thames Path (CRRR9)	Local air quality – effects from construction road traffic, tugs for river barges and plant emissions	Negligible	None	Negligible
	Effects from construction dust	Minor adverse	None	Minor adverse
Recreational - River Thames (CRRR10)	Local air quality – effects from construction road traffic, tugs for river barges and plant emissions	Negligible	None	Negligible
	Effects from construction dust	Minor adverse	None	Minor adverse

Vol 10 Table 4.10.2 Odour - summary of operational assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Residential - 5 Carnwath Road (CRRR8)	Odour	Negligible	None	Negligible
Residential - 89-101 Carnwath Rd (CRRR1)		Negligible	None	Negligible
Residential - Philpot Square (CRRR3)		Negligible	None	Negligible
Residential - 358 Wandsworth Bridge Road (CRRR6)		Negligible	None	Negligible
Residential - Down House, Wandsworth Bridge Rd (CRRR5)		Negligible	None	Negligible
Educational - Thomas' London Day School (building) (CRRR4)		Negligible	None	Negligible
Office/commercial – Piper Centre, 50 Carnwath Road (CRRR2)		Negligible	None	Negligible
Commercial - Carnwath Road Retail Park (CRRR7)		Negligible	None	Negligible
Recreational - Thames Path (CRRR9)		Negligible	None	Negligible
Recreational - River Thames (CRRR10)		Negligible	None	Negligible

References

[1] Greater London Authority and London Councils. *Best Practice Guidance: The Control of Dust and Emissions from Construction and Demolition* (November 2006).

[2] Highways Agency. *Design Manual for Roads and Bridges*, Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 1 pg D-1 HA207/07 Air Quality, May 2007.

[3] Michigan Environmental Science Board. *Health Effects of Low-Level Hydrogen Sulfide in Ambient Air* (2000).

[4] UK Government. *Environment Act 1995*. Available at: http://www.legislation.gov.uk/ukpga/1995/25/contents. Accessed June 2012.

[5] Defra. *Background Maps*. Available at: http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html. Accessed June 2012.

[6] LB of Hammersmith and Fulham. *Personal Communication*, July 2012.

[7] World Health Organization. *Air Quality Guidelines for Europe* Second Edition Chapter 6.6 (2000).

[8] Defra. *Emissions.* Available at: http://laqm.defra.gov.uk/review-and-assessment/tools/emissions.html#eft. Accessed June 2012.

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

[10] Institute of Air Quality Management. *Guidance on the Assessment of the Impacts of Construction on Air Quality and the Determination of their Significance* (January 2012).

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.10**

Volume 10: Carnwath Road Riverside site assessment

Section 5: Ecology - aquatic

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 10: Carnwath Road Riverside site assessment

Section 5: Ecology – aquatic

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5 Ecology – aquatic

5.1 Introduction

5.1.1 This section presents the findings of the assessment of the likely significant effects on aquatic ecology of the proposed development at the Carnwath Road Riverside site.

5.1.2 The proposed development may lead to effects on aquatic ecology due to the physical works in-river during construction of the Thames Tideway Tunnel project. Development associated with the Carnwath Road Riverside highway works site would be entirely inland and would not generate effects on aquatic ecology. All references here after to the site refer to the main Carnwath Road Riverside site.

5.1.3 Operational effects for aquatic ecology for this site have not been assessed. This is on the basis that there would be no combined sewer overflow (CSO) interception at this site or permanent in-river works; the site is a main tunnel drive and reception site, and Frogmore connection tunnel reception site only. No significant operational effects are considered likely and for this reason only construction effects on aquatic ecology are assessed.

5.1.4 The project wide effects of the Thames Tideway Tunnel on aquatic ecology are assessed in Volume 3 Project-wide effects assessment.

5.1.5 The assessment of the likely significant effects of the project on aquatic ecology has considered the requirements of the National Policy Statement (NPS) for Waste Water[1]. In line with these requirements, designations, species and habitats relevant to aquatic ecology are identified and measures incorporated into the proposed development described. Based on assessment findings, measures to address likely significant adverse effects are identified. Vol 2 Section 5 provides further details on the methodology.

5.1.6 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Volume 10 Carnwath Road Riverside Figures).

5.2 Proposed development relevant to aquatic ecology

5.2.1 The proposed development is described in Section 3 of this volume. The elements of the proposed development relevant to aquatic ecology are set out below.

Construction

5.2.2 The construction site at Carnwath Road Riverside would be located both on land and on the foreshore. Construction activities would occur over six years. The elements of the construction relevant to aquatic ecology would be as follows:

a. a campshed against the river wall measuring approximately 2160m^2 suitable for three barges of up to 800t located within the intertidal zone of the site (Option A). Dredging to a depth of approximately 1.7m would be required in order to create a level base for the campshed

b. the installation of a shallow sheet pile wall within the foreshore, around the outer edge of the campshed to maintain its stability.

c. strengthening of the existing river wall where the shaft cuts through its ties and along its length to accommodate barge operations.

d. as an alternative, a jetty may be constructed (Option B) with associated campshed in the subtidal zone of the site, also with a shallow sheet pile wall. The construction of the jetty would be as follows:

 i A jetty and two associated conveyors (all supported on piled piers installed by a jack-up barge) would be present during the construction period and subsequently removed.

 ii Dredging to a depth of approximately 0.3m would be required in order to create a level base for the campshed. The campshed would be approximately 2160m^2 and dredging would only take place within the area required for the campshed.

 iii The campshed would be of the same construction as for option A.

 iv It is envisaged that there would always be a barge present at the jetty to receive tunnel spoil without having to divert spoil to stockpile.

e. associated regular barge movements and resting on the campshed (with a peak monthly average of four movements per day)

f. 24 hour working, during tunnel construction and also for barge movements, during which there would be lighting of in-river structures. Lighting would meet the requirements of the *Lighting management plan* described in 5.2.4j

5.2.3 Both options are assessed with respect to in-river transport at this site (Option A: a campshed only and Option B: a campshed plus jetty), since some of the potential impacts and likely significant effects of the two types of structure are different.

Code of Construction Practice

5.2.4 The *Code of Construction Practice (CoCP)*[i] sets out the standards, procedures, and measures for managing and reducing construction effects. The *CoCP Part A* includes the following measures, which are an integral part of the project and relevant for the purposes of this assessment:

a. The location of barges and design of facilities such as campsheds would minimise environmental impacts. In-river structures would be

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[i] The *Code of Construction Practice (CoCP)* is provided in Vol 1 Appendix A. It contains general requirements (Part A), and site specific requirements for this site (Part B).

removed on completion of the works unless otherwise agreed. Where concrete is used, a membrane would protect the underlying riverbed. Reinstatement would be subject to a method statement (*CoCP Part A* Section 11).

b. Avoiding piling at night to ensure to allow fish to migrate past the site within each 24-hour period (*CoCP Part A* Section 6).

c. Limiting allowable noise and vibration levels to leave part of the river cross-section passabl*e at all times (CoCP Part A* Section 6).

d. Where technically feasible, low noise/vibration campshed or pile/pier installation techniques would be used. Where vibro-piling is undertaken, slowly increasing the power of the driving to enable fish to swim away before the full power of the pile driver is felt through the river (*CoCP Part A* Section 6).

e. Removal of all piles from the bed of the river. Any piles which prove impossible to remove would be driven down, cut off or removed to a depth of a least 1 metre below the adjacent riverbed level (CoCP Part A Section 4).

f. Application of fish rescue arrangements (*CoCP Part A* Section 8). .

g. Avoidance of pollution of the river (*CoCP Part A* Section 8).

h. Minimise the release of suspended sediment and solids into the water column (*CoCP Part A* Section 8).

i. Management arrangements to prevent spillage of transferred materials when loading to and from the river. Monitoring methods and contingencies arrangements are to be included in the River Transport Management Plan and Emergency Preparedness Plan (CoCP *Part A* Section 8).

j. Avoid direct lighting of watercourses, where reasonably practical, to avoid inhibiting movements of photophobic species such as eel (*CoCP Part A* Section 4 and Section. 5.2 for *CoCP Part B*).

5.2.5 Since the site lies within the stretch of the river known to support spawning habitat for smelt and dace additional restrictions on dredging would be applied (*CoCP Part A* Section 8.11.) They can be summarised as follows:

a. Due regard should be given so as to minimise any impact on biodiversity within the river.

b. The restricted period for dredging (ie, June to August) may need to be extended to include the spring period (ie, March to May).

5.2.6 The CoCP *Part B* at Carnwath Road Riverside commits to the following measures that are of relevance to aquatic ecology:

a. A site-specific lighting plan would include the use of low level directional lighting where possible whilst meeting safe work requirements (*CoCP Part B* Section 4).

b. Works to reduce the foreshore level, build campsheds, and/or jetties, and rebuilding a stretch of the existing river wall would be required at the start of the construction period (*CoCP Part B* Section 4) be restored prior to the completion of works, with similar material and to a similar baseline condition (*CoCP Part B* Section 11) and Vol 3 Appendix 4.

Environmental design measures

5.2.7 Generic design principles of relevance to aquatic ecology at Carnwath Road Riverside are as follows:

a. Fenders on the river wall to promote aquatic ecology.

b. Habitat at the base of any foreshore structure to encourage retention of sediment in order to promote aquatic ecology.

c. No lighting in the River Thames or directed towards it unless required for navigational purposes. On-site lighting would use capped, directional and cowled lighting units.

5.2.8 Design principles of specific relevance to Carnwath Road Riverside are as follows:

a. Rebuilding of the river wall would include fenders to promote biodiversity

b. Lighting to the Thames Path and new public realm would be in accordance with the Lighting Design Principles to avoid light spill on biodiversity.

5.3 Assessment methodology

Engagement

5.3.1 Volume 2 Environmental assessment methodology documents the overall engagement which has been undertaken in preparing the *Environmental Statement*. The *Scoping Report* was prepared before the Carnwath Road Riverside site had been identified as a preferred site and therefore it has not been the subject of scoping. The scope for aquatic ecology for this site has therefore drawn on professional judgement.

5.3.2 Comments received after scoping and during phase two consultation in relation to this site, and the approach to addressing them are presented in Vol 10 Table 5.3.1.

Vol 10 Table 5.3.1 Aquatic ecology – stakeholder engagement for Carnwath Road Riverside

Organisation	Comment	Response
Environment Agency (phase two consultation response – February 2012)	Noted that if any river-wall alteration or rebuilding is required, then reference to the Estuary Edges guidance should inform any new flood defence or river wall designs.	Rebuilding of the river wall would include design measures detailed in paras 5.2.7 and 5.2.8.

Organisation	Comment	Response
	Noted that the likelihood of successful reinstatement of the 0.16ha area under the temporary campshed must be considered within the *Environmental Statement*.	The impact of the temporary campshed on habitats is assessed in the *Environmental Statement*. Reinstatement would be subject to a method statement as detailed in para. 5.2.4a.
	Indicated that the site is within the area that smelt are thought to utilise for spawning, which should be incorporated into the assessment.	The sensitivity of this reach of the river and the suitability of the site for spawning smelt is reflected in the assessment.
	Noted that it would be preferable to cut off temporary sheet piles at 1m below bed level, and remove all new concrete, to allow the foreshore to re-establish itself.	In order to comply with navigational requirements, the contractor would seek to completely remove the piles where technically feasible (see para. 5.2.4e).
	Requested clarify with respect to use of piling.	Piling would be used to construct the in-river infrastructure needed for barging. Measures to control piling impact are contained within the *CoCP Part A* (Section 6) (see para. 5.2.4)
	Requested that consideration should be given in the *Environmental Statement* to the possible negative effects of localised smothering of subtidal gravels by sediments mobilised by dredging or construction activities. This could impact upon fish spawning areas.	Increases in suspended sediment loads are considered in Section 5.5 of this assessment. The volume of sediment mobilised by dredging is assessed in the context of existing sediment loads within the estuary.
Environment Agency (Section 48 consultation response – 2012)	Requested clarity with regard to whether in-river structures would be temporary or permanent, and assuming the former the nature of foreshore reinstatement.	The structures would be temporary. The *CoCP Part B* (Section 11) states that areas of foreshore used for temporary works would be restored to similar condition and material prior to the completion of the works (see para 5.2.4a).

Organisation	Comment	Response
	Noted that terracing along the line of the existing flood defence could provide habitat creation.	Opportunities for terracing at this location have been considered. Hurlingham Wharf would continue to operate as a working wharf following completion of construction and therefore terraces at this location are considered inappropriate. Timber fendering has been incorporated into the replacement river wall design.

Baseline

5.3.3 The baseline methodology follows the methodology described in Vol 2 Section 5. There are no site specific variations for identifying the baseline conditions for this site.

5.3.4 The assessment is based on desk study and survey data. For habitats, fish, invertebrates and algae desk study data has been obtained for the whole of the tidal Thames. The data sets for fish, invertebrates and algae are based on fixed sampling locations at intervals through the River Thames. Sites as close to Carnwath Road Riverside as possible have been selected. Details of the background or desk study data sets are provided in Vol 2 Section 5.

5.3.5 Surveys for fish and invertebrates were undertaken during May 2011, within the proposed development site and within a 100m radius of the site boundary. During these surveys, the intertidal habitats present were recorded. Surveys for juvenile fish were also undertaken at five sampling locations along the tidal Thames six times between May and September 2011. The nearest sampling location for juvenile fish to the site was at Putney Embankment Foreshore approximately 1km upstream. Surveys for algae were undertaken at eight sampling locations in May 2012, including most of the foreshore sites. The river wall was deemed unsuitable for algae at Carnwath Road Riverside since it is comprised of sheet piles and concrete which are too smooth for algal colonisation. Algal surveys were therefore not undertaken at this site. The nearest site that was surveyed for algae was Putney Embankment Foreshore, approximately 300m upstream. The survey comprised sampling of algae along a vertical transect of the river wall located within or as close to the proposed development site as possible.

Construction

5.3.6 The assessment methodology for the construction phase follows that described in Vol 2 Section 5. The assessment area is the zone which lies within a 100m radius of the boundary of the proposed development site. The assessment year for construction effects is Site Year 1, ie, when construction would commence. There are no site-specific variations for undertaking the construction assessment of this site.

5.3.7 Section 5.5 details the likely significant effects on aquatic ecology arising from the construction of the proposed development at the Carnwath Road Riverside site. There are no other Thames Tideway Tunnel project sites which could give rise to additional effects on aquatic ecology receptors within the construction assessment area for this site, therefore no other Thames Tideway Tunnel project sites are considered in this assessment.

5.3.8 No schemes from the site development schedule (see Vol 10 Appendix N) are considered relevant to the aquatic ecology base case as none comprise in-river development, development adjacent to the river or development discharging into the river. Similarly there are no schemes in this schedule relevant to a cumulative impact assessment for the same reasons. Therefore no cumulative impact assessment has been undertaken.

5.3.9 The assessment of construction effects considers the extent to which the assessment findings would be likely to be materially different, should the programme for the Thames Tideway Tunnel project be delayed by approximately one year.

Assumptions and limitations

5.3.10 The assumptions and limitations associated with this assessment are presented in Vol 2 Section 5. Assumptions and limitations specific to this site are outlined below.

Assumptions

5.3.11 It has been assumed that:

a. Campsheds (applicable to either option) would be concrete structures;

b. Campsheds would be constructed using a method whereby shallow sheet piles would be used to create the outer edge of the campshed. Soft material would be removed from within the sheet piled area and replaced with a coarser material similar to the existing river bed in order to provide stability. Concrete would be placed into the sheet piled area on top of a geotextile membrane.

c. Vibro piling techniques would be used.

d. Periodic removal of settled material within the navigational channel around the campshed would be required.

e. There would be illumination at this facility given the need for 24hr working.

Limitations

5.3.12 During fish surveys at the site carried out in May 2011, on two out of four occasions, large pieces of submerged debris were encountered whilst hauling the seine net, which may have reduced catch efficiency. However, in conjunction with the background data, the survey results are considered to represent a robust baseline for this site.

5.4 Baseline conditions

5.4.1 The following section sets out the baseline conditions for aquatic ecology within and around the site. Future baseline conditions (base case) are also described.

Current baseline

5.4.2 The following section sets out the existing baseline applicable to this site. The section begins with a discussion of any statutory (i.e. with a basis in law) or non-statutory (i.e. designated only through policy) sites designated for their nature conservation value. It then addresses habitats, followed by the species receptors associated with those habitats, namely mammals, fish, invertebrates and algae. This order is followed throughout the assessment sections.

Designations and habitats

5.4.3 This section sets out the effects on designations and habitats applicable at the site specific level. Designations and habitats applicable at the project wide scale are assessed in Vol 3 Section 5.

5.4.4 The River Thames is part of the proposed Thames Estuary South East Marine Conservation Zone (MCZ no.5) the details of which were submitted to Government in early 2012. If adopted, it will be designated as a national statutory site under the Marine and Coastal Access Act 2009. The purpose of MCZs is to protect the full range of nationally important biodiversity, as well as certain rare and threatened species and habitats. Species include smelt (*Osmerus eperlanus*), European eel (*Anguilla anguilla*) and tentacled lagoon worm (*Alkmaria romijnii*) (Balanced Seas, 2011) [2]. The Thames offers important spawning and migratory habitat for smelt, and migratory habitat for European eel.

5.4.5 There are no other international or national statutory sites (ie, Sites of Special Scientific Interest or Local Nature Reserves) designated for aquatic ecology within the assessment area.

5.4.6 Carnwath Road Riverside falls within the non-statutory River Thames and Tidal Tributaries Site of Importance for Nature Conservation (Grade III of Metropolitan importance)[ii]. The SINC is designated by the Greater London Authority and adopted by all boroughs which border the tidal Thames. It recognises the range and quality of estuarine habitats including mudflat, shingle beach, reedbeds and the river channel. The SINC citation notes that over 120 species of fish have been recorded in the Tideway, though many of these are only occasional visitors. The more common species include dace (*Leuciscus leuciscus*), bream (*Abramis brama*) and roach (*Rutilus rutilus*) in the freshwater reaches (described in para. 5.4.8), and sand-smelt (*Atherina presbyter*), flounder (*Platichthys flesus*) and Dover sole (*Solea solea*) in the estuarine reaches. Important migratory species include Twaite shad (*Alosa fallax*), European eel, smelt, salmon (*Salmo salar*) and sea trout (*Salmo trutta*). A number of nationally

[ii] SINC (Grade M) = Site of Importance for Nature Conservation (Grade III of Metropolitan importance)

rare snails occur, including the swollen spire snail (*Mercuria confusa*), as well as an important assemblage of wetland and wading birds.

5.4.7 The tidal reaches of the River Thames (tidal Thames) are the subject of a *Habitat Action Plan* (*HAP*) within the *London Biodiversity Action Plan* (*BAP*) (Thames Estuary Partnership Biodiversity Action Group, undated)[3], and the targets prescribed for this *HAP* are reflected in the London Borough (LB) of Hammersmith & Fulham *Habitat Action Plan* (*HAP*) for the River Thames (LB of Hammersmith and Fulham, undated)[4]. The Thames *HAP* identifies a number of habitats and species which characterise the estuary, such as gravel foreshore, mudflat and saltmarsh. A number of these habitats and species, including mudflat, are also the subject of action plans under the UK *BAP*.

5.4.8 The river is divided into three zones within the tidal Thames *HAP*; freshwater, brackish and marine (Vol 3 Figure 3.4.1, see separate volume of figures). The brackish zone is equivalent to the category known as transitional waters or estuaries under the Water Framework Directive (WFD). Further details of the WFD river zone classifications can be found in Vol 3 Section 5.

5.4.9 Carnwath Road Riverside lies within the freshwater zone, which means that the fish and invertebrate communities which occur within the river at this location consist of freshwater species and more freshwater tolerant marine species. Invertebrate diversity is generally higher than in the brackish zone, but species must be able to withstand some variations in salinity and a stressful environment. Stress is caused by the fluctuating tidal conditions, which means that flora and fauna have to be able to tolerate wide variations in their physical environment.

5.4.10 The intertidal habitat is relatively narrow in this section of the river due to development on either bank, and the river in this location is confined by a constructed vertical river wall. The substrate at this survey site is predominantly pebbles (40-100mm) and infrequent cobble stones (150-250mm) overlying a consolidated silt under-layer and mud deposits. In the middle of the proposed foreshore construction site is a large expanse of mud reaching from the channel wall to the water line (c.10m wide).

5.4.11 A summary of habitat types present and other features of interest recorded during May 2011 surveys are presented in Vol 10 Table 5.4.1 and Vol 10 Figure 5.4.1(see separate volume of figures).

Vol 10 Table 5.4.1 Aquatic ecology – principal habitat, substrate and other features of interest at Carnwath Road Riverside

UK *BAP* target habitats present and features of interest	Substrate present in intertidal zone (approximate % cover)	Substrate present in subtidal zone
Gravel foreshore Sublittoral sand and gravels River wall	Cobbles (50%) Pebbles (30%) Silt (20%)	Pebble Gravel Sand

5.4.12 The shallow river margins, which shift across the intertidal foreshore with the ebb and flood of the tides, provide an important migration route for juvenile fish along the estuarine corridor. The young of species such as eel (known as 'glass eels' or 'elvers'), flounder, dace and smelt rely upon access to these areas of lower water velocity to avoid being washed out by tides and to avoid predation by the larger fish that occur in deeper water. Migrants of larger fish tend to use faster mid-channel routes. Young fish also feed predominantly amongst the intertidal habitat.

Evaluation of habitats for Carnwath Road Riverside

5.4.13 The value of the habitats for individual aquatic ecology receptors is described in the relevant baseline sections. The habitats are considered to be of medium-high (metropolitan) value as part of the River Thames and Tidal Tributaries SINC (Grade M).

Marine mammals

5.4.14 Records compiled by the Zoological Society of London (ZSL) for 2003-2011 indicate that no marine mammals have been observed in this area of the tidal Thames.

Evaluation of marine mammals for Carnwath Road Riverside

5.4.15 The site is considered to be of low-medium (local) value for marine mammals due to absence of records.

Fish

5.4.16 In general, tidal Thames fish populations are mobile and wide ranging. Although the abundance and diversity of fish at any one site may provide some indication of the habitat quality offered at that site it is important to consider the data within the context of sites throughout the tidal Thames, since the factors influencing distribution are likely to be acting at this wider scale. To this end, the findings of the Thames Tideway Tunnel project site specific survey, relevant juvenile fish surveys and EA background data are presented in this section and are used to inform the evaluation of the site. Effects at the project wide scale are assessed in Vol 3 Section 5.

5.4.17 The site lies within the zone of the river known to offer spawning habitat for dace and smelt. The zone for dace extends from Richmond downstream to Battersea, and the zone for smelt from Wandsworth to Battersea (Colclough et al, 2002)[5]. Spawning takes place during the spring on gravel habitats at night just below the low tide level. Smelt is priority species under the UK BAP[6].

Baseline surveys

5.4.18 A single day survey was undertaken at Carnwath Road Riverside during May 2011. Full details of the methodology and rationale for the timing of surveys are presented in Vol 2 Section 5.

5.4.19 Fish are routinely categorised into 'guilds' according to their tolerance to salinity and habitat preference (Elliott and Taylor, 1989[7]; Elliott and Hemingway, 2002[8]) which can be defined as follows:

a. Freshwater – species which spend their complete lifecycle primarily in freshwater.

b. Estuarine resident – species which remain in the estuary for their complete lifecycle.

c. Diadromous – species which migrate through the estuary to spawn having spent most of their life at sea.

d. Marine juvenile – species which spawn at sea but spend part of their lifecycle in the estuary.

5.4.20 The survey recorded low fish abundance in the area of Carnwath Road Riverside, with only four species and five individuals captured in total. This was a very low number in terms of absolute abundance of fish, compared with a catch exceeding 200 fish at Barn Elms, Western Pumping Station and Cremorne Wharf Depot, which had the highest abundance of fish of all sites surveyed in relation to the Thames Tideway Tunnel project. The assemblage of species, with mostly freshwater (common bream and dace) and diadromous species (smelt) present reflects the location of the site within the freshwater zone of the river. The range of species recorded and the number of individuals is presented in Vol 10 Table 5.4.2 .

Vol 10 Table 5.4.2 Aquatic ecology – results of fish surveys at Carnwath Road Riverside

Common name	Scientific name	Number of individuals Oct 2010	Guild
Flounder	*Platichthys flesus*	1	Estuarine resident
Smelt	*Osmerus eperlanus*	1	Diadromous
Common bream	*Abramis brama*	1	Freshwater
Dace	*Leuciscus leuciscus*	2	Freshwater

5.4.21 A single smelt of 130mm was caught at this survey site. This is the furthest up-stream a smelt was recorded during the May 2011 survey.

Juvenile fish surveys

5.4.22 Surveys for juvenile fish were undertaken at Putney Embankment Foreshore, the nearest site surveyed to Carnwath Road Riverside, as part of a suite of five sites sampled six times between May and September 2011 as part of the project wide assessment. The site locations are presented in Vol 2 Figure 4.4.5 (see separate volume of figures). The aim of the surveys was to record juvenile fish migrations through the Tideway to inform a modelling study of the hydraulic effects of the temporary and permanent structures on fish migration. The extent of the surveys and details of the methodology are presented in Vol 2 Section 5. The data from the juvenile fish surveys at Putney Embankment Foreshore are shown in Vol 10 Table 5.4.3.

Vol 10 Table 5.4.3 Aquatic ecology – results of 2011 juvenile fish surveys at Putney Embankment Foreshore

Common name	Scientific name	Number of individuals					
		Survey					
		1 May	2 late May	3 June	4 July	5 Aug	6 Sept
Flounder	*Platichthys flesus*	813	3698	1301	26	7	0
Smelt	*Osmerus eperlanus*	2	3	1	0	0	0
Eel	*Anguilla anguilla*	10	10	4	1	1	0
Common bream	*Abramis brama*	0	0	0	1	0	0
Dace	*Leuciscus leuciscus*	74	30	177	21	2	2
Roach	*Rutilus rutilus*	5	18	67	19	11	3
Perch	*Perca fluviatilis*	36	52	33	3	0	0
Goby	*Pomatoschistus* spp.	1	0	5	283	851	995
Sea bass	*Dicentrarchus labrax*	0	0	97	72	67	28
10-spined stickleback	*Pungitius pungitius*	0	0	20	1	0	1
3-spined stickleback	*Gasterosteus aculeatus*	6	0	52	60	26	17
Barbel	*Barbus barbus*	0	0	1	0	0	0
Gudgeon	*Gobio gobio*	0	0	2	1	1	0
Stone loach	*Barbatula barbatula*	0	0	2	0	0	0
Sand smelt	*Atherina presbyter*	0	0	1	0	1	1
Chub	*Leuciscus cephalus*	0	0	0	0	0	1
Mullet	*Chelon labrosus*	0	0	0	0	0	14

5.4.23 Post-larval flounders dominated the catch from surveys one, two, and three, followed by dace and perch (*Perca fluviatilis*) at Putney during surveys one and two, and dace and roach in survey three. Flounder were caught in the shallow littoral zone, indicating early springtime colonisation from marine spawning sites.

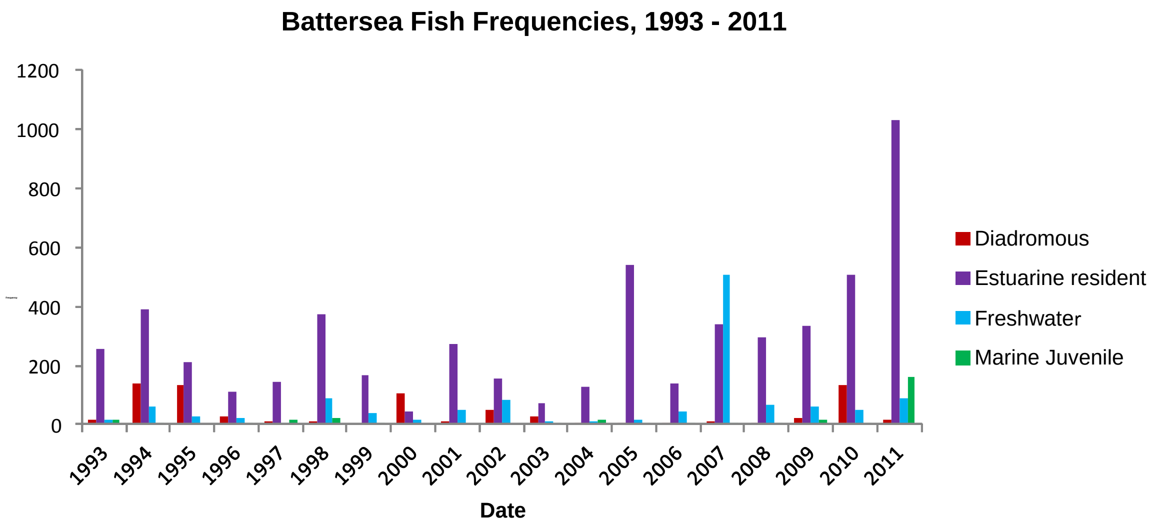
5.4.24 From surveys three to six, three-spined stickleback and sea bass (*Dicentrarchus labrax*) were numerous, whilst goby numbers increased considerably from survey four onwards, peaking at 995 individuals in survey six. Perch, roach and flounder declined over surveys four to six. Those species recorded at very low frequencies spawn outside the estuary and do not depend on the tidal Thames as nursery habitat.

Environment Agency background data

5.4.25 The surveys described in paras. 5.4.16 to 5.4.24 provide up-to-date baseline information directly relevant to fish community composition at Carnwath Road Riverside. EA records have also been used to provide a wider context for the fish community in the tidal Thames. The EA carry out annual surveys of fish within the tidal Thames, with data available from 1992-2011. Methodologies for the survey are provided in Vol 2 Section 5. There is an EA sampling site at Battersea, located 1.6km downstream, where EA surveys have been carried out every year from 1993 to 2011. Fifteen fish species are recorded for Battersea. These show fairly consistent catches in trawls but some indication of increasing seine-net catches in recent years (Vol 10 Plate 5.4.1).

5.4.26 Catches are dominated by estuarine resident fish such as common goby, flounder and sand smelt, freshwater species including dace, common bream, perch and roach, and migratory species including eel and smelt. Other migratory species such as salmon and sea trout must pass through the area but are too infrequently present to be detected by only one or two surveys per year. The high frequency of freshwater species recorded in 2007 may be as a result of very high rainfall during that year. High flows may have led to a greater number of freshwater fish being washed into the tidal Thames and lower salinity conditions which allowed them to survive.

Vol 10 Plate 5.4.1 Aquatic ecology – long term EA total fish catches from Battersea site



Water quality and current fish baseline

5.4.27 Prior to the 1960s, water quality in the tidal Thames was heavily degraded by raw sewage inputs caused by under-capacity of sewage treatment works (STWs). With the construction of new works (Wheeler, 1979)[9] recorded the progressive improvement of fish populations from the 1960s onwards was recorded. The ecology of the tidal Thames has undergone further improvement in recent decades, with some 125 fish species now recorded by the EA. However, hypoxia events arising from regular CSO spills and occasional discharges of untreated waste from STWs still occur. Discharges have the effect of depleting dissolved oxygen (DO) (measured in mg/l) by the biological breakdown of organic matter in the discharge. This is referred to as biochemical oxygen demand (BOD). Substantial fish mortalities begin to occur when DO levels drop beneath 4mg/l. An example of the effects of a hypoxia event occurred in June 2011, in which approximately 26,000 fish were killed, across the tidal Thames study area, following a release of around 450,000 tonnes of untreated sewage. This incident is discussed in further detail in the project wide assessment (Vol 3 Section 5).

5.4.28 The Tideway Fish Risk Model (TFRM) was developed to evaluate (DO) standards for the tidal Thames (Turnpenny *et al*., 2004)[10] as part of the *Thames Tideway Strategic Study* (*TTSS*). The DO standards for the tidal Thames comprise four threshold levels expressed as concentrations of DO in mg/l specified tidal durations. Frequencies are set on the number of times per year each of these thresholds can be exceeded. Further details of the standards are presented in Vol 2 Section 14. Details of the TFRM are presented in Vol 2 Section 5 and Vol 2 Appendix C.3). The TFRM considers fish distribution and the effects of low DO conditions within defined 3km zones within the tidal Thames. The zones are based on those used by the EA's automated water quality monitoring system (AQMS), for which DO data are collected continuously.

5.4.29 The model uses known hypoxia tolerance thresholds for seven species which are considered to represent the range of species which occur in the tidal Thames. The model is based on the assumption that for most species of fish, populations will be sustainable provided hypoxia related mortality does not exceed 10% of the total population. The model considers both adult and juvenile fish (known as 'lifestage cases'), since juveniles generally have a lower tolerance to hypoxia.

5.4.30 It is not possible to isolate the contribution of individual CSO discharges on hypoxia related fish mortalities in the tidal Thames. This is because the TFRM provides outputs only at a population level. For example, DO conditions may be below a lethal threshold in one zone known to be used by a particular species of fish. However, provided conditions are above the threshold in other zones such that 90% of the population are unharmed then conditions are considered to be sustainable. The outputs are discussed in further detail in the project wide assessment (Vol 3 Section 5.6). However, TFRM results for the existing baseline suggest that a total of five of the seven species/lifestage cases are expected to suffer unsustainable hypoxia related mortality in the tidal Thames each year. Given that the indicator species used in the model act as surrogates for a wider range of ecosystem components, other sensitive taxa are also likely to be unsustainable under this water quality regime.

Evaluation of fish community for Carnwath Road Riverside

5.4.31 The Carnwath Road Riverside site is considered to be of medium-high (metropolitan) value for fish. Although catches at this site were low during surveys in May 2011, the site lies within the zone of the river known to support spawning habitat for smelt which is a UK Biodiversity Action Plan species. A relatively high diversity of freshwater and estuarine species was also indicated by EA records.

Invertebrates

5.4.32 Benthic invertebrates are used in the freshwater, estuarine and marine environments as biological indicators of water and sediment quality since their diversity, abundance and distribution reflects natural or man-made fluctuations in environmental conditions. Species diversity is influenced by factors such as substrate and salinity. However high species diversity (or numbers of species) at any given site generally indicates good water and/or sediment quality, whilst low diversity, often accompanied by high abundances of pollution tolerant species may indicate poor quality.

5.4.33 Invertebrate populations and particularly those which occur in the water column (pelagic) are influenced by conditions throughout the estuary. The strongest influences on invertebrate distribution and density tend to be physical factors such as salinity, and substrate type followed by water quality and local habitat conditions.

Baseline surveys

5.4.34 A single day survey was undertaken at Carnwath Road Riverside during May 2011. The area covered by the survey is the same as that described for the fish surveys above (para. 5.4.18) and illustrated in Vol 10 Figure 5.4.1 (see separate volume of figures). Details of the sampling methods used can be found in Vol 2 Section 5. Three intertidal and two subtidal samples were taken.

5.4.35 The invertebrates collected during the May 2011 field surveys are presented in Vol 10 Table 5.4.4, below. The Community Conservation Index (CCI) score (Chadd and Extence, 2004)[11] has initially been used to identify species of nature conservation importance. CCI classifies many groups of invertebrates of inland waters according to their scarcity and conservation value in Great Britain and relates closely to the Red Data Book (RDB) (Bratton, 1991[12] and Shirt, 1987[13]) by attributing a score between 1 and 10. The higher the CCI score the more scarce the species and/or greater its conservation value.

Vol 10 Table 5.4.4 Aquatic ecology – invertebrate fauna sampled at Carnwath Road Riverside May 2011

Taxa	CCI Score	No. of individuals - subtidal samples		No. of individuals - Intertidal samples		
Sample numbers		**Air lift 1**	**Air lift 2**	**Kick sample**	**Sweep net 1**	**Sweep net 2**
Theodoxus fluviatilis	3	1	7	0	0	0
Potamopyrgus antipodarum	1	60	600	0	0	0
Radix balthica	1	1	1	0	0	0
Pisidium amnicum	1	1	0	0	0	0
Corbicula fluminea	-	0	9	0	0	0
Helobdella stagnalis	1	0	1	0	0	0
Polychaeta	-	0	1	0	30	0
Palaemon longirostris	5	0	0	0	0	2
Oligochaeta	-	250	600	5	250	1500
Erpobdella sp.	-	0	0	0	1	0
Erpobdella testacea	5	0	2	0	0	0
Gammarus sp	-	0	0	1	0	0
Gammarus zaddachi	1	0	2200	0	40	3
Number of taxa	**-**	**5**	**9**	**2**	**4**	**3**

5.4.36 Samples taken at Carnwath Road were characterised by a fauna dominated by pollution tolerant taxa, such as Oligochaeta worms, and *Potamopyrgus antipodarum*, which were present in high abundances. The most pollution sensitive taxon, *Theodoxus fluviatilis* was present in the subtidal samples and the moderately pollution sensitive shrimp *Gammarus zaddachi* was also present in high abundances in one of the subtidal samples.

5.4.37 Some significant differences appear between the intertidal and the subtidal samples, such as a higher diversity in the subtidal samples, the absence of the river neritid *T. fluviatilis* (which is present in subtidal) from the intertidal samples, and the higher abundances of the shrimp *G. zaddachi* in the subtidal samples. This is likely to be due to the fact that the intertidal habitat is highly disturbed and may be regularly dredged.

5.4.38 As at other survey sites, the taxa present were brackish species, with varying tolerance of different levels of salinity from estuarine to near freshwater. The invasive Asiatic clam (*Corbicula fluminea*), which can only tolerate high levels of salinity for a limited period (Aguirre and Poss, 1999)[14] was sampled at this survey site in one sample.

Environment Agency background data

5.4.39 Carnwath Road Riverside is located 1.6km upstream of the EA monitoring site at Battersea, which is the nearest sampling location with recent data (2005-2011). The EA samples are taken using a number of techniques, including cores and kick sampling in the intertidal and day grab and core samples in the subtidal.

5.4.40 A total of 50 taxa were recorded at Battersea over the seven year period in which samples were collected. The taxa Oligochaeta (worms), which thrives in organically polluted conditions, was relatively abundant, together with other pollution tolerant species such as the snail *P. antipodarum*. However, *G. zaddachi*, a moderately pollution-sensitive species was also highly abundant and *T. fluviatilis* (pollution sensitive river neritid) was present most years.

5.4.41 All of the taxa present are brackish species or animals that have a varying tolerance to different levels of salinity from estuarine to near freshwater. No obligate freshwater or marine animals were present. The occasionally brackish nature of the water is demonstrated by species such as *G. zaddachi* (a brackish species of shrimp, rather than its more commonly occurring freshwater homologue *Gammarus pulex*) and *Crangon crangon* (shrimps, typical of estuarine and brackish conditions).

5.4.42 The only species of high nature conservation importance was the mudshrimp *Apocorophium lacustre* (CCI 8), a RDB species which was present in subtidal samples at the site EA data have however shown *A. lacustre* to be common in the tidal Thames. Therefore the relative value of the invertebrate community is not considered to be higher in this instance.

5.4.43 In addition to the native *G.zaddachi,* the amphipod *Gammarus tigrinus*, of North American origin, was recorded at Battersea (one individual) in 2006. The species was not sampled at the Carnwath Road Riverside site in May 2011.

5.4.44 It is believed that this species of amphipod arrived in English waters via ballast water from ships. It lives in fresh and brackish waters and can expand rapidly, outcompeting local amphipods. However, based on available data, it appears to be much less abundant than the native *G. zaddachi* within the tidal Thames.

5.4.45 The zebra mussel (*Dreissena polymorpha*) was present in EA sampling at Battersea. It is a non native invasive species that can establish in densities that crowd-out native invertebrates. It also colonises shells of native species, reducing the ability of the ‘host’ to feed and burrow.

Water quality and current invertebrate baseline

5.4.46 The influence of water quality, and specifically CSO discharges was investigated through statistical analysis of the EA invertebrate background data, Thames Tideway Tunnel project baseline data, and EA water quality data. The analysis is presented in Vol 3 Appendix C.1. Although it was not possible to isolate trends over time at a site specific level, a number of observations were made that helps to identify the factors influencing invertebrate abundance and diversity. For example, certain species of Oligochaete worm, present at sites with CSO discharges are indicative of polluted conditions because they are able to tolerate the low DO conditions and multiply rapidly in the enriched sediments.

5.4.47 The analysis is described in further detail in Vol 3 Section 5.4. The following summary is relevant to the freshwater zone of the tidal Thames in which the Carnwath Road Riverside site is located.

5.4.48 The varying level of salinity and saline fluctuations appear to be a dominant factor determining the diversity and structure of benthic invertebrate assemblages. The analysis showed that, in general, samples in the brackish zone were less diverse compared with samples taken in the freshwater zone. This concurs with previous research into the invertebrate community of the tidal Thames and other estuaries, which show diversity decreasing downstream as the saline influence increases (Bailey-Brock *et al*., 2002)[15]. This is generally attributed to the fact that relatively few invertebrates are adapted to significant fluctuations in salinity. Other factors such as poor water quality and lack of habitat diversity, particularly in central London, are also likely to contribute.

5.4.49 Redundancy analysis (RDA)[iii] was used to compare the invertebrate dataset with water quality data for the period between 1992 and 2011. The analysis demonstrated the importance of environmental variables in determining the invertebrate communities in the tidal Thames. It appears that dominance of either Gammaridae (sensitive to hypoxia) or Oligochaeta (more tolerant to hypoxia) is influenced by the DO concentrations and DO sags in the Thames, although other factors such as habitat are also highly important. Other invertebrate taxa also appeared to be affected by poor water quality (low DO) and/or saline intrusion, notably the insect group (mayflies), while other groups (essentially Polychaete and Oligochaete worms) were shown to be tolerant of these conditions.

Evaluation of invertebrate community for Carnwath Road Riverside

5.4.50 The Carnwath Road Riverside site is considered to be of medium (borough) importance due to the limited diversity and abundance of species recorded, and dominance of the invertebrate community by pollution tolerant species. Only a single species of conservation importance (*A. lacustre*) was recorded, and it is ubiquitous within the tidal Thames.

[iii] Redundancy analysis is a form of regression analysis which provides information on the influence of environmental variables on the composition/abundances of the invertebrate assemblages.

Algae

5.4.51 Algae occurs in the tidal Thames both in the water column and growing on the river wall and associated structures. The diversity of species which occur in the tidal Thames reflects salinity, habitat and environmental conditions. As well as their intrinsic value algal communities provide valuable habitat for invertebrates and juvenile fish. Algae are often used as an indicator of water quality, since nutrients associated with sewage promote the growth of certain species of algae. This assessment focuses on the algal communities which grow on the river wall and associated structures.

Baseline surveys

5.4.52 A single day survey was undertaken in May 2012 at Putney Embankment foreshore, which is the closest site surveyed. All records are shown in Vol 10 Table 5.4.5.

Vol 10 Table 5.4.5 Aquatic ecology – marine algae sampled at Putney Embankment foreshore

Species	2012 Survey observations	Species presence within the Thames Estuary
Blidingia minima	Occasionally present on the river wall.	Widespread and abundant.
Cladophora glomerata	Occasionally present on the lower level of the river wall only.	A widespread and abundant species.
Rhizoclonium riparium	Dominant on the river wall.	Common in the tidal Thames.
Ulva prolifera	Occasionally present on the river wall.	Common in the tidal Thames.
Vaucheria sp.	Present at upper littoral levels of the river wall.	The *Vaucheria sp* recorded is most probably *Vaucheria compacta*, which occurs on the upper littoral levels on sea walls. Widespread in the tidal Thames.

Natural History Museum background data

5.4.53 Data was obtained from the Natural History Museum, London (NHM) that identifies records of marine algae received for the period from the early 1970s to 1999. Algae were recorded from a sampling location at Putney Embankment Foreshore, and the records all shown in Vol 10 Table 5.4.6.

Vol 10 Table 5.4.6 Aquatic ecology – marine algae sampled at Putney Embankment Foreshore between early 1970s and 1999

Species	Observations
Urospora penicilliformis	Upper littoral on sea walls and floating structures just above the water line. Widespread in the tidal Thames.
Blidingia marginata	Upper littoral and supra-littoral, and floating structure just above the water-line. Widespread and abundant.
Blidingia minima	Upper littoral and supra-littoral, wood breakwaters and halophyte stems. Abundant in tidal Thames.
Rhizoclonium riparium	Upper mid-littoral levels on sea walls and occasionally on floating structures above the water-line. Common in the tidal Thames.

Water quality and algal communities

5.4.54 Algae depend on the nutrients nitrate and phosphate for growth. Discharges of untreated sewage can result in elevated levels of nutrients which can lead to excessive growth of algae. As these algae die and decompose they use up oxygen in the water resulting in hypoxia (para. 5.4.27). This process is known as eutrophication. Excessive levels of algae can disrupt other elements of the ecosystem by smothering them.

5.4.55 Studies of the pelagic algae (para. 5.4.33) of the tidal Thames to inform its classification for the WFD have concluded that the estuary is not eutrophic due to strong tidal flows (English Nature, 2001)[16]. However, historically poor water quality has had a considerable negative influence on the algal communities of the tidal Thames and the loss of pollution sensitive species. Improvements in sewage treatment since the 1960s have led to a gradual process of recovery (Tittley, 2009)[17], although pollution tolerant species such as the green algal species still dominate the community.

Evaluation of algal community for Carnwath Road Riverside

5.4.56 None of the species recorded in Vol 10 Table 5.4.5 and Vol 10 Table 5.4.6 have protected or notable status (e.g. RDB species or UK or local *BAP* species). The algal populations are therefore given low-medium (local) value as only limited records of widespread species occur from this location.

Aquatic ecology receptor values and sensitivities

5.4.57 Using the baseline set out above the value accorded to each receptor considered in this assessment is set out in Vol 10 Table 5.4.7 . The definitions of the receptor values and sensitivities used in this evaluation are set out in Vol 2 Section 2.4.

Vol 10 Table 5.4.7 Aquatic ecology – summary of receptors and their values/sensitivities at Carnwath Road Riverside

Receptor	Value/sensitivity
Foreshore habitat (intertidal and subtidal)	Medium-high (metropolitan)
Marine mammals	Low-medium (local)
Fish	Medium-high (Metropolitan)
Invertebrates	Medium (borough)
Algae	Low-medium (local)

Construction base case

5.4.58 The base case in Site Year 1 of construction would include the improvements at the five main sewage treatment works that discharge into the tidal Thames (Mogden, Beckton, Crossness, Long Reach and Riverside), and the Lee Tunnel project. TFRM modelling (Vol 3 Appendix C.3) has shown that at a river wide level there will be a significant reduction in the occurrence of mass or population level fish mortalities with these schemes (ie hypoxia events which result in more than 10% mortality of fish populations). However, predictions for the base case show that, even with these schemes, unsustainable mortalities of salmon, the most sensitive species can be expected. Salmon is considered as acting as a surrogate for the more sensitive aspects of ecology, and thus taxa other than salmon may also be harmed under this condition.

5.4.59 Given that CSOs within the tidal Thames would continue to spill and no significant changes in habitat quality are anticipated the fish baseline for the Chambers Wharf site may therefore be expected to support a similar assemblage of species to the current baseline, with potentially a greater number of pollution sensitive species and life stages. Recovery due to water quality improvements will, however, be at an early stage.

5.4.60 The invertebrate analysis demonstrates that more pollution sensitive groups such as shrimps (Gammaridae) are subject to considerable fluctuations in abundances during low DO periods. With the improvements associated with the Lee Tunnel project and sewage treatment works upgrades at Mogden, these fluctuations are likely to be reduced.

5.4.61 Increases in abundance and diversity will however be limited by the fact that even with the Lee Tunnel and STW improvements in place there are still predicted to be numerous failures of DO standards. Colonisation by DO sensitive taxa such as Corophiidae, Crangonidae and Gammaridae which would otherwise occur within the freshwater zone, including Carnwath Road Riverside would continue to be suppressed. As for fish, recovery of the invertebrate communities would be at an early stage. The recovery in algal communities that has taken place since the 1960s is expected to continue under the base case, however the baseline conditions are not anticipated to significantly change from that described in Section 5.4. No changes in marine mammals are anticipated as they are relatively insensitive to point source sewage discharges.

5.4.62 As noted in para 5.3.8 no known developments would change the base case. Furthermore there is unlikely to be encroachment onto the River Thames foreshore for non-river dependent uses as this is restricted through *London Plan* 2011 (GLA, 2012)[18] Policy 7.28 Restoration of the Blue Ribbon Network which states that development should 'protect the value of the foreshore of the Thames and tidal rivers'. The EA's *National Encroachment Policy for Tidal Rivers and Estuaries* (EA, 2005)[19] also presumes against developments riverward of the existing flood defences where these would, individually or cumulatively, change flows so that fisheries were affected or cause loss or damage to habitat. Therefore the base case is assumed to be as per the baseline.

5.5 Construction effects assessment

5.5.1 This section presents the findings of the construction phase assessment. It outlines the construction impacts arising from the proposed development and the likely significant effects on aquatic ecology receptors.

Construction impacts

Temporary landtake

5.5.2 As noted in para 5.2.2 there are two options in terms of construction. The overall impact of landtake, taking account of each option, is detailed below.

Option A campshed

5.5.3 There would be up to approximately 2160m^2 of temporary landtake from intertidal habitats associated with the campshed. There would be dredging of the same area prior to campshed construction. This represents 0.01% of the River Thames and Tidal Tributaries SINC (Grade M). Moreover, part of the site (Hurlingham Wharf) is a safeguarded wharf. The proposed works would entail extending this existing area. Barges would be moored in a single line, thus maintaining intertidal habitat on the riverward side of the campshed.

5.5.4 Sheet piles would be installed and material from within the area required for the campshed would be removed and a geotextile membrane used to separate the underlying substrate from the imported concrete. The campshed would be in place for a total of six years which is therefore the duration of this temporary landtake.

5.5.5 Given the uncertainty over the re-establishment of the habitat, the impact of temporary landtake is considered to be negative, however due to the small area involved in the context of the wider SINC designation it is accorded low magnitude. The probability of the impact occurring is considered to be certain.

Option B campshed plus jetty

5.5.6 For the campshed plus jetty option, there would be approximately 2160m^2 of temporary landtake from subtidal habitats associated with the campshed. The same area would also be subject to dredging prior to campshed installation. There would be additional temporary landtake associated with the steel piles supporting the jetty and conveyors. It is considered that it is unlikely that the total landtake from piles would be more than 50m^2. Sheet piles would be installed and material from within the area required for the campshed would be removed and a geotextile membrane used to separate the underlying substrate from the imported concrete. The campshed would be in place for a total of six years which is therefore the duration of this temporary landtake. It is assumed for the purposes of the assessment that removal of the jetty would involve removing the piles using a jack-up barge.

5.5.7 Given the uncertainty over the re-establishment of the habitat, the impact of temporary landtake is considered to be negative, however due to the small area involved in the context of the wider SINC designation it is accorded low magnitude. The probability of the impact occurring is considered to be certain.

Sediment disturbance and consolidation

Option A Campshed

5.5.8 It has been assumed that an area outside the outer edge of the campshed would be subject to disturbance and consolidation due to the use of a jack-up barge to install the sheet piles. At Carnwath Road Riverside this represents a total area of approximately 14805m^2 outside the campshed area which would be affected by construction activities during the site establishment phase. There is also likely to be consolidation and disturbance due to barge movements.

5.5.9 Impacts on the intertidal and subtidal habitats and associated flora and fauna are considered to be low negative, probable and temporary, due to the small area likely to be subject to regular consolidation and disturbance within the maximum working area boundary.

Option B Campshed plus jetty

5.5.10 It has been assumed that an area outside the outer edge of the campshed and jetty would be subject to disturbance and consolidation due to the use of a jack-up barge to install the sheet piles, thus affecting intertidal and subtidal habitat. At Carnwath Road Riverside this represents a total area of approximately 14855m^2 outside the campshed area and the area physically occupied by the piles which would be affected by construction activities during the site establishment phase. There is also likely to be consolidation and disturbance due to barge movements.

5.5.11 Impacts on the intertidal and subtidal habitats and associated flora and fauna are considered to be low negative, probable and temporary, due to the small area likely to be subject to regular consolidation and disturbance within the maximum working area boundary.

Shading of the river

Option A Campshed

5.5.12 There would be no shading of the river for Option A

Option B Campshed plus jetty

5.5.13 The presence of the temporary jetty and conveyors to facilitate processing/handling of excavated material would result in temporary (approximately five years) shading of the section of intertidal habitat which lies beneath. However, there is relatively little intertidal habitat in this area and none of it consists of emergent vegetation (such as saltmarsh) that would be potentially very susceptible to shading. Moreover, most of the area covered by the decking would be subtidal and thus subject to some degree of shading at all times and localised shading can provide shelter to fish from predators. Overall therefore the impact is considered to be low negative, certain and temporary.

Hydrodynamic impact

Option A Campshed

5.5.14 There would be no changes to hydraulic regime with Option A

Option B Campshed plus jetty

5.5.15 Some limited changes to the hydraulic regime in the intertidal and subtidal zones may result from the presence of the campshed or piers that would support the jetty and conveyors. However, any such changes are likely to be either negligible or slightly positive since the velocity of the water would slow down around the piers resulting in slack water that may aid fish movement. The impact is considered to be negligible, probable and temporary.

Waterborne noise and vibration

Option A Campshed

5.5.16 There would be approximately 100m of sheet piling installed for the campshed construction. Piles would be driven using vibro piling techniques, thus limiting the principal source of waterborne noise and vibration impacts. Other measures to limit noise and vibration impacts during the construction stage of the project have been incorporated into the *CoCP Part A* and *Part B* (Section 6). These are described in Section 5.2.

5.5.17 There would be additional sources of noise and vibration associated with the construction of the shaft itself and vehicle and barge movements. Although background levels of noise and vibration within the tidal Thames are likely to be moderately high due to existing boat movements, and ground-propagated noise from transport systems, the proximity of the works to the river and their scale means that noise and vibration levels are likely to be elevated during construction. Noise and vibration have the potential to cause physical damage to fish, and disrupt behaviour. However, in this case, given the piling techniques proposed and the extent of the works relative to the width of the channel this is considered to be a low negative impact, probable and temporary.

Option B Campshed plus jetty

5.5.18 In addition to the noise impacts described for Option A, there would be piling associated with the installation of the jetty.

5.5.19 The piles in the foreshore and subtidal zone would be installed using vibro piling techniques, thus limiting the principal source of waterborne noise and vibration impacts. Further measures to limit noise and vibration impacts during the construction stage of the project have been incorporated into the *Code of Construction Practice* (para. 5.2.2). The impact is considered to be low negative, probable and temporary.

Spillage of light from construction compound into surrounding riverine habitats

Option A Campshed and option B Campshed plus jetty

5.5.20 Light spillage into the water column has the potential to cause disturbance to fish. This site would have 24hr working during main tunnel excavation. Flood lighting, or similar would be required in the vicinity of the shaft location, however this would be minimised by the presence of the noise enclosure. In addition, there would be round the clock barging and therefore lighting of barges and the campshed. The extent of light spillage is anticipated to be physically limited but intense within that zone for a period of five years, and it would be of relatively short duration especially during the summer months. Nonetheless, the *CoCP Part A* and *B* (Section 4) measures (para. 5.2.6) commit to avoidance of lighting impacts on aquatic ecology where possible. The impact is therefore considered to be low negative, probable and temporary.

Increase in suspended sediment loads

5.5.21 Construction of a campshed and barge movements/loading is likely to lead to localised increases in suspended sediment and potentially contaminants, with the possibility for effects on local and downstream habitats.

Option A Campshed

5.5.22 During chemical analysis of sediment within the intertidal zone, one of the three samples (WBC04) was found to contain elevated concentrations of some heavy metals compared to the Probable Effects Level (PEL). This related to cadmium (10 mg/kg compared to a PEL of 4.2 mg/kg), copper (180 mg/kg compared to 108 mg/kg), lead (250 mg/kg compared to 112 mg/kg), mercury (2.8 mg/kg compared to 0.7 mg/kg) and zinc (830 mg/kg compared to 271 mg/kg). However only one of the two remaining samples showed elevated heavy metals (mercury concentrations of 1.3 mg/kg compared to 0.7 mg/kg), indicating that heavy metal contamination appears very localised on the foreshore. The majority of poly-aromatic hydrocarbon compounds were recorded above the PEL in at least one of the samples and in some cases, all three, indicating that these are also less localised on the foreshore. These levels are all very typical of levels in the tidal River Thames. Excavation on the foreshore would be confined within a cofferdam which would effectively prevent release of contamination during sediment removal.

5.5.23 Approximately 3,500m^3 of sediment removal would take place at this site to install a campshed. This is most likely to be undertaken with a backhoe. HR Wallingford[20] identified an approximately 5% sediment loss as being typical through use of a normal backhoe (i.e. without an enclosed bucket) which could mean that approximately 175m^3 (or 350t assuming an in-situ density of 2t per m^3) of sediment could be lost. Given that the foreshore at this site contains levels of contaminants above the PEL and that sediment removal would not be contained within a cofferdam, the *CoCP Part B* (Section 4) identifies that an enclosed bucket would be used on the backhoe during sediment removal to minimise sediment loss and thus mobilisation of contaminants.

5.5.24 There would be small quantities of sediment liberated during cofferdam installation; however these would be negligible compared to the 40,000 tonnes (or 20,000m^3 assuming an in-situ density of 2t per m^3) of sediment that are carried on a spring tide (HR Wallingford, 2006)[21]. In this context, the volumes produced by the construction works would not be detectable against natural fluctuations in sediments and would not have an impact on water resources (HR Wallingford, 2012)[22]. Impacts are considered to be low negative, probable and temporary.

5.5.25 Measures and safeguards to minimise the risk of accidental releases of silty or contaminated discharges to the tidal Thames are included in the *CoCP Part A* (Section 8) and are described in Section 5.2. No impacts from polluted discharges are anticipated with these control measures and safeguards in place.

5.5.26 The impact associated with re-suspended sediment is considered to be low negative, probable and temporary.

Option B Campshed plus jetty

5.5.27 Piling operations for the jetty and dredging for the campshed are likely to lead to localised increases in suspended sediment with the potential to affect local and downstream habitats. As for option A dredging would be undertaken using an enclosed bucket on the backhoe to minimise sediment loss. Dredging would also take place outside the sensitive spring spawning season (see para. 5.2.5). Furthermore, background levels of suspended sediments in the tidal Thames are relatively high, and increases associated with the scheme are unlikely to be significant except on a very localised basis. The impact is again considered to be low negative, probable and temporary.

Construction effects

5.5.28 The following section describes the effects of these impacts on aquatic ecology receptors based on the significance criteria set out in Vol 2 Section 2.3. Only those impacts which are considered relevant to each receptor are assessed, in accordance with the methodology presented in Vol 2 Section 5.

Designations and habitats

Loss of intertidal and subtidal habitat due to temporary landtake

Option A Campshed

5.5.29 There would be a temporary loss of 3160m^2 of intertidal habitat through the presence of a campshed. The habitats affected by temporary landtake are presented in Vol 10 Table 5.4.1 and include a gravel foreshore and sublittoral sand and gravels. These habitats which are considered to be of medium-high (metropolitan) importance are represented elsewhere across the tidal Thames. The impact of temporary landtake is considered to be of low negative magnitude since the extent of the areas affected in the context of the overall size of the upper and middle tidal Thames is small.

5.5.30 Subsequent excavation and removal of the concrete campshed followed by reinstatement of substrate of comparable particulate material to the original substrate would facilitate recovery. This is expected to lead to establishment in the medium (1-5 years) or long term (+5 years). The overall effect is considered to be **minor adverse**.

Option B Campshed plus jetty

5.5.31 There would be a temporary loss of 3160m^2 of subtidal habitat through the presence of a campshed, and a very small amount of additional temporary loss of intertidal and subtidal habitat, from the jetty and conveyor piles. The habitats affected by temporary landtake are presented in Vol 10 Table 5.4.1 and include a gravel foreshore and sublittoral sand and gravels. These habitats which are considered to be of medium-high (metropolitan) importance are represented elsewhere across the tidal Thames. The impact of temporary landtake is considered to be of low negative magnitude since the extent of the areas affected in the context of the overall size of the upper and middle tidal Thames is small.

5.5.32 Subsequent excavation and removal of the concrete campshed followed by reinstatement of substrate of comparable particulate material to the original substrate would facilitate recovery. This is expected to lead to establishment in the medium (1-5 years) or long term (+5 years). Sediment is expected to naturally and quickly accrete to cover the bases of the jetty piles once they are removed. This option would also give rise to a **minor adverse** effect.

Disturbance and consolidation of intertidal and subtidal habitat

Option A Campshed

5.5.33 There would be disturbance and consolidation of approximately 14805m^2 outside the campshed during the site establishment phase due to the presence of a jack up barge. Habitats within this zone are expected to recover within the short term (less than 12 months) following site establishment. Coupled with the low intrinsic value of the habitats in this area the effect is considered to be **minor adverse** due to the low negative magnitude of the impact on a receptor of medium-high (metropolitan) value.

Option B Campshed plus jetty

5.5.34 There would be disturbance and consolidation of approximately 14855m^2 outside the campshed plus jetty during the site establishment phase due to the presence of a jack up barge. Habitats within this zone are expected to recover within the short term (less than 12 months) following site establishment. Coupled with the low intrinsic value of the habitats in this area the effect is considered to be **minor adverse** due to the low negative magnitude of the impact on a receptor of medium-high (metropolitan) value.

Marine mammals

Interference with the migrations of marine mammals within the Tideway

5.5.35 Noise, vibration and other construction activity have the potential to disturb mammals and deter them from passing the site. However, given the low-medium (local) value of the receptor, and the low negative impact reflecting the piling methods proposed, the duration of the period when piling would be taking place, and the controls on underwater noise-generating activities described in the *CoCP Part A* and *Part B* (Section 6), (see Section 5.2 of this document) this is considered to be a **negligible** effect.

Fish

Loss of feeding, resting and nursery habitat for fish due to temporary landtake

Option A Campshed

5.5.36 The site itself is not considered to offer suitable spawning habitat for smelt, or any other fish species, since it lies within the intertidal zone which dries at low tide, and due to the presence of an existing wharf facility. Although loss of foreshore habitat is considered to be a low negative impact; the effect on fish, a medium-high (metropolitan) value receptor, is considered to be **minor adverse**.

Option B Campshed plus jetty

5.5.37 The temporary landtake required for option B does lie within the zone in which dace and smelt are known to spawn. The loss represents approximately 0.7% of the total area of the smelt spawning habitat (approximately 308140m^2). The loss of subtidal foreshore habitats is considered to be a low negative impact; taking into account the quality of the habitat for fish, the effect on fish, a medium-high (metropolitan) value receptor, is considered to be minor adverse. However, given the loss from smelt spawning habitat, the effect is elevated to **moderate adverse**.

Loss of feeding, resting and nursery habitat for fish due to sediment disturbance and consolidation

Option A Campshed

5.5.38 The area which would be subject to disturbance and consolidation outside the campshed lies primarily in the subtidal zone. Given that recovery is likely to occur within the short term (less than 12 months) and taking into account the quality of the habitat the effect is considered to be **negligible**.

Option B Campshed plus jetty

5.5.39 The area which would be subject to disturbance and consolidation outside the campshed plus jetty lies primarily in the subtidal zone. Given that recovery is likely to occur within the short term (less than 12 months) and given the medium-high (metropolitan) value of the receptor coupled with a low negative impact, the effect is considered to be **minor adverse**.

Temporary shading of intertidal and subtidal feeding and resting habitat for fish.

Option A Campshed

5.5.40 There would be no shading of intertidal and subtidal habitat under this option.

Option B Campshed plus jetty

5.5.41 There is relatively little intertidal habitat at Carnwath Road foreshore and there is no marginal habitat (such as saltmarsh or reedbed) that would be potentially very susceptible to shading. The intertidal mudflat would support communities of microalgae which would be used as a feeding resource by fish, and this may be affected by reduced light levels. However, given the limited extent of the shaded area, and the availability of similar feeding habitat, this low negative impact combined with the effect is considered to give rise to be a **negligible**.

Interference with the migratory movements of fish associated with a jetty

Option A Campshed

5.5.42 There would be no effects on the migratory movements of fish since there would be no fixed structures above the water line.

Option B Campshed plus jetty

5.5.43 The jetty and conveyors would be on piled piers and would therefore not obstruct movement as part of juvenile fish migrations for species such as glass eels or elvers, dace, goby and flounder as they move through the estuary. Indeed, the water velocity would slow down around each pier thus potentially providing some additional temporary refuge and resting areas for fish. Such impacts are however difficult to quantify. It is concluded that given the negligible nature of the impact and medium high (metropolitan) value of the receptor, the ecological effect would be **negligible**.

Effects of waterborne noise and vibration on fish

5.5.44 The effects of waterborne noise and vibration on fish vary according to the proximity of the receptor to the source. Effects depend on distance from source, ranging from potential death at very close proximities, through injury, and behavioural disturbance with increasing distance from the source. The driving of sheet piles for the campshed would be undertaken using a vibro piling technique from a jack up barge, thus minimising the level of noise and vibration. Furthermore, a series of control measures relating to the timing and duration of piling operations have been included in the *CoCP Part A* (Section 6) (see Section 5.2 of this document).

Option A Campshed

5.5.45 Waterborne noise and vibration from campshed installation is considered to be a low negative impact, and given that the value of the receptor is medium-high (metropolitan), the overall effect is assessed as being **minor adverse**.

Option B Campshed and jetty

5.5.46 The key potential source of noise and vibration under Option B is the installation of the piles to form the piers for the jetty and conveyors. This would be undertaken using a vibro piling technique from a jack up barge, thus minimising the level of noise and vibration. A series of control measures relating to the timing and duration of piling operations have been included in the *CoCP Part A* (Section 6) to ensure that there would be no impacts on spawning smelt. The overall effect as a result of this low impact on this medium-high (metropolitan) receptor is considered **minor adverse.**

Spillage of light from construction compound into surrounding riverine habitats

Option A Campshed

5.5.47 Effects depend on distance from source, with the likelihood of behavioural disturbance decreasing with distance from the source. Under option A the site is not considered to support sensitive spawning habitat, and therefore there is only low receptor sensitivity, as no significant numbers of any fish species would be present for extended periods coincident with strong lighting of intertidal and subtidal habitat. However, given the potential for duration of lighting exposure around the campshed and barges loading and unloading 24hrs for five years, and the presence of photophobic species such as eel the overall effect is considered **minor adverse** based on low negative impact on a receptor of medium-high (metropolitan) value.

Option B Campshed and jetty

5.5.48 Given its location within the sensitive smelt spawning zone effects may be expected to be more severe during the spawning season between March and May. Lighting may be expected to affect only a relatively isolated zone around the campsheds and would be controlled through a lighting management plan. Nevertheless given the proximity of the campsheds to sensitive spawning habitat effects may be expected to increase to **moderate adverse** during the spawning season (March to May), reducing to **minor adverse** for the remainder of the year.

Reduction in water quality due to suspended sediment

5.5.49 Although the tidal Thames is a sedimentary environment with high levels of suspended solids, construction activities such as clearance of settled material, piling and barge movements may generate localised high levels of suspended sediment which may cause disorientation of fish.

5.5.50 The dredging required for the campshed under either option, has the potential for resuspended sediments to affect fish spawning habitats and juvenile fish migrations. However, based on control measures outlined in the CoCP the timing of the dredging operation would be outside the sensitive spawning and nursery period (para.5.2.5). Accreted material within the subtidal zone may be expected to be removed by tidal movements. Adult fish are considered to be less likely to be affected as they are able to move away from the turbid water. Given that the impact is considered to be low negative, and the receptor is of medium (borough) value effects on juvenile fish are considered to be **minor adverse**, with natural recovery of habitats anticipated.

Invertebrates

Direct mortality of invertebrates due to temporary landtake, sediment disturbance and consolidation

Option A Campshed

5.5.51 There would be direct mortality of invertebrates within sediments removed or covered by the campshed and due to consolidation and disturbance of sediment during construction. The impact magnitude however would be low negative. Due to the medium (borough) importance of the receptor the overall effect is considered to be **negligible**.

Option B Campshed plus jetty

5.5.52 There would be direct mortality of invertebrates within sediments removed or covered by the campshed and removed or covered by the construction of piled piers for the jetty, and due to compaction and disturbance of sediment during the site establishment phase. However, the scale of landtake would be small such that the negligible level of the impact combined with the medium (borough) importance of the receptor, would result in a **negligible** effect.

Loss of burrowing and feeding habitat for invertebrates due to temporary landtake

Option A Campshed

5.5.53 There would be a temporary loss of approximately 3160m^2 of habitat for invertebrates due to the presence of a campshed. Due to the medium (borough) importance of the receptor and the low negative impact magnitude the overall effect is considered to be **negligible**.

Option B Campshed plus jetty

5.5.54 There would be a temporary loss of approximately 3160m^2 of habitat for invertebrates due to the presence of a campshed and approximately 50m^2 for the piles associated with the jetty. The effect on invertebrates is therefore considered to be **negligible**, based on the low magnitude of the impact and the medium (borough) importance of the receptor.

Loss of feeding and burrowing habitat for invertebrates due to sediment disturbance and consolidation

Option A Campshed

5.5.55 The area affected is small, and therefore the temporary consolidation and disturbance to the habitat for burrowing invertebrates is considered to be a **negligible** effect. This is due to the fact that the receptor is of medium (borough) value, the impact of sediment disturbance and consolidation is considered to be low negative, and any effects are considered to be rapidly reversible.

Option B Campshed plus jetty

5.5.56 The area affected is small, and therefore the temporary consolidation and disturbance to the habitat for burrowing invertebrates is considered to be a **negligible** effect. This is due to the fact that the receptor is of medium (borough) value, the impact of sediment disturbance and consolidation is considered to be low negative, and any effects are considered to be rapidly reversible.

Temporary shading of intertidal and subtidal feeding and resting habitat for invertebrates

Option B Campshed plus jetty

5.5.57 There is relatively little intertidal habitat at Carnwath Road Riverside and there is no marginal habitat (such as saltmarsh or reedbed) that would be potentially very susceptible to shading. The intertidal mudflat would support communities of microalgae which would be used as a feeding resource by invertebrates, and this may be affected by reduced light levels. However, given the limited extent of the shaded area, and the availability of similar feeding habitat; the low negative level of the impact combined with the medium (borough) importance of the receptor is considered to give rise to **negligible** effect.

Reduction in water quality due to suspended sediment

5.5.58 The predicted increases in suspended sediment due to general construction activity such as barging are not expected to affect invertebrate communities given the existing background levels within the tidal Thames.

5.5.59 The majority of the invertebrates present are not considered to be particularly sensitive to accretion or low DO conditions. These organisms are adapted to withstand tidal flows that bring about movements of degradable and non degradable solids. The feeding mechanisms of animals that filter water might be affected (e.g. larger bivalves), but these are sparsely recorded in the tidal Thames. Tube living animals such as Corophiidae might be more susceptible, but they are quite mobile and able to move away from sources of impact.

5.5.60 Effects are thus considered to be **negligible** under either option when considering the negligible impact magnitude and medium (borough) receptor value.

Algae

Loss of habitat due to temporary landtake

5.5.61 Stretches of the river wall would be rebuilt and strengthened; this applies under either option. Given the low-medium (local) value of the receptor, the low negative magnitude of the impact and the fact that algae are likely to re-colonise rapidly following strengthening, the effect is considered **negligible**.

Sensitivity test for programme delay

5.5.62 For the assessment of effects on aquatic ecology during construction, a delay to the Thames Tideway Tunnel project of approximately one year would not be likely to materially change the assessment findings reported above (Section 5.5). This is because there are no developments in the site development schedule (Vol 10 Appendix N) that would fall into the base case as a result of this delay and therefore the base case would remain as described in paras. 5.4.58 - 5.4.62.

5.6 Operational effects assessment

5.6.1 As stated in para.5.1.2, there would be no CSO interception at Carnwath Road Riverside, or any permanent in-river works, thus no significant operation phase effects on aquatic ecology are anticipated. Therefore the operational phase has not been assessed.

5.7 Cumulative effects assessment

5.7.1 As described in Section 5.3, during the construction phase there are no schemes within the site development schedule (Vol 10 Appendix N) that would have an impact on aquatic ecology receptors, and so no cumulative impacts with the proposed development would arise. Therefore the effects on aquatic ecology would remain as described in Section 5.5.

Sensitivity test for programme delay

5.7.2 In the event that the programme for the Thames Tideway Tunnel project is delayed by approximately a year, the cumulative effects assessment would remain unchanged. As described above in para. 5.7.1, there are no schemes anticipated to generate cumulative effects on aquatic ecology and this would remain the case with a programme delay of approximately one year.

5.8 Mitigation

5.8.1 It is not considered possible to mitigate or compensate for the significant adverse effect of temporary loss of smelt spawning habitat under Option B, since the creation of replacement habitat within the subtidal zone is not considered practical. However, the impact would be temporary and the affected area would be reinstated following completion of construction.

5.8.2 There would also be a moderate adverse effect associated with lighting for option B during the smelt spawning season. Light spillage would be minimised through the lighting management plan as per measures within the *CoCP*. It would not be possible to implement any further mitigation.

5.9 Residual effects assessment

Construction effects

5.9.1 As no mitigation measures are proposed, the residual construction effects remain as described in Section 5.5. All residual effects are presented in Section 5.10.

5.10 Assessment summary

Vol 10 Table 5.10.1 Aquatic ecology – summary of construction assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Designated sites and habitats	Loss of intertidal and subtidal habitat due to temporary landtake (with Option A Campshed).	Minor adverse	None	Minor adverse
	Loss of intertidal and subtidal habitat due to temporary landtake (with Option B Campshed plus jetty).	Minor adverse	None	Minor adverse
	Disturbance and consolidation of intertidal and subtidal habitat (with Option A Campshed).	Minor adverse	None	Minor adverse
	Disturbance and consolidation of intertidal and subtidal habitat (with Option B Campshed plus jetty).	Minor adverse	None	Minor adverse
Marine mammals	Interference with the migrations of marine mammals within the Tideway.	Negligible	None	Negligible
Fish	Loss of feeding, resting and nursery habitat for fish due to landtake (with Option A Campshed)	Negligible	None	Negligible
	Loss of feeding, resting and nursery habitat for fish due to landtake (with Option B Campshed plus jetty)	Moderate adverse	None	Moderate adverse
	Loss of feeding, resting and nursery habitat for fish due to sediment consolidation and disturbance (with Option A Campshed).	Negligible	None	Negligible
	Loss of feeding, resting and nursery habitat for fish due to sediment consolidation and disturbance (with Option B Campshed plus jetty)	Minor adverse	None	Minor adverse
	Temporary shading of habitat (with Option B	Negligible	None	Negligible

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
	Campshed plus jetty)			
	Interference with migratory movements (with Option A or B)	Negligible	None	Negligible
	Effect of waterborne noise and vibration on fish (with Option A or B)	Minor adverse	None	Minor adverse
	Spillage of light from construction compounds into surrounding riverine habitat (with Option A)	Minor adverse	None	Minor adverse
	Spillage of light from construction compounds into surrounding riverine habitat (with Option B)	Moderate adverse during the spawning season (March to May), reducing to minor adverse for the remainder of the year	None	Moderate adverse during the spawning season (March to May), reducing to minor adverse for the remainder of the year
	Reduction in water quality due to suspended sediment.	Minor adverse	None	Minor adverse
Invertebrates	Direct mortality of invertebrates due to temporary landtake and disturbance and consolidation of sediment (Option A Campshed)	Negligible	None	Negligible
	Direct mortality of invertebrates due to temporary landtake and disturbance and consolidation of sediment (Option B Campshed plus jetty)	Negligible	None	Negligible
	Loss of feeding/burrowing habitat for invertebrates due to landtake (Option A Campshed)	Negligible	None	Negligible

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
	Loss of feeding/burrowing habitat for invertebrates due to landtake (Option B Campshed plus jetty)	Negligible	None	Negligible
	Loss of feeding/burrowing habitat for invertebrates due to sediment consolidation and disturbance (Option A Campshed)	Negligible	None	Negligible
	Loss of feeding/burrowing habitat for invertebrates due to sediment consolidation and disturbance (Option B Campshed plus jetty).	Negligible	None	Negligible
	Temporary shading of habitat (Option B Campshed plus jetty)	Negligible	None	Negligible
	Reduction in water quality due to suspended sediment.	Negligible	None	Negligible
Algae	Loss of habitat due to temporary landtake	Negligible	None	Negligible

References

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

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Volume 10: Carnwath Road Riverside site assessment

Section 6: Ecology - terrestrial

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Thames Tideway Tunnel

Environmental Statement

Volume 10: Carnwath Road Riverside site assessment

Section 6: Ecology – terrestrial

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6 Ecology – terrestrial

6.1 Introduction

6.1.1 This section presents the findings of the assessment of the likely significant effects of the proposed development on terrestrial ecology at the Carnwath Road Riverside site. The main site and the highway works site are considered in this assessment.

6.1.2 The proposed development has the potential to affect terrestrial ecology due to:

a. vegetation clearance, and subsequent habitat reinstatement and creation

b. construction and site activities

c. temporary structures within the foreshore

d. 24 hour working associated with the main tunnel drive and secondary tunnel lining

e. barge movements.

6.1.3 Operational effects for terrestrial ecology for this site have not been assessed. This is on the basis that permanent operational lighting would be minimal and would comply with the lighting design principles (see *COCP* Part A (Section 4[i])) to minimise light spill, and maintenance works are limited to intermittent visits to site by maintenance personnel and vehicles. No significant operational effects are considered likely and for this reason, only construction effects are assessed.

6.1.4 The following are not considered within the assessment:

a. contaminated runoff and atmospheric pollution as these would be controlled through the implementation of the *Code of Construction Practice* (*CoCP*)i

b. designated sites relevant to terrestrial ecology. This is because those that lie within 250m of the site are isolated from the site. No likely effects on these sites due to proposed construction works have been identified. However, the baseline includes details of the designated sites within 250m of the site (para. 6.4.2)

c. the presence of invasive plants listed on Schedule 9 of the Wildlife and Countryside Act 1981 (WCA 1981) as this would be managed in advance of site clearance and by the measures set out in the *CoCP* Part A (Section 11). However, the baseline includes the results of the invasive plants survey (para. 6.4.22).

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[i] The Code of Construction Practice (CoCP) is provided in Vol 1 Appendix A. It contains general requirements (Part A), and site specific requirements for this site (Part B).

6.1.5 The assessment of the likely significant effects of the project on terrestrial ecology has considered the requirements of the *National Policy Statement (NPS) for Waste Water* (Defra, 2012)[1]. In line with these requirements, designations, species and habitats relevant to terrestrial ecology are identified and measures incorporated into the proposed development described. Based on assessment findings, measures to address likely significant adverse effects are identified. Vol 2 Section 6 provides further details on the methodology.

6.1.6 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Vol 10 Carnwath Road Riverside Figures).

6.2 Proposed development relevant to terrestrial ecology

6.2.1 The proposed development is described in Section 3 of this volume. The elements of the proposed development relevant to terrestrial ecology are set out below.

Construction

6.2.2 The following elements of the construction phase have the potential to affect terrestrial ecology receptors:

a. removal of introduced shrub adjacent to the river wall in the south of the site and dense scrub from the western end of the construction site.

b. removal of four semi-mature trees at the Carnwath Road Riverside highway works site

c. removal of ten trees at the existing entrance on the northern boundary of the site, and pruning of scrub along the eastern boundary of the main construction site

d. demolition of buildings, and the removal and replacement of the river wall

e. construction works throughout the construction phase that would create noise and vibration, such as the use of construction machinery and vehicles, demolition and the tunnel excavation. This includes noise and vibration during 24 hour working

f. artificial lighting of the site in evenings during winter, and continuously during the main tunnel drive and subsequent secondary lining

g. use of barges in either Option A, which would be a temporary campshed on the foreshore or Option B, which would be a jetty on the foreshore with a temporary campshed

h. reinstatement of foreshore after completion of works and removal of temporary structures.

Code of construction practice

6.2.3 The *CoCP* is formed of Part A covering measures to be applied at all sites and Part B covering site specific measures. The *CoCP* sets out the standards, procedures, and measures for managing and reducing construction effects. These measures would be implemented through a site specific *Construction environmental management plan* (*CEMP*), which would encompass an *Ecology and landscape management plan* (*ELMP*). The *ELMP* would include measures to protect and minimise impacts on sensitive ecological receptors such as designated sites, sensitive habitats (eg. trees, scrub, watercourses, grassland), and notable species.

Part A

6.2.4 The *CoCP* Part A includes the following measures to reduce impacts on terrestrial ecology:

a. consultation with a suitably qualified ecologist in preparing the control measures within the *ELMP* and *CEMP*

b. a check of the site in advance of the works to identify any ecological constraints in addition to those discussed in this *Environmental Statement* (ES)

c. supervision of works by a suitably qualified ecologist

d. protection of trees

e. measures specific to bats such as the control of lighting, noise and vibration, and procedures to follow if a bat roost is present on site

f. measures to prevent harm to nesting birds and birds that are listed on Schedule 1 of the Wildlife and Countryside Act 1981 (WCA, 1981)

g. use of capped and cowled lighting that is directed away from sensitive ecological receptors

h. controls to minimise noise and vibration, including use of noise enclosures, careful plant selection and careful programming of works

i. controls for site drainage to minimise the potential for pollution of watercourses and contamination of sensitive habitats

j. controls to prevent spread of non-native invasive plants, where present.

Part B

6.2.5 Site-specific measures contained in the *CoCP* Part B (Section11) for terrestrial ecology are detailed below:

a. protection measures for bats

b. planting of replacement native trees after construction

c. protection measures for trees along the eastern boundary of the site

d. restoration of the foreshore after works.

Environmental design measures

6.2.6 The following measures to minimise adverse effects or provide biodiversity enhancements have been incorporated into the design:

a. landscaping would comprise native planting supplemented by London plane (*Platanus x acerifolia)* where appropriate

b. provision of a brown roof on the ventilation building

c. replacement of the four trees removed at the Highways Works site as close as possible to their existing locations

d. provision of nesting features for black redstarts.

6.3 Assessment methodology

Engagement

6.3.1 Vol 2 Environmental assessment methodology documents the overall engagement which has been undertaken in preparing the *Environmental Statement*.

6.3.2 The *Scoping Report* was prepared before Carnwath Road Riverside had been identified as a preferred site. The scope for terrestrial ecology for this site has therefore drawn on other scoping responses, feedback from biodiversity workshops held with statutory stakeholders, which were attended by London Borough (LB) of Hammersmith and Fulham officers, and ongoing engagement. Specific comments relevant to this site for the assessment of effects on terrestrial ecology are presented here in Vol 10 Table 6.3.1.

Vol 10 Table 6.3.1 Terrestrial ecology – stakeholder engagement

Organisation	Comment	Response
London Borough of Hammersmith and Fulham (Meeting held on 9 August 2011)	A meeting was held to discuss the bat survey methodology and the potential impacts of the project at Carnwath Road Riverside on bats, including those at the nearby Hurlingham Park.	It is considered unlikely that there would be impacts on bats in the nearby Hurlingham Park or surrounding area as a result works at Carnwath Road Riverside, based on the interpretation of baseline data (para. 6.4.8 to 6.4.13).

Baseline

6.3.3 Baseline data collection follows the methodology described in Vol 2 Section 6. In summary, the following baseline data has been reported in this assessment:

a. desk study

b. a Phase 1 Habitat Survey was undertaken on 17 May 2011

c. remote recording bat surveys were undertaken over three nights from 1 to 3 July 2011, and three nights from 4 to 6 October 2011

d. wintering bird surveys were undertaken on 26 October, 28 November and 12 December 2011, and on 10 January, 8 February and 9 March 2012

e. black redstart surveys were undertaken on 26 May, 24 June, and 1, 8 and 19 July 2011

f. an invasive plant survey (species listed on Schedule 9 of the Wildlife and Countryside Act 1981) was undertaken on 1 July 2011.

Construction

6.3.4 The assessment methodology for the construction phase follows that described in Vol 2 Section 6. There are no site specific variations for this site. All likely significant effects throughout the duration of the construction phase are assessed. The term significance is used within this volume to refer to significance levels from negligible to major effects (adverse and beneficial). Adverse moderate or major effects are considered to be significant and require mitigation. Negligible and minor effects are not considered significant and therefore do not require mitigation. These significance criteria and their relationship with levels of significance are based on the Institute for Ecology and Environmental Management guidelines (IEEM, 2006)[2] (see Vol 2 Section 6).

6.3.5 No effects on habitats are predicted beyond 10m of the site boundary. Therefore, the assessment area comprises the site and adjacent land within 10m of the site boundary.

6.3.6 The assessment considers bats, breeding birds and wintering birds within 100m of the site. This is considered to be a sufficient distance within the context of the urban environment to ensure that any significant effects on species, for example from disturbance as a result of construction lighting and noise, are assessed.

6.3.7 Section 6.5 details the likely significant effects arising from the construction at the Carnwath Road Riverside site. There are no other Thames Tideway Tunnel project sites which could give rise to additional effects on terrestrial ecology within the assessment area for this site, therefore no other Thames Tideway Tunnel project sites are considered in this assessment.

6.3.8 No change to the base case conditions for terrestrial ecology are considered likely from those developments listed in Vol 10 Appendix N, due to the isolated location of these developments from the proposed development site, within the urban context.

6.3.9 No likely significant cumulative effects have been identified as the developments listed in Vol 10 Appendix N that would be under construction at the same time as the construction phase at the Carnwath Road Riverside site are isolated from the proposed development site within the urban context (Section 6.7). It is therefore unlikely that there would be potential for interaction with the ecology of the Carnwath Road Riverside site.

6.3.10 The assessment of construction effects considers the extent to which the assessment findings would be likely to be materially different, should the programme for the Thames Tideway Tunnel project be delayed by approximately one year.

Assumptions and limitations

6.3.11 The assumptions and limitations associated with this assessment are presented in Vol 2 Section 6. Site specific assumptions and limitations are detailed below.

Assumptions

6.3.12 It is assumed for the purposes of this assessment that the current use of the Carnwath Road Riverside site (described in 6.4) will continue as at present.

Limitations

6.3.13 It was not possible to undertake a bat activity survey at dawn at this site due to restrictions on access. Therefore, two sets of remote recording surveys were undertaken from one location. A dawn activity survey has been used at Thames Tideway Tunnel project sites to determine the location of potential roosts on site and to assess the type of usage of the site for commuting or foraging. During the remote recording surveys at this site, there were no records of bats close to dawn or dusk when bats leave and return to the roost. Therefore, it is unlikely that bats are roosting on or close to the site. Based on the results from other Thames Tideway Tunnel project sites, the site is considered to be used mainly for commuting with occasional foraging on site. Therefore, the lack of a dawn activity survey is not considered to limit the baseline results and the assessment of effects on bats is considered robust.

6.4 Baseline conditions

6.4.1 The following section sets out the baseline conditions for terrestrial ecology receptors within and around the site, including their value. Future baseline conditions (base case) are also described. All figures referred to in this section are contained in the Vol 10 Carnwath Road Riverside Figures (see separate volume of figures).

Current baseline

Designated sites

6.4.2 The following designated sites relevant to terrestrial ecology are within 250m of the site and are shown on Vol 10 Figure 6.4.1 (see separate volume of figures):

a. the site is within and adjacent to the River Thames and Tidal Tributaries Site of Importance for Nature Conservation (SINC Grade III of Metropolitan importance[ii]) and comprises inter-tidal habitat and river channel. This designated site is included in the aquatic ecology assessment (see Section 5 of this volume) and is not considered further in this assessment

[ii] SINC (Grade M) = Site of Importance for Nature Conservation (Grade III of Metropolitan importance)

b. South Park SINC (Grade L[iii]) is located 250m to the north of the site comprising trees, scrub and grassland

c. Hurlingham Club Grounds SINC (Grade L) is located 180m to the west of the site comprising trees, scrub, semi-improved grassland and a waterbody.

Habitats

6.4.3 Habitats recorded within the survey area during the Phase 1 Habitat Survey are described in Vol 10 Table 6.4.1 below and shown on the Vol 10 Figure 6.4.2 (see separate volume of figures).

Vol 10 Table 6.4.1 Terrestrial ecology – Phase 1 Habitat Survey

Habitat type	Habitat description
Buildings and structures	A number of modern buildings are present at the eastern end of the site. These appear to be in good condition and have been assessed as being sub-optimal in terms of suitability for bats. There is a river wall on site. There are a range of industrial, residential and commercial buildings adjacent to the site.
Hardstanding	Hardstanding, including roads and footpaths, is present within the majority of the site and the surrounding area.
Scattered trees	There are several scattered trees on site and the surrounding area. This includes silver birch which are present in the eastern portion of the survey area. Ornamental trees are scattered throughout the car park within and adjacent to the highway works site. Street trees are present along Carnwath Road adjacent to the site.
Dense scrub	Hawthorn (*Crataegus monogyna*), apple (*Malus sp*.), and butterfly-bush (*Buddleja davidii*) are present within the northwest of the site.
Introduced shrub	Introduced shrub is present on site along the southern edge of the main construction site, within the car park to the west of the construction site and within the surrounding area.
Running water and intertidal zone	A section of the River Thames intertidal zone lies within the survey area. This habitat type is part of the aquatic ecology assessment (Section 5 of this volume).
Amenity grassland	There are several small areas of amenity grassland within the survey area, although there is no amenity grassland on site.

[iii] SINC (Grade L) = Site of Importance for Nature Conservation (Grade I of local importance)

6.4.4 The hardstanding, buildings and structures (including the river wall) on site are not considered to have ecological value as habitats, and therefore are considered to be of negligible value.

6.4.5 The semi-mature scattered trees and dense scrub on site are common within London and the UK. They do not include any UK or London BAP priority species. The dense scrub is limited in extent. However, these habitats offer some value as semi-natural habitat in an otherwise urban setting. Consequently the trees and dense scrub are considered to be of low (site) value.

6.4.6 The introduced shrub areas comprise non-native species that are not considered to contribute to the local biodiversity resource and therefore are of negligible value.

Notable species

6.4.7 Survey results are set out in a notable species report, which is included in Vol 10 Appendix D.1. A summary of the results and an assessment of the value of species associated with the site are set out below.

Bats

6.4.8 The Phase 1 Habitat Survey identified some potential foraging habitat for bats on site such as trees, dense scrub and introduced shrub habitats. The stretch of river corridor within and adjacent to the site is likely to represent an area of importance to commuting bats. Therefore, remote recording surveys were undertaken.

6.4.9 All bats are European Protected Species (EPS) under the Conservation of Habitats and Species Regulations 2010. Seven of the 18 bat species that regularly occur in England are listed as priority species on the UK BAP. Nine bat species are listed on the London BAP including common pipistrelle *(Pipistrellus pipistrellus)*, soprano pipistrelle *(Pipistrellus pigmaeus)* and noctule *(Nyctalus nyctalus)*. These three species were all recorded on site. Detailed survey results are provided in Vol 10 Appendix D.1 and on Vol 10 Figure 6.4.3 (see separate volume of figures).

6.4.10 The common pipistrelle bat is the UK's most common bat species, and is a widespread species in Greater London. Soprano pipistrelle bat is also widespread and common across Greater London but has a smaller UK population than the common pipistrelle (London Bat Group, 2012)[3], (Harris S. et al., 1994)[4]. Both species are in decline mainly due to habitat loss. The noctule bat is widespread across London but is generally uncommon in the UK.

6.4.11 During the remote recording surveys, the maximum number of common pipistrelle bat passes recorded in any one night was 24. No common pipistrelle bats were recorded close to sunrise or sunset when bats leave and return to their roost sites. Therefore, no common pipistrelle bat roosts are likely to be present on or in close proximity to the site. Bat activity is likely to be associated with the River Thames, which provides a corridor for bats to commute between foraging areas and, occasionally, may be used as a foraging resource itself. The trees and scrub on site are likely to provide a small foraging resource. With consideration given to the conservation status of common pipistrelle, that it is common relative to other UK bat species, and the relatively small number of this species using the site, the common pipistrelle population associated with this site is considered to be of low (site) value.

6.4.12 During the remote recording surveys, the maximum number of soprano pipistrelle bat passes recorded in any one night was 80. No bats were recorded close to sunrise or sunset when bats leave and return to their roost sites. Therefore, it is considered unlikely that there is a soprano pipistrelle bat roost on or in close proximity to the site. Like the common pipistrelle, the soprano pipistrelle is likely to be commuting along the River Thames through the site and foraging on and adjacent to the site around vegetation. Given the slightly higher number of soprano pipistrelle bat passes associated with the site and their conservation status, the population is considered to appreciably enrich the local biodiversity resource. Therefore, the soprano pipistrelle population is considered to be of low-medium (local) value.

6.4.13 Only one single noctule bat pass was recorded during the remote recording surveys. This suggests that small numbers of noctule bats occasionally visit the site for foraging and/or commuting purposes. The River Thames on site is considered to provide a corridor for the movement of noctule bats. As the number of bat passes was low and with consideration to the conservation status of noctule bats, the population of noctule bats associated with the site is considered to be of low (site) value.

Breeding birds

6.4.14 During the Phase 1 Habitat Survey, the trees, scattered scrub and tall ruderal vegetation adjacent to the site were considered to provide a foraging and nesting resource for birds, although the quality of the habitat was considered to be sub-optimal to support a notable population or assemblage of species that would require a breeding bird survey to be undertaken.

6.4.15 Birds that are likely to be nesting within vegetation are likely to comprise bird species common to the area, such as those listed in Vol 10 Appendix D.1, including some that are listed as London and UK BAP priority species. However, the number of nests that the vegetation could support is considered to be small. The bird resource on site is therefore considered to be of low (site) value.

Wintering birds

6.4.16 During the Phase 1 Habitat Survey, the foreshore adjacent to the site was considered to have potential to support wintering bird species. Therefore, wintering bird surveys were undertaken. Details of the wintering bird survey results are provided in Vol 10 Appendix D.1 and shown on Vol 10 Figure 6.4.4 (see separate volume of figures).

6.4.17 A total of 15 waterbird[iv] species were recorded foraging on the foreshore on and adjacent to the site. Of these, seven species are of nature conservation importance and are included on the Birds of Conservation Concern 3 (Royal Society for the Protection Birds, 2009)[5] Red or Amber List[v] and/or UK and London BAP as priority species (Vol 10 Table 6.4.2).

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

b. the confluence of the River Thames and the River Wandle on the opposite foreshore supported foraging bird species including lesser black-backed gull *(Larus fuscus)*, herring gull *(Larus argentatus)*, common gull (*Larus canus*), great black-backed gull *(Larus marinus),* gadwall *(Anas strepera)* and mallard *(Anas platyrhynchos)*.

6.4.18 The records of waterbirds of nature conservation importance recorded on the foreshore on and adjacent to the site have been compared to counts at other sites published in the London Bird Report 2007 (London Natural History Society, 2011)[6]. All waterbird species associated with the foreshore habitat were recorded at low numbers relative to their London populations. However, the seven species of conservation importance appreciably enrich the local biodiversity resource, and are each considered to be of low-medium (local) value. The remaining eight species of waterbird that are not of conservation importance are considered to each be of low (site) value.

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

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

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

Vol 10 Table 6.4.2 Terrestrial ecology – wintering waterbirds of nature conservation importance recorded within the survey area

Common name	Latin name	Conservation designation[vi]	Comments	Value
Gadwall	*Anas strepera*	Amber List	Recorded during February and March 2012 when numbers were recorded as ten in February and five in March.	Low-medium (local)
Mallard	*Anas platyrhynchos*	Amber List	Recorded on each visit, with a maximum count of 26 in February 2012 and numbers varying between six and 26 in other months.	Low-medium (local)
Black-headed gull	*Larus ridibundus*	Amber List	Recorded on each survey visit, with a maximum count of 147 in November 2011 and numbers varying between 27 and 134 in other months.	Low-medium (local)
Common gull	*Larus canus*	Amber List	Recorded on each survey visit, with a maximum count of 28 in November 2011 and between one and 21 in other months.	Low-medium (local)
Lesser black-backed gull	*Larus fuscus ssp. graellsii*	Amber List	Recorded on each survey visit, with the exception of December 2011. A maximum count of three was recorded in November 2011 and between one and two in other months.	Low-medium (local)
Herring gull	*Larus*	Red List and	Recorded on each survey visit, with a maximum count of 14	Low-medium

[vi] 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].

Common name	Latin name	Conservation designation[vi]	Comments	Value
	argentatus	UK and London BAP Priority List	in February 2012 and between three and 13 in other months.	(local)
Great black-backed gull	*Larus marinus*	Amber List	Recorded on three survey visits during November 2011, February 2012 and March 2012. A maximum count of two was recorded in March 2012, with single counts in other months.	Low-medium (local)

Black redstart

6.4.19 During the Phase 1 Habitat Survey, the buildings on site were identified as providing potential black redstart nesting habitat and therefore, breeding surveys have been undertaken for this species. The site and immediate surrounds have a lack of suitable foraging habitat for black redstart. Full results are provided in Vol 10 Appendix D.1 and shown on Vol 10 Figure 6.4.5 (see separate volume of figures).

6.4.20 The Rare Breeding Birds Panel for the UK reported that 20–54 pairs of black redstart were identified at 49 sites in 2008, with birds reported from 21 counties nationally (Holling and Rare Breeding Birds Panel, 2008)[7]. The population in London therefore represents between 10% and 30% of the UK population (RSPB, 2012)[8].

6.4.21 Black redstart is uncommon in the UK and does not occur at every site where suitable habitat is present. Although potential nesting habitat is present on site, no black redstarts were recorded on or around the site during surveys. Hence, the black redstart resource is considered to be negligible.

Invasive plants

6.4.22 A survey for invasive plant species was undertaken at the Carnwath Road Riverside site. No invasive plant species listed in Schedule 9 Part II of the Wildlife and Countryside Act 1981 (as amended) were recorded within or in the immediate vicinity of the proposed development site as shown in Vol 10 Figure 6.4.6 (see separate volume of figures).

Noise, vibration and lighting

6.4.23 As noise, vibration and lighting have the potential to disturb species on and adjacent to the site, baseline conditions are described here.

6.4.24 Current sources of noise and vibration are mainly derived from vehicle movement along adjacent roads, and the operation of the commercial units currently occupying the eastern half of the site.

6.4.25 At night the site receives relatively low levels of light spill from river traffic and riverside developments. However, there is street lighting along Carnwath Road which runs adjacent to the northern boundary of the site. Consequently lighting levels are moderate to high in this location.

Construction base case

6.4.26 Assuming use of the site continues as at present, conditions at Site Year 1 of construction would be the same as the current baseline conditions. As stated in para. 6.3.8, there are no developments in the vicinity of the site that would change the terrestrial ecology baseline conditions.

6.4.27 The noise and vibration base case is described in detail in Section 9 of this volume. Noise levels are likely to be similar to those currently present on and in close proximity to the site, with slight increases in noise experienced due to an anticipated increase in traffic levels adjacent to the site. The levels of lighting and vibration around the site are considered unlikely to change between the present time and the base case.

6.5 Construction effects assessment

Construction impacts

Habitat clearance and creation

6.5.1 Scattered trees and dense scrub of low (site) value, as well as hardstanding, buildings and structures (including the river wall) and bare ground, all of negligible ecological value, would be removed as part of site clearance on the main site. Scattered trees would be removed at the highway works site. This could affect breeding birds and foraging bats.

6.5.2 A brown roof would be implemented upon completion of the works. At least the same or larger area or ecologically beneficial habitat as that lost during construction would be provided. The same or greater number of trees would replace those that would be lost during construction. Native species, or non-native species that provide a biodiversity benefit would be planted and would provide replacement nesting habitat for birds and foraging habitat for bats.

6.5.3 The provision of nesting features at appropriate locations on site for black redstarts would increase the availability of nesting opportunities for black redstarts.

6.5.4 There would be temporary loss of foreshore habitat for wintering birds during construction from the use of either Option A with the campshed or Option B with the jetty and campshed. The area of foreshore affected would be similar with both options. This is likely to affect wintering birds that use the foreshore for foraging and resting. The choice of river infrastructure would not change the likely impacts on terrestrial ecology, as each would constitute a loss of foreshore. The area of foreshore habitat would be reinstated upon completion of the works.

Movement, noise, vibration and lighting

6.5.5 Noise and vibration impacts are based upon the data and assessment in Section 9 of this volume. Noise and vibration is likely to increase during construction with the greatest increases in noise levels likely to be experienced during site clearance (building demolition) and shaft sinking (mainly from piling), however the shaft and gantry crane at the site would be contained within a noise enclosure. These activities could cause disturbance to wintering birds on the foreshore adjacent to the site.

6.5.6 As vehicle movement along Carnwath Road Riverside site is currently high, the movement of vehicles and site personnel on site is unlikely to increase the level of disturbance to birds adjacent to the site.

6.5.7 Light spill onto the western portion of the main site from surrounding street lights and buildings is moderate. Existing security lighting is present on the eastern portion of the main site. The highway works site is lit by street lighting. Given the current moderate background light levels, night lighting during construction of the main tunnel and secondary lining would be slightly higher on the western portion of the site than current levels. Light levels would not be appreciably higher on the eastern portion of the site and the highway works site, where background light levels are high. The horizontal and vertical light spill beyond those areas at ground level would be minimal due to control measures in the *CoCP* Part A (Section 4). Therefore, the change in light levels is likely to be small.

6.5.8 As no bat roosts have been identified on or immediately adjacent to the site, bats are only likely to be present within habitat adjacent to the site whilst foraging at night and whilst commuting through the site. Foraging and commuting bats are unlikely to be affected by the very small increases in noise and vibration levels, and movements of vehicles at night. There may be a small increase in light levels immediately adjacent to the site. However given the current high to moderate levels of lighting this is unlikely.

6.5.9 The movement of construction workers and machinery on site could disturb birds adjacent to the site during construction.

Barging

6.5.10 Although light spill would be minimised through measures in the *CoCP* Part A (Section 4), some increases in lighting are expected on the foreshore as a result of lighting of the barging facilities for navigational purposes with either Option A or Option B. Therefore, some disturbance from lighting is anticipated on wintering birds and commuting bats.

6.5.11 The movement of barges in and out of the site with both Option A and Option B is likely to cause disturbance to wintering birds on the foreshore adjacent to the site. Wash created by the movement of barges may also displace birds from the foreshore adjacent to the site.

Construction effects

Habitats

6.5.12 There would be loss of vegetation of low (site) and negligible value, the removal of buildings and hardstanding and works to rebuild the river wall; both habitat types are of negligible value. With the subsequent reinstatement and creation of habitat, including the replacement tree planting and brown roof, there would be no significant change to the local habitat resource. Therefore, the effect is considered to be probable, **negligible** and not significant.

Species

Bats

6.5.13 As there are currently no roosts on or adjacent to the site, there would be no disturbance to roosting bats. Small changes in light levels are unlikely to create a barrier to the movement of commuting bats. Pipistrelle bats can tolerate relatively high light levels, up to 14 lux, which would not be exceeded by the installation of lighting due to control measures in the *CoCP* Part A (Section 11). Noctule bat activity associated with the site is low and comprises occasional passes on site. There may be some minor changes in bat behaviour as bats are likely to commute over or around the works within the foreshore and the campshed and/or jetty facilities. The River Thames is a wide corridor at this point, and the function of this habitat as a commuting route is unlikely to be affected. It is considered unlikely that changes in light levels and commuting behaviour would have an effect on the local distribution and abundance of bat populations. Therefore, the effect is considered to be probable, **negligible** and not significant.

6.5.14 There would be temporary loss of a small area of foreshore and terrestrial habitat (scattered trees and scrub) with a resultant loss of bat foraging habitat. However, the habitat loss is small relative to the large scale of the River Thames and associated foreshore and terrestrial habitat. Therefore, it is considered unlikely that this temporary loss would result in a decline in bat populations. The displacement effect would be reversed after construction as habitat would be reinstated on site. The effect is considered to be probable, **negligible** and not significant**.**

Breeding birds

6.5.15 There would be a temporary loss of a limited area of breeding bird habitat on site. The change in habitat is considered unlikely to result in perceptible changes in breeding bird populations. The small numbers of nesting birds associated with the site are likely to be displaced to alternative habitat in the wider area. The effect of temporary habitat loss is considered to be probable, **negligible** and not significant.

6.5.16 Birds on and adjacent to the site are likely to habituate to changes in noise levels, and disturbance from lighting would be minimised through measures in the *CoCP* Part A (Section 11). There is likely to be some displacement of small numbers of nesting birds from trees in close proximity due to small increases in disturbance from lighting and noise. This is considered unlikely to adversely affect breeding bird populations as alternative habitat is available in the wider area. The displacement effect would be reversed following cessation of the noise and vibration impacts following construction. Any small fluctuations in populations as a result of this disturbance would not be perceptible against background population fluctuations. Therefore, the effect of disturbance on breeding birds is considered to be probable, **negligible** and not significant.

Wintering birds

6.5.17 Works within the foreshore would result in the loss of foreshore habitat for wintering waterbirds during construction. It is considered likely that waterbirds would be displaced to other areas of foreshore adjacent to the site. Following reinstatement of the foreshore, wintering birds are considered likely to return to the site. No perceptible change in wintering bird populations associated with the site are anticipated as a result of changes to the foreshore habitat. Therefore, the effect on wintering bird populations at the site is considered to be probable, **negligible** and not significant.

6.5.18 There would be a temporary increase in noise and vibration levels. It is considered unlikely that waterbirds from the River Thames adjacent to the site would be displaced. Birds associated with the River Wandle confluence are considered to be a sufficient distance away from the site to be highly unlikely to be displaced by noise and vibration. Occasional displacement of birds adjacent to the site would be expected should sudden noises occur and when barges pass close by, with small numbers of wintering birds from adjacent intertidal habitat temporarily moving away from the habitat and returning shortly after. This displacement and return of wintering birds has been observed on the foreshore at other sites on the Thames, particularly where people walk along the foreshore. It is considered unlikely that this displacement would result in a perceptible change in wintering bird populations. Therefore, the effect of disturbance on wintering bird populations is considered to be probable, **negligible** and not significant.

6.5.19 Changes in light levels are considered to be small relative to the existing background levels on the foreshore. The increase in light levels is unlikely to result in the displacement of wintering birds from habitats adjacent to the site. Therefore, the effect of disturbance on wintering bird populations is considered to be probable, **negligible** and not significant.

Black redstart

6.5.20 There is currently no breeding black redstart resource associated with the site. The proposed black redstart nesting feature may be used by breeding black redstart in the future. This is likely to result in an overall increase in the local population of black redstart. Consequently, the effect on black redstart is considered to be probable, **moderate (local) beneficial** and therefore is significant.

Sensitivity test for programme delay

6.5.21 For the assessment of effects on terrestrial ecology during construction, a delay to the Thames Tideway Tunnel project of approximately one year would not be likely to materially change the assessment findings reported above (paras. 6.5.1 to 6.5.20). This is because there are no developments in the site development schedule that would fall into the base case as a result of this delay and therefore the base case would remain as described in paras. 6.4.26 to 6.4.27.

6.6 Operational effects assessment

6.6.1 As stated in para. 6.1.3, operational activities are limited at this site and not likely to lead to significant operational effects.

6.7 Cumulative effects assessment

Construction effects

6.7.1 No likely significant cumulative effects on terrestrial ecology have been identified as a result of construction activities from those developments as identified in para. 6.3.8. This is because the schemes are too far from the Carnwath Road Riverside site to generate potential for interaction with terrestrial ecology. Therefore, the effects on terrestrial ecology would remain as described in Section 6.5.

Sensitivity test for programme delay

6.7.2 In the event that the programme for the Thames Tideway Tunnel project is delayed by approximately a year, the cumulative effects assessment would remain unchanged. As described above in para. 6.7.1, there are no schemes anticipated to generate cumulative effects on terrestrial ecology and this would remain the case with a programme delay of approximately one year.

6.8 Mitigation

6.8.1 All measures embedded in the design and the *CoCP* of relevance to terrestrial ecology are summarised in Section 6.2. As no significant adverse effects have been identified in Section 6.5 at this site, no further mitigation measures are required.

6.9 Residual effects assessment

Construction effects

6.9.1 As no mitigation measures are proposed, the residual construction effects remain as described in Section 6.5. All residual effects are presented in Section 6.10.

6.10 Assessment summary

Vol 10 Table 6.10.1 Terrestrial ecology – construction assessment summary

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Habitats				
Scattered trees, dense scrub, introduced shrub, buildings, hardstanding and river wall	No significant change in habitat as replacement planting would be provided.	Negligible	None	Negligible
Notable species				
Bats	No significant changes to bat populations as a result of disturbance from small increases in light levels and works within the foreshore.	Negligible	None	Negligible
	No significant change in bat populations as a result of temporary loss of foraging and commuting habitat for bats.	Negligible	None	Negligible
Breeding birds	No significant change in breeding bird populations as a result of temporary loss of nesting habitat on site.	Negligible	None	Negligible
	No significant change in bird populations as result of low levels of disturbance from noise and lighting.	Negligible	None	Negligible
Wintering birds	No significant change in bird populations as a result of temporary loss of foreshore habitat loss on site for foraging wintering birds.	Negligible	None	Negligible

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
	No significant change in wintering bird populations as a result of disturbance from noise, vibration and wash from barge movements.	Negligible	None	Negligible
	No significant changes in populations and assemblages of wintering birds due to lighting from construction activities.	Negligible	None	Negligible
Black redstart	An increase in black redstart population as a result of the provision of black redstart nesting features.	Moderate beneficial	None	Moderate beneficial

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.10**

Volume 10: Carnwath Road Riverside site assessment

Section 7: Historic environment

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Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

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Thames Tideway Tunnel

Environmental Statement

Volume 10: Carnwath Road Riverside site assessment

Section 7: Historic environment

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7 Historic environment

7.1 Introduction

7.1.1 This section presents the findings of the assessment of the likely significant effects on the historic environment of the proposed development at the Carnwath Road Riverside site. The historic environment is defined in para. 4.10.2 of the NPS as including all aspects of the environment resulting from the interaction between people and places through time, including all surviving physical remains of past human activity, whether visible, buried or submerged, and landscaped and planted or managed flora. For the purposes of this assessment, heritage assets comprise below and above ground archaeological remains, buildings, structures, monuments and heritage landscapes within and around the site. Effects during construction and operation have been assessed. Effects on buried heritage assets are presented first, followed by above ground assets.

7.1.2 Based on a review of the noise and vibration assessment (Section 9), it is concluded that there would be no significant noise or vibration effects requiring offsite mitigation to any listed building. Such effects are therefore not considered further in this assessment.

7.1.3 Although it is recognised in the land quality assessment (Section 8) that remediation is likely to be required at this site, this would be confirmed following completion of detailed risk assessments and potentially further site investigation. It does therefore not form part of the assessment; however, any remediation required would be within the area of the below ground construction works.

7.1.4 The operational phase would not involve any activities below-ground aside from maintenance confined within the tunnel infrastructure. For these reasons, an assessment has not been undertaken of operational effects on buried assets.

7.1.5 A separate but related assessment of effects on townscape character and visual amenity is included in Section 11 Townscape and visual.

7.1.6 An assessment of effects from ground movement resulting from the Thames Tideway Tunnel itself is covered in Volume 3 Project-wide Effects. No effects are predicted on historic receptors in the vicinity of this site, therefore no assessment of ground movement effects is presented.

7.1.7 The assessment of the historic environment effects of the project has considered the requirements of the *National Policy Statement for Waste Water* (NPS)[1]. As such the assessment covers designated and non-designated assets, and a description of the significance of each heritage asset affected by the proposed development and the contribution of their setting to that significance. The assessment covers both above and below ground assets. The effect of the proposed development on the significance of heritage assets is clearly detailed in line with the requirements of the NPS. The role of the design process in helping to minimise effects on the historic environment is explained, and where appropriate, mitigation is proposed. Vol 2 Section 7 provides further details on the methodology.

7.1.8 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Volume 10 Carnwath Road Riverside Figures).

7.1.9 Unless otherwise indicated, 'the site' refers to the Carnwath Road Riverside main site. A small highway works site at the junction of Wandsworth Bridge Road and Carnwath Road is referred to as the Carnwath Road Riverside highway works site.

7.2 Proposed development relevant to the historic environment

7.2.1 The proposed development is described in Section 3 of this volume. The elements of the proposed development relevant to the historic environment are set out below.

Construction

7.2.2 All below ground works during construction are relevant to the assessment because they would potentially truncate or entirely remove any archaeological assets within the footprint of the works. These are described below.

7.2.3 Initial site set-up would require the demolition of existing modern buildings, and concrete post, plank and wooden site boundary fencing and brickwork walls (see Demolition and site clearance plan, separate volume of figures - Section 1). The construction of the works compound would entail preliminary site stripping to reach a depth of approximately 0.5m below ground level (mbgl), as assumed for the purposes of this assessment. Site fencing would be erected, supported by timber posts in concrete foundations. Office and welfare facilities and storage areas would be constructed on pad foundations with a depth of approximately 1.0mbgl, as assumed for the purposes of this assessment. A crane base would extend to a similar depth (see Construction phase plan 1, separate volume of figures - Section 1). Existing utilities located within the eastern part of site boundary would be removed, whilst those in the western part of the site may be removed if required.

7.2.4 A section of the existing 19th/20th century river wall would be demolished and a new wall constructed in its place with sheet piles (see Demolition and site clearance plan, see separate volume of figures - Section 1). It is assumed for the purposes of this assessment that as part of this there would be 1.0m-deep ground reduction up to 5m northwards from the line of the existing river wall. Two options are proposed for river transport during construction; barge berthing on a campshed adjacent to the river wall (Option A), and barge berthing on a jetty using a campshed further into the river channel (Option B).

7.2.5 A temporary campshed would be constructed on the Thames foreshore adjacent to the river wall (Option A). Approximately 1.7m of alluvium and other soft foreshore deposits would be removed from within the campshed footprint in order to ensure a level bed (see Construction phase 1 plan, see separate volume of figures - Section 1).

7.2.6 A secondary river transport option (Option B) would require the construction of a piled temporary jetty within the Thames channel, using a jack up barge (see Construction phase 1 plan, see separate volume of figures - Section 1). For the purposes of this assessment it is assumed that a campshed would be constructed on the southern side of the jetty, which would include ground reduction by approximately 0.5m.

7.2.7 The permanent works would include deep excavations for the main tunnel shaft. Construction of a building to house air management plant and equipment ('the ventilation building') and ventilation column and associated ducting and two underground air treatment chambers, would also entail ground disturbance.

7.2.8 Ground intrusion from tree replanting is assumed for the purposes of this assessment to reach a depth of approximately 1.5mbgl.

7.2.9 At the Carnwath Road Riverside highway works site a 20th century wall would be demolished (see Demolition and site clearance plan, see separate volume of figures - Section 1). No groundworks are proposed.

7.2.10 The construction activities which would give rise to effects on the historic character and setting of heritage assets are:

a. establishment of hoardings around the boundary of the construction site

b. use of cranes and other plant during shaft construction sinking and secondary lining of the tunnel

c. lighting of the site when required.

Code of Construction Practice

7.2.11 Measures incorporated into the *Code of Construction Practice (CoCP)* Part A (Section 12) to protect heritage assets include:

a. The requirement for the contractor to prepare a site-specific *Heritage Management Plan* (HMP), indicating how the historic environment is to be protected. This may take form of both physical protection and working practices.

b. Protective measures, such as temporary support, hoardings, barriers, screening and buffer zones around heritage assets, and archaeological mitigation areas within and adjacent to worksites.

c. Advance assessment to inform the types of plant and working methods for use where heritage assets are close to worksites, or attached to structures that form parts of worksites.

d. Care shall be taken when jack-up barges; piling or borehole rigs; mechanical excavators or other plant is operating over areas of the river channel or foreshore known to be particularly archaeologically sensitive. In exceptional cases exclusion zones may apply.

Safeguards may include appropriate methods for installing and operating plant, and the use of suitable foreshore protection.

e. Security procedures to prevent unauthorised access to heritage assets and archaeological investigations, and damage to or theft from them, including by the use of metal detectors.

f. Procedures in the event of the discovery of human remains.

g. Procedures under the Treasure Act Code of Conduct 1997, to address the discovery of any artefacts defined in the Treasure Act 1996.

7.2.12 The *CoCP* is provided in Vol 1 Appendix A. It contains general requirements (Part A), and site specific requirements for this site (Part B).

7.2.13 There are no site specific measures incorporated in the *CoCP* Part B (Section 12).

7.2.14 All the measures detailed above form part of the proposed development subject to the assessment, and therefore impacts such as strike damage on heritage assets are considered unlikely to occur and are not assessed. However, site specific measures to mitigate effects on buried heritage, which would be detailed in *Site Specific Archaeological Written Scheme of Investigation (SSAWSI)*, in line with the *Overarching Archaeological Written Scheme of Investigation (OAWSI)* (Vol 2 Appendix E.2), would be subject to the findings of field evaluation, and are therefore reported as mitigation as detailed further in Section 7.8.

Operation

7.2.15 The proposed operation of the infrastructure at Carnwath Road Riverside site is described in Section 3. The particular components of importance to this topic include the design of the public realm and the design and siting of the proposed ventilation building, and ventilation column.

Historic environment design measures

7.2.16 A high quality design in keeping with the character of the surrounding townscape has been proposed for the development of this site to minimise adverse effects on the historic character, appearance setting of heritage assets in accordance with the design principles set out in Vol 1 Appendix B. Generic design principles of relevance to the historic environment at this site include:

a. All the principles for the integration of functional components that apply at this site including those relating to materials, and careful detailing because they would inform the appearance of the completed operational infrastructure at the site.

b. The heritage design principles that apply at the site. These set out measures to safeguard significance and to develop designs and carry out works that are in accordance with established conservation principles and that also have regard to the interest of neighbouring heritage assets.

c. All the riparian and in-river structure principles relevant to the site regarding appearance and functionality.

d. All the landscape principles relevant to the site relating to the quality of soft and hard landscaping, materials and public accessibility.

e. All the lighting design principles relevant to the site. These include matters relating to safety, the aesthetic effect of the lighting and the quality of fittings.

7.2.17 The following site specific design principles are also relevant:

a. The surface of the shaft would be incorporated into a new area of landscaped public space that can be integrated into the wider development of the area. The top of the shaft slab would be buried 1m below the finished surface level to enable tree planting and soft landscaping.

b. The new public area would strengthen the links between Carnwath Road and the river by improving visual and pedestrian permeability across the site.

c. The architectural treatment of the ventilation building and boundary would coordinate with and complement the landscape design for the space.

d. The architectural treatment of the ventilation building and boundary would coordinate with and complement the landscape design for the space.

e. The height and cross-section of the ventilation requirements at this site preclude the use of the signature design ventilation column. However, the form and design of the column would make a visual reference to the signature design for consistency with other sites.

f. The design of the ventilation column would mark it as a local landmark and enhance the local townscape. In particular it would mark a ‘moment’ from the river.

g. The building and boundary to the eastern edge of Whiffin Wharf would be clad in the same high quality materials. The selection of materials will comply with the Sands End Conservation Area Appraisal for the River Corridor.

h. London Plane trees would be used where appropriate to supplement native planting to enhance the landscape design of the site.

i. High quality secure hoardings would be left around the boundary of Hurlingham Wharf and the Carnwath Road industrial area.

7.2.18 The design intent for the ventilation column and building at this site are shown in the ventilation column and ventilation design intent drawings for this site (see separate volume of figures - Section 1).

7.3 Assessment methodology

Engagement

7.3.1 Volume 2 Environmental assessment methodology documents the overall engagement which has been undertaken in preparing the *Environmental*

Statement. Specific comments relevant to this site for the assessment of the historic environment are presented here. Vol 10 Table 7.3.1 summarises the comments raised by consultees and how each comment has been addressed.

Vol 10 Table 7.3.1 Historic environment – consultation response

Organisation and date	Comment	Response
English Heritage phase two consultation response (February 2012)	EH welcomes the recognition of the significance of the Sands End Conservation Area to the design development of this site.	Noted
	EH concurs with the coverage of the above ground heritage assets in the assessment.	Noted
	EH raised concerns that the potential for prehistoric remains is underestimated in the assessment.	On the basis of current evidence, particularly as dredging has taken place on the foreshore, it is considered that the potential for prehistoric remains, as detailed in the baseline (see para. 7.4.32), is robust and based on sound evidence. Therefore no amendment has been made to the level of potential.

Baseline

7.3.2 The baseline methodology follows the methodology described in Vol 2. It should be noted that whilst most topics within the ES use the term 'value' to define the sensitivity of environmental receptors within the baseline, the historic environment assessment uses 'asset significance' as per the terminology used within the NPS. Distinction is made between the significance of the resource, i.e. asset significance, and the significance of the environmental effect throughout the following assessment.

7.3.3 Baseline conditions for above ground heritage and buried heritage assets are described within a 450m area around the centre point of the site, which is considered through professional judgement to be most appropriate to characterise the historic environment potential of the site. There are occasional references to assets beyond the baseline area, for example, a metalled Roman road which lies approximately 4.5km to the northwest of the site, which contributes to current understanding of the site and its environs in the Roman period.

7.3.4 The assessment area for the assessment of effects on the historic character and setting of above ground heritage assets has been defined using professional judgement by identifying heritage assets within the Zone of Theoretical Visibility (ZTV), generated as part of the townscape and visual assessment (see Section 11), whose settings have the potential to be significantly affected by the proposed development. The setting of these assets is then described in the baseline. Where appropriate this assessment area extends beyond the 450m radius baseline area. In addition, 'Views of Heritage Value' (VHV) considered important for understanding the historic character and setting of heritage assets have been identified where appropriate. These are drawn from professional judgement based on observation and understanding of historic context and architectural purpose and design. The Sands End Conservation Area Appraisal was also consulted to help define key views.

7.3.5 Site visits were carried out in April and October 2011 to identify assets on or adjacent to the site. A further site visit was carried out in January 2012 to identify assets for inclusion within the assessment of effects on historic character and setting.

Construction

7.3.6 The assessment methodology for the construction phase follows that described in Vol 2. There are no site specific variations for undertaking the construction assessment of this site.

7.3.7 In terms of physical effects on above ground or buried heritage assets, likely significant effects could arise throughout the construction phase. Effects arising from all stages of the construction period are therefore assessed. The construction assessment area for such effects is as defined by the site boundary.

7.3.8 In terms of effects on the character and setting of above ground heritage assets, while there would be effects throughout the construction period the peak construction phase is Site Years 3-5, during the main tunnel drive and subsequent secondary lining, including 24 hour working and the presence of the noise shed and cranes at the site. This has therefore been used as the assessment phase for effects on the character and setting of heritage assets. It should be noted that in some instances, the townscape and visual assessments may differ to the historic environment assessments despite the receptors being largely coincident. This is due to the different value / sensitivity that may be attributed to a receptor and also due to consideration of different factors when assessing the magnitude of change and significance of effect (the reasoning is explained in relation to each asset as appropriate). The construction assessment area is as described in para. 7.3.4.

7.3.9 Section 7.5 details the likely significant effects arising from the construction at the Carnwath Road Riverside site. There are no other Thames Tideway Tunnel project sites which could give rise to additional effects on the historic environment within the assessment area for this site as the nearest sites (Putney Embankment Foreshore to the west and Dormay Street to the south) are too distant from Carnwath Road Riverside site to have significant effects on the setting of the relevant heritage assets. Therefore no other Thames Tideway Tunnel project sites are considered in this assessment.

7.3.10 Archaeological remains are a static resource, which have reached equilibrium with their environment and do not change (i.e., decay or grow) unless their environment changes as a result of human or natural intervention. At this site ongoing fluvial erosion is changing the archaeological baseline within the foreshore. However, the rate of erosion is not known so the base case is assumed to be as per the baseline. Furthermore none of the schemes included in the site development schedule (Vol 10 Appendix N) would lead to physical changes in above ground or buried heritage assets within the Carnwath Road Riverside site. Whilst the baseline within the baseline area beyond the site may change as a result of any archaeological excavation and recording carried out as part of a standard program of mitigation for other developments, such information is unlikely to significantly change the current understanding of the historic environment of the site. Therefore any changes to the surrounding baseline would not affect the assessment and are not detailed further within the construction base case.

7.3.11 None of the schemes included in the site development schedule (Vol 10 Appendix N) would have a significant physical cumulative effect on buried or above ground heritage assets within the site. This is because there are no assets common to Carnwath Road Riverside site and those schemes listed in the schedule. Therefore no assessment of cumulative effects has been undertaken for physical effects on assets in the construction phase.

7.3.12 Several of the schemes included in the site development schedule (Vol 10 Appendix N) have been included in the assessment of effects on character, appearance and setting as they are within or close to the Sands End Conservation Area, a heritage asset of high significance. These include:

a. Townmead Road

b. Imperial Wharf

c. Wandsworth Riverside Quarter.

7.3.13 These schemes are considered as part of the base case. None of the other schemes in the development schedule are relevant given the distance from the site and the presence of intervening structures.

7.3.14 Buildings 6A and 6B of the Wandsworth Riverside Development in the site development schedule (Vol 10 Appendix N) could potentially give rise to a cumulative effect on the historic character and setting of above ground heritage assets, and are therefore included in the assessment of cumulative effects.

7.3.15 The assessment of construction effects on the character, appearance and setting of heritage assets also considers the extent to which the assessment findings would be likely to be materially different, should the programme for the Thames Tideway Tunnel project be delayed by approximately one year, for example due to changes in schemes which form part of the base case or cumulative assessment. In the case of buried heritage, as described above, whilst the baseline within the baseline area beyond the site may change as a result of any archaeological excavation and recording carried out as part of a standard programme of mitigation for other developments, such information is unlikely to significantly change the current understanding of the historic environment of the site. Therefore a delay to the Thames Tideway Tunnel project, with a consequent change in other schemes which may have been developed by the time of Thames Tideway Tunnel construction, would not lead to any change in the archaeological baseline and therefore no change in the assessment of effects on these assets.

Operation

7.3.16 The assessment methodology for the operational phase follows that described in Vol 2. There are no site specific variations for undertaking the operational assessment of this site which is based on an assessment in Year 1 of operation, when the development's full effect upon its surroundings would be evident. As with the construction assessment, it should be noted that in some instances the townscape and visual assessments may differ to the historic environment assessments of the operational phase, despite the receptors being largely coincident. This is due to the different value / sensitivity that may be attributed to a receptor and also due to consideration of different factors when assessing the magnitude of change and significance of effect (the reasoning is explained in relation to each asset as appropriate). The operational assessment area is as described in para. 7.3.4.

7.3.17 As stated in para. 7.3.9, there are no other Thames Tideway Tunnel project sites which could give rise to additional effects on the assessment of the historic environment at this site. Therefore no other Thames Tideway Tunnel project sites are considered.

7.3.18 Schemes included in the operational base case, are as per the construction base case described in paras 7.3.12 and 7.3.13.

7.3.19 As all of the schemes set out in the site development schedule (Vol 10 Appendix N) would be completed and operational by the operational phase assessment year they therefore do not meet project criteria (set out in Vol 2 Section 3.8) for inclusion in the assessment of cumulative effects. Therefore no operational phase cumulative assessment has been undertaken.

7.3.20 The assessment of operational effects on the character, appearance and setting of heritage assets also considers the extent to which the assessment findings would be likely to be materially different, should the programme for the Thames Tideway Tunnel project be delayed by approximately one year, for example due to changes in schemes which form part of the base case or cumulative assessment.

Assumptions and limitations

7.3.21 The assumptions and limitations associated with this assessment are presented in Vol 2. Site specific assumptions and limitations are detailed below.

Assumptions

7.3.22 The assessment of effects on buried heritage assets is based on the shaft and other below ground structures being located anywhere within the zones identified on the permanent works plan for these structures (see Site works parameter plan, separate volume of figures - Section 1). For this site the assessment is not sensitive to variations in location within these zones because the desk-based assessment has not located any buried heritage assets of high significance within the site which would warrant preservation *in situ*.

7.3.23 A number of assumptions have been made regarding the likely depth of temporary construction works (e.g. site strip, footings for plant and accommodation), based on professional knowledge of construction projects. Whilst the precise nature of construction effects on buried heritage would vary if the depths varied, the mitigation proposed to address any effects would remain as stated, as would the residual effects. These assumptions are detailed in Section 7.2.

7.3.24 The assessment of effects on the historic character and setting of above ground heritage assets is similarly based on the proposed above ground structures being located anywhere within the zones for these structures. For this site the assessment is not sensitive to variations in location within these zones because of the largely open character of the riverfront wharves and the road bounding the site to the north.

Limitations

7.3.25 A limitation of the assessment relates to the site walkover survey which did not include the central part of the foreshore due to an area of deep, soft mud, meaning conditions were unsuitable for survey for health and safety reasons. The soft mud relates to a further limitation of the assessment, which is that the extent of the dredging on the site is not currently known and no data is readily available.

7.3.26 A further limitation is that no intrusive archaeological investigation has been carried out on the site in the past and few investigations have been carried out in the baseline area. Nevertheless the assessment is considered to be robust and in accordance with best practice.

7.4 Baseline conditions

7.4.1 The following section sets out the baseline conditions for the historic environment within and around the site. Future baseline conditions (base case), which would remain as per the baseline, are also described. The section comprises seven sub-sections:

a. a description of historic environment features within the 450m baseline area

b. a description of statutorily designated assets within the site and baseline area. Locally designated assets and known burial grounds are included, where relevant, as described in Volume 2

c. a description of the site location, topography and geology

d. a summary of past archaeological investigation, providing an indication of how well the area is understood archaeologically

e. a chronological summary of the archaeological and historical background of the site and its environs

f. a statement of significance for buried heritage assets, including buried heritage setting, taking account of factors affecting survival

g. a statement of significance for above ground assets within and around the site, describing the features which contribute to their significance, including historic character, appearance and setting.

Current baseline

Historic environment features

7.4.2 The historic environment features map (see Vol 10 Figure 7.4.1, see separate volume of figures) shows the location of known above ground and buried historic environment features within the 450m baseline area, compiled from the baseline sources set out in the methodology in Vol 2. These have been allocated a unique historic environment assessment reference number (HEA 1, 2, etc), which are listed in the gazetteer in Vol 10 Appendix E.1. It should be noted that the baseline for the assessment of effects on the character, appearance and setting of heritage assets, is informed by professional judgement and the ZTV, with assets described in 'Statement of significance: above-ground heritage assets' later in this section.

Designated assets

International and national designations

7.4.3 The site and the immediate vicinity (i.e., within a 100m-radius of the site) does not contain any nationally designated (statutorily protected) heritage assets, such as scheduled monuments, listed buildings, or registered parks and gardens. There are no internationally designated heritage assets near to the site.

Local authority designations

7.4.4 The site lies within the Sands End Conservation Area. The site itself contains no locally listed buildings, although there are a number of locally listed buildings within the baseline area. These include the modernist murals on the Piper Building (HEA 54) on the opposite side of Carnwath Road, north of the site. These murals were not assessed as they are sited on the opposite side of the building from the site and the site does not form a part of their setting.

7.4.5 The site does not lie within an archaeological priority area.

7.4.6 The significance of these relevant assets and those further afield and relevant are described further in the 'Statement of Significance; above ground heritage assets' below in paras 7.4.36 - 7.4.47.

Known burial grounds

7.4.7 There are no known burial grounds within the site or adjacent to it.

Site location, topography and geology

7.4.8 The site is fairly flat with a gentle slope towards the east. Ground level on Carnwath Road, immediately to the north of the site, is at approximately 105.5m ATD (above Tunnel Datum). The level of the foreshore beside the river wall is between 102.2m ATD and 103.3m ATD, and drops down to the Thames at low tide at levels between 100.2m ATD and 100.6m ATD. The river bed at the southern boundary of the site lies at 96.0m ATD.

7.4.9 The site is situated at the northern edge of the floodplain in an area of alluvium overlying Shepperton sand and gravel deposits. The Kempton Park river terrace lies on the northern perimeter of the site a little to the north of Carnwath Road.

7.4.10 Nearby British Geological Survey boreholes suggest the surface of alluvium might lie at c. 102.0m ATD and the gravel surface at 100.0m ATD. Towards the southern boundary of the site, however, the alluvium is likely to have been eroded by the river, as the riverbed lies at about 100.0m ATD, below the surface of the floodplain gravels and it is likely that any deposits of archaeological interest would have been removed by past river scour and/or historic dredging.

7.4.11 A watercourse and tidal creeks are shown on eighteenth and nineteenth century maps, but there is no geotechnical data for the area to suggest whether such features existed prior to this time. The site topography and geology is discussed in more detail in Vol 10 Appendix E.2.

Past archaeological investigations

7.4.12 In the 1990s the Thames Archaeological Survey carried out a survey of the foreshore which identified the remnants of a post-medieval chalk barge bed (HEA 1D) in the southwestern part of the site, which is still visible. Possible post-medieval mooring features comprising a timber post and plank (HEA 1C) and the remnants of a post-medieval wharf (HEA 1E) were also identified, but these are no longer visible.

7.4.13 Three archaeological investigations have been carried out within the baseline area. An evaluation carried out in 1996, 85m to the west of the site (HEA 2), revealed a soil horizon with fire-cracked flint suggesting prehistoric activity, overlain by alluvial and peaty deposits. In 2002 alluvial deposits were recorded during a watching brief undertaken 185m to the northeast of the site (HEA 6). In 2004, an archaeological watching brief (HEA 3) 200m to the west of the site recorded remains of a post-medieval wharf. Further details of past archaeological investigations carried out within the site and baseline area are included in Vol 10 Appendix E.3.

Archaeological and historical background of the site

7.4.14 The following section presents a chronological summary of the archaeological and historical background of the site. Further detail is included in Vol 10 Appendix E.4.

7.4.15 During the prehistoric period (700,000 BC–AD 43), the site would have been situated on a step or promontory of higher drier ground extending into the floodplain from the river terrace. The location of the site at the interface of the wetland of the floodplain and dry land of the river terrace is likely to have made it attractive for occupation in prehistory. There may have been a prehistoric ford crossing in the area of the current Wandsworth Bridge, 160m east of the site (HEA 11). In 1996, an archaeological evaluation 85m to the west of the site (HEA 2), recorded a small undated prehistoric pit or hollow which contained fragments of fire-cracked flint. The pit was associated with a buried soil horizon, formed in the surface of the river terrace gravels and later sealed by alluvium. The Greater London Historic Environment Record (GLHER) includes the findspot of a Mesolithic tranchet axe on the Thames foreshore, 15m east of the site (HEA 9). A number of artefacts from the Neolithic, Bronze Age and Iron Age periods have been recovered from the baseline area, approximately 100–200m distant from the site (detailed in Vol 10 Appendix E.4), suggesting possible ritual deposition along this stretch of the river.

7.4.16 There is no evidence of Roman period (AD 43–410) occupation within the baseline area. From the Iron Age onwards it is likely that the location of the site became wetter and subject to regular inundation by the river. During this period it is likely that the site would have been used for rough grazing and as a base for fishing. The site lay 8km southwest of the Roman town of *Londinium* and 4.5km to the southeast of the road from the town to Silchester and the west of Britain, which ran on the line of modern Holland Park Avenue. With the development of *Londinium* as a trading port, river traffic along the Thames would have increased. The evidence for Roman activity in the baseline area is limited to the findspot of a Roman token recovered from the Thames (HEA 53) and a possible ford crossing the Thames near modern Wandsworth Bridge (HEA 11).

7.4.17 Throughout much of the medieval period (AD 410–1485), the site lay in marshland, prone to flooding, but which was probably used as grazing land. The site is located 1.3km south east of the main settlement of Fulham beside Fulham Palace. A number of smaller manorial estates grew up in the area, including Broomhouse, a small settlement 75m to the west of the site (HEA 5). A ferry operated from the bottom of the medieval Broomhouse Lane (HEA 4). The fringes of the river were meadows in this period, a number of which were documented in the medieval period (HEA 4 and 8), including some on the site itself (HEA 1A). A man made river wall or bank, which may have had medieval origins is shown on later maps running along the northern boundary of the site, along Carnwath Road. Throughout this period, the site probably lay in meadows, close to the small settlement of Broomhouse.

7.4.18 For the early part of the post-medieval period (AD 1485–present) the site would have remained as open land and meadow. An 18th century map shows the site within meadows or pasture alongside the Thames, with market gardens on the drier ground to the north of the site. A natural watercourse or field drain crosses the site from north to south. Despite industrial development elsewhere, the rural character of the baseline area was maintained into the second half of the 19th century. At this time, most of the site falls within two fields, with tree-lined drainage ditches across and between them. The southern half of the site lies on the Thames foreshore and partly extends out into the river. The river wall ran along the northern boundary of the site (HEA 1G).

7.4.19 In the late 19th century housing development took place to the north of the site with industrial development by the riverside. There were a number of wharves to the east of the site. The western part of the site is still an open field with boundaries comprising earthen banks. The eastern field of the site became ‘West Wharf (Metropolitan Asylums Board)’ (HEA 1F) with access to a floating pier on the Thames. This was an embarkation point for the Metropolitan Asylums Board river ambulance service for transporting smallpox patients to and from three hospital ships moored at Long Reach near Dartford.

7.4.20 From the late 19th century the site was an industrial area dominated by wharves (HEA 1E) and associated industrial buildings. None of the older buildings survive. The eastern section of the site currently consists of small single-storey yellow brick industrial units of late 20th century date. The west of the site consists of Whiffin Wharf and Hurlingham Wharf which are areas of open hard standing surrounded by a concrete boundary wall.

Statement of significance: buried heritage assets on the site

Introduction

7.4.21 The following section discusses past impacts on the site which are likely to have compromised asset survival (generally from late 19th and 20th century developments, eg, building foundations), identified primarily from historic maps, the site walkover survey, and information on the likely depth of deposits.

7.4.22 In accordance with the NPS, *National Planning Policy Framework* (DCLG, 2012)[2] and *PPS5 Planning Practice Guide* (DCLG, 2012)[3] (which remains extant) and national planning policy guidance, this is followed by a statement on the likely potential for and significance of buried heritage assets within the site, derived from current understanding of the baseline conditions, past impacts, and professional judgement.

Factors affecting survival

7.4.23 Archaeological survival potential across the site is generally likely to be high on the landward part of the site, with localised disturbance from building development from the late 19th century onwards. Conversely it is likely to be low on the foreshore side, with the exception of post-medieval remains.

7.4.24 It is possible some of the late 20th century structures on the site had piled foundations. Piles would have removed any remains within each pile footprint. The severity of the impact would depend on pile density. It is possible in the case of the warehouse buildings that only the structural (external) walls were piled which would have caused only localised impacts to the ground beneath the perimeter walls rather than across the building footprint.

7.4.25 Part of the foreshore has been dredged in the past, in order to lower the channel bed for boat access, although the extent is not known. This is likely to date from the 20th century use of the site for industrial wharves including a cement works. It was noted on the site visit that there is an area of soft deposits in the central section of the foreshore which is likely to be a dredged area that has infilled with silt. Dredging would have entirely removed any archaeological remains present. The presence of a post-medieval barge bed in the western part of the site (HEA 1E) suggests that this part of the foreshore was not dredged and therefore survival potential in this part of the site is higher.

7.4.26 Past river scour is likely to have removed the alluvial deposits from the foreshore, especially towards the low tide mark and below the modern riverbed. Ground levels suggest that alluvium might survive below modern foreshore deposits close to the river wall, but is likely to have been completely eroded towards the low water mark and below the modern riverbed.

7.4.27 Borehole data discussed in para. 7.4.10 suggests a low potential for early archaeological remains below the low water mark, where the riverbed lies below the predicted surface of the gravels that form the base of the archaeological sequence. This may be due to either river scour or dredging.

7.4.28 On the landward side of the river wall there are several factors which influence archaeological survival potential. This area has been reclaimed and built up behind the river wall. It is likely that the construction of industrial buildings on the site from the late-19th/early-20th century onwards would have caused localised ground disturbance within the made ground, eg, foundations and services to 1.0–1.5mbgl (possibly deeper for pad foundations of the larger buildings) and up to 3.0mbgl (c 102.5m ATD) for basements. However it is considered unlikely that these buildings have basements. This would have locally truncated archaeological remains within the made ground (eg later medieval and post-medieval remains).

7.4.29 The top of the alluvial sequence is likely to lie at around 102.0m ATD and the surface of the underlying gravels at c 100.0m–101.0m ATD. Depending on the depth of ground raising and made ground, modern ground disturbance may have truncated assets at the top of the underlying alluvial sequence, but in general the alluvium is likely to remain intact on the landward side of the river wall.

Asset potential and significance

7.4.30 The following statement of asset significance takes into account the levels of natural geology and the level and nature of later disturbance and truncation.

Palaeo-environment

7.4.31 The site has a low to moderate potential to contain palaeoenvironmental remains. Soils are likely to have formed at the surface of the gravel on the site in prehistory, which would have formed a dry land surface. Such soils are unlikely to have high preservation of environmental remains, owing to their dry environment and mixing caused by exposure. The overlying alluvium is likely to be mainly clay and silts deposited by flooding. Such alluvium might preserve organic remains, but these could be ex-situ having been deposited by water action. Alluvium is also subject to weathering which would dryout any organic remains. The potential for past environment reconstruction from the alluvium on the site is likely to be low, aside from allowing basic characterisation of the depositional environment and topographic deposit modelling. The significance of any palaeoenvironmental remains, based on their evidential value, would be low.

Prehistoric

7.4.32 The site has an uncertain, probably moderate, potential to contain prehistoric remains. The majority of the site would have remained largely dry in the prehistoric period with the potential for settlement, with the land surface becoming increasingly wet from the Iron Age onwards. Scattered remains dating to this period have been discovered within the baseline area, most of them residual finds (ie outside the context in which they were originally deposited), although evidence of human activity has been recorded within deep alluvial deposits. Redeposited finds would be of low significance. Evidence of settlement, riverside activity (eg timber structures, revetments and trackways) would potentially be of high significance, derived from the evidential value of the remains. Such remains are most likely to exist at the gravel/alluvium interface, at the base of the alluvial sequence. The main potential would be below the upper part of the foreshore and on the landward side of the river wall, where the alluvium (1–2m thick) is sealed by 3m or more of reclamation deposits and modern made ground. Further down the foreshore and below the riverbed there is less potential due to likely scour and localised dredging.

Roman

7.4.33 The site has an uncertain, probably low, potential to contain Roman remains. It is likely that the site became wet marshland in this period and unsuitable for settlement. In consequence, there is likely to be only low potential for the recovery of Roman archaeological evidence, except for the type of remains that might be expected to exist in a seasonally flooded marsh or wet meadowland environment (eg water management features such as ditches). Isolated artefacts and features would be of low significance, as derived from the evidential value of such remains. Archaeological survival in the foreshore area is less likely due to river scour and localised dredging.

Medieval

7.4.34 The site has a low potential to contain early and later medieval remains. It is possible that the site remained meadows or wet marshland, which was possibly reclaimed and drained for pasture or agriculture in the later medieval period. Pre-18th century maps show the landward part of the site in an area of meadows. Evidence of reclamation and drainage ditches would be of low significance. This would be derived from the evidential and historical value of these remains.

Post-medieval

7.4.35 The site has a high potential to contain post-medieval remains. The site and its immediate vicinity began to be developed into a mixed industrial and residential area from the mid-19th century onwards. It is possible that the footings of the late 19th century West Wharf ambulance centre of the Metropolitan Asylums Board (MAB) (HEA 1F) survive, along with later 19th and early 20th century industrial buildings, wharf infrastructure and earlier river walls. Such remains, if present, would be of low asset significance. Remains associated with the MAB ambulance centre would potentially be of medium significance, derived from the comparative potential and documentary evidence associated with London's typhoid outbreaks. This would be derived from their evidential and historical value.

Statement of significance: above ground heritage assets

Introduction

7.4.36 In accordance with the *National Policy Statement for Waste Water* and the associated guidance, the following section provides a statement of the likely significance of heritage assets based on professional and expert judgement. The significance of assets is a reflection of their value or importance, derived from their perceived historical, evidential, aesthetic and communal value. These terms are defined in Vol 2.

7.4.37 This section also describes the significance, historic character and setting of conservation areas and settings of listed buildings within the construction and operational Zones of Theoretical Visibility (ZTV) where their historic character, appearance and settings may be affected by the proposed development. Such assets are shown in Vol 10 Figure 7.4.2 (see separate volume of figures). This figure also shows the construction and operational ZTVs and Views of Heritage Value (VHV) which illustrate important views to and from heritage assets. There are no other heritage assets in the baseline area whose settings would be significantly adversely affected by the proposed scheme.

Within the site

Sands End Conservation Area

7.4.38 The site is located with the Sands End Conservation Area which extends from the corner of Broomhouse Road and Carnwath Road covering the stretch of river embankment to the east and northeast and reaches its easternmost extent at Chelsea Creek. The conservation area was created with the intention of "protect[ing] the riverside from unsympathetic development and to encourage the preservation and enhancement of the riverside itself, ensuring that new development is of a good and appropriate design" (LB of Hammersmith and Fulham, 1999)[4]. The river front is considered to provide important vistas, and to define the character of the River Thames. The conservation area is a designated heritage asset of high significance, as derived from its aesthetic, evidential, historical and communal values.

7.4.39 With the exception of Wandsworth Bridge and Wandsworth Bridge Tavern (approximately 140m to the east of the site), this part of the Sands End Conservation Area along the riverside is devoid of historic buildings and structures. The area is characterised by late 20th century retail, light industrial and residential development as shown in Vol 10 Plate 7.4.1. The site is surrounded by hoardings, as illustrated in Vol 10 Plate 7.4.2. There are clear views downriver towards Wandsworth Bridge (HEA 28) and upriver to Wandsworth Park. Views from the conservation area to the opposite bank of the river either side of Wandsworth Bridge is characterised largely by late 20th and early 21st century residential development and industrial structures. Views into the Sands End Conservation Area from Wandsworth Bridge are illustrated in View of Heritage Value 1, which is the historic view from the bridge (see Vol 10 Figure 7.4.2, see separate volume of figures) and Viewpoint 2.1 detailed in Section 11 Townscape and visual. Views towards the site from Wandsworth Park are illustrated in View of Heritage Value 2, Vol 10 Plate 7.4.4 and Viewpoint 1.4 detailed in Section 11 Townscape and visual. In general, historic character and setting makes a limited contribution to the significance of the Sands End Conservation Area.

Vol 10 Plate 7.4.1 Historic environment – view west from Wandsworth Bridge towards the site within Sands End Conservation Area

Vol 10 Plate 7.4.2 Historic environment – view south east from the western boundary of the site on Carnwath Road towards the site

River wall

7.4.40 The site contains part of a late 19th or early 20th century river wall (HEA 1G). It is formed of a combination of concrete blocks and Larsson pattern steel sheet piling and is of low heritage significance, derived from its evidential and historical value.

Barge bed

7.4.41 The foreshore contains the remnants of an old barge bed (HEA 1D) of probable 19th or 20th century date. Such barge beds were common along the foreshore and were constructed using a layer of chalk and, as in this case, held back by a timber revetment, although the timber at this site was not visible on the site walkover survey. Concrete sand bags partly cover the chalk. Barge beds were designed to prevent barges from getting beached or stuck on the river mud banks. The timber revetment structure, if extant, would be a reminder of the past industrial use of the site and one of the few remaining markers of the industrial heritage of the river in the area. It would be an asset of low significance, derived from its evidential and historical value.

Within the assessment area

Wandsworth Bridge

7.4.42 Wandsworth Bridge (HEA 28) lies approximately 140m to the east . Dating to 1939, the bridge, designed by the London County Council Chief Engineer, Mr T Pierson Frank, replaced a metal lattice-work bridge constructed in 1873 which became structurally unsafe due to the increased volume of traffic. Although the bridge is not a statutorily designated heritage asset it is noted as a landmark within the conservation area character profile, and due it is considered to be of medium asset significance.

7.4.43 The bridge is a prominent focal point within the Sands End Conservation Area. The bridge affords far reaching views to the west towards Wandsworth Park on the southern bank of the river and to the northwest towards the Sands End Conservation Area. This is illustrated in View of Heritage Value 1 (shown on Vol 10 Figure 7.4.2, see separate volume of figures) and Vol 10 Plate 7.4.1. There are also views eastwards along the River Thames towards Chelsea. However, the contribution of setting to the significance of the bridge is limited due to the extent of modern development both banks of the River Thames. This is illustrated in Vol 10 Plate 7.4.3.

Vol 10 Plate 7.4.3 Historic environment – view south from the Sands End Conservation Area towards Wandsworth Bridge

Hurlingham Conservation Area

7.4.44 The Hurlingham Conservation Area lies to the west adjacent to the Sands End Conservation Area. It is characterised by the grounds of Hurlingham Park, which surround the Hurlingham Club, a private members club founded in 1869 occupying Hurlingham Park house built in 1760. The conservation area is largely screened from the site by the presence of intervening modern buildings.

7.4.45 The Hurlingham Conservation Area is a heritage asset of high significance, as derived from its aesthetic, evidential, historical and communal values. The open, landscaped character of the conservation area makes a strong contribution to the historic character of this part of the River Thames. However, its setting is diminished by the extent of modern development within the adjacent Sands End Conservation Area.

Wandsworth Park

7.4.46 Across the River Thames, to the southwest of the site, lies Wandsworth Park, a Grade II registered park and garden. Designed by Lt Col. JJ Sexby, superintendent of the LCC Parks Department at the turn of the 20th century, the park was created to provide open space and a recreational area within what was, at the turn of the 19th century, a heavily polluted industrial suburb. Wandsworth Park is a designated heritage asset of high significance, as derived from its aesthetic, evidential, historical and communal values.

7.4.47 The park offers far reaching views northwards to the Hurlingham Conservation Area and north-eastwards across to the site within the Sands End Conservation Area, framed by Wandsworth Bridge to the east. This is illustrated in View of Heritage Value 2 as shown in Vol 10 Figure 7.4.2 (see separate volume of figures) and Vol 10 Plate 7.4.4. Given its prominent location on the River Thames, setting makes a strong contribution to the significance of Wandsworth Park.

Vol 10 Plate 7.4.4 Historic environment – view west from Wandsworth Park towards Sands End Conservation Area and Wandsworth Bridge

Construction base case

7.4.48 As detailed in para. 7.3.10 whilst ongoing fluvial erosion is changing the archaeological baseline within the foreshore, since the rate of erosion is not known the base case for the foreshore is assumed to be as per the baseline for the purposes of the assessment. Similarly as detailed in para. 7.3.10 no other non-Thames Tideway Tunnel developments would lead to any loss of or change in the buried or above ground assets within the site. The base case for the assessment of physical construction effects on buried and above ground heritage assets within the site would be the same as at present.

7.4.49 Several of the schemes included in the site development schedule (Vol 10 Appendix N) would change the character and setting of the Sands End Conservation Area. These include the large buildings proposed at Townmead Road and the redevelopment of Imperial Wharf to the north-west, both of which would be complete and operational by the time of construction of the Thames Tideway Tunnel project works at Carnwath Road Riverside site. The setting of the conservation area may also be changed by development beyond its boundary, particularly Wandsworth Riverside Quarter across the Thames. By virtue of its designation the conservation area is an asset of high significance, but its special character derives mainly from its riverside location which primarily features redundant industrial buildings of negligible heritage interest that are being replaced by modern redevelopments. Consequently, while these schemes would change the conservation area's present appearance and setting, the effect upon its heritage value would be minimal. These developments, therefore, would not change the existing baseline for this assessment in terms of character and setting of above ground heritage assets Therefore the base case remains as per the baseline detailed in this section.

Operational base case

7.4.50 Several of the schemes included in the site development schedule (Vol 10 Appendix N) would change the character and setting of the Sands End Conservation Area. These include the large buildings proposed at Townmead Road and the redevelopment of Imperial Wharf to the north-west, both of which would be complete and operational by the time of operation of the Thames Tideway Tunnel project at the Carnwath Road Riverside site. The setting of the conservation area may also be changed by development beyond its boundary, particularly Wandsworth Riverside Quarter across the Thames. As noted above, by virtue of its designation the conservation area is an asset of high significance, but its special character derives mainly from its riverside location which primarily features redundant industrial buildings of negligible heritage interest that are being replaced by modern redevelopments. Consequently, while these schemes would change the conservation area's present appearance and setting, the effect upon its heritage value would be minimal. These developments, therefore, would not change the existing baseline in terms of character and setting of above ground assets. Therefore the base case remains as per the baseline detailed in this section.

7.5 Construction effects assessment

Buried heritage assets

7.5.1 Effects of construction works are described in the following section in the sequence in which they would occur, with the individual impacts from each phase described. The effects on heritage assets are summarised in Section 7.10, by chronological period.

Site set-up

7.5.2 Works carried out as part of the initial site set-up would potentially truncate archaeological remains. Works include ground disturbance associated with the demolition of the existing modern (20th century) buildings and walls, site stripping, vegetation removal, construction of the works compound including fencing, and a crane base. These works would have a localised impact (medium magnitude of change) on any archaeological remains within the upper made ground, which could comprise post-medieval remains, including the footings of late 19th-20th century industrial buildings (of low significance), and footings of the Metropolitan Asylums Board ambulance station (HEA 1E), of medium asset significance. Truncation would locally reduce the significance of assets, possibly to negligible, and would result in a **minor adverse** effect (in the case of low significance assets) and a **moderate adverse** effect (in the case of the medium significance asset). However, if the upper made ground proves to be entirely modern, there would be no impact upon archaeological remains.

Construction of campshed (Option A)

7.5.3 The campshed alongside the river wall (Option A) would be constructed over approximately half of the foreshore area within the site, with up to approximately 1.7m depth of alluvium and other soft deposits removed in order to ensure a level bed prior to infilling with hardcore or concrete. The campshed is proposed partly within an area of historic dredging, within which there would be no archaeological impact as any archaeological remains would already have been removed. Beyond the footprint of historic dredging, campshed construction would have a high magnitude of impact on potential assets:

a. There is a low to moderate potential for palaeoenvironmental remains within the alluvium of low asset significance. Removal of such remains would reduce their significance to negligible locally, and would result in a **minor adverse** effect.

b. There is an uncertain, possibly moderate potential (low on the lower part of the foreshore), for evidence of prehistoric settlement and/or riverfront activity, of high asset significance. The removal of such remains, if present, would reduce their asset significance and would result in a **major adverse** effect. The removal of residual prehistoric finds of low asset significance would result in a **minor adverse** effect.

c. There is a low potential for Roman remains of low asset significance. If present, the removal of such remains would reduce their asset significance to negligible and would result in a **minor adverse** effect.

d. There is a high potential for buried post-medieval remains on the foreshore comprising industrial remains, bargebeds, and the footings of wharves and jetties. These would be of low asset significance and their removal would reduce their significance to negligible, resulting in a **minor adverse** effect.

e. Removal of remains of a jetty associated with the Metropolitan Asylums Board ambulance station (HEA 1E), of medium asset significance, would result in a **moderate adverse** effect.

Construction of piled jetty and campshed (Option B)

7.5.4 The proposed alternative option (Option B) would require the construction of a piled jetty from a jack up barge, with a campshed on the southern side of the jetty. Piling, ground reduction for the campshed, and the legs of the jack up barge would locally impact any archaeological remains. The footprint of the jetty and campshed would lie in an area where archaeological remains are likely to have been largely removed. The works would comprise a low magnitude of impact which would result in **minor adverse** effects for each affected asset (as listed in para. 7.5.3 above).

Dredging

7.5.5 Dredging would be confined to removal of material to allow construction of the campshed (Option A or B).

Scour around temporary structures

7.5.6 Scour around the temporary campshed or alternative jetty and campshed would have an impact upon any archaeological remains surviving close to these structures. The significance of any assets affected could be reduced to negligible, which would constitute a high magnitude of impact for these assets. The significance of effect on heritage assets would be as per that of the campshed described in para. 7.5.3 above.

Strengthening of the river wall

7.5.7 Strengthening of the river wall within the site would require demolition of the 19th/20th century wall and subsequent construction of a new sheet pile wall in its place, from the landward side.

7.5.8 The demolition of the existing 19th/20th century river wall would expose or remove buried deposits on the landward side of the wall. The significance of this effect on heritage assets would be as that of the construction of the shaft and associated structures described in para. 7.5.9 below. Ground reduction by 1.0m on the landward side of the existing wall as part of the works would have the same impact as the site set up described in para. 7.5.2 above.

Construction of the shaft and associated structures

7.5.9 Excavation of the shaft would entirely remove any archaeological remains from within its footprint. Piled foundations associated with the ventilation building would remove any archaeological deposits within the footprint of each piled foundation. Below ground air ducts would connect the shaft to the ventilation building, with two underground air treatment chambers. These deep constructions would comprise a high magnitude of impact and reduce the significance any archaeological remains to negligible. The environmental effect would depend on the asset significance as follows:

a. There is a low to moderate potential for palaeoenvironmental remains within the alluvium of low asset significance. Removal of such remains would result in a **minor adverse** effect.

b. There is an uncertain, possibly moderate potential for evidence of prehistoric settlement and/or riverfront activity, of high asset significance. The removal of such remains would result in a **major adverse** effect. The removal of residual prehistoric finds of low asset significance would result in a **minor adverse** effect.

c. There is a low potential for Roman artefacts of low asset significance. If present, the removal of such remains would result in a **minor adverse** effect.

d. There is a low potential for later medieval remains associated with reclamation, flood defences and agriculture, of low asset significance. Removal of such remains would result in a **minor adverse** effect.

e. There is a high potential for post-medieval remains on the landward side of the river wall, in the form of industrial remains of low asset significance. Their removal would result in a **minor adverse** effect. Removal of remains associated with the Metropolitan Asylums Board ambulance station (HEA 1E), of medium asset significance, would result in a **moderate adverse** effect. The proposed shaft would be located too far west of this asset and would have no impact.

Above ground heritage assets

Physical effects on above ground heritage assets

7.5.10 Construction of the campshed (Option A) would remove the remains of an earlier campshed (HEA 1E) of low asset significance. This high magnitude of impact would result in a **minor adverse** effect.

7.5.11 The removal of a section of the 19th/20th century river wall, of low asset significance, prior to the construction of a new wall, would constitute a high magnitude of impact on this asset and would result in a **minor adverse** effect.

Effects on the historic character and setting of above ground heritage assets

7.5.12 The NPS recognises in paragraph 1.4.4 that nationally significant infrastructure projects are likely to take place in mature urban environments, with adverse construction effects on historic environment receptors likely to arise. Construction works similar to those proposed are commonplace in London, and therefore the following assessment should be viewed in this context. It should also be noted that construction effects are temporary in nature and, as assessed, relate to the peak construction phase. Effects during other phases of works are likely to be lower due to reduced levels of plant being required and a reduced intensity of construction activity.

Sands End Conservation Area

7.5.13 The presence of the construction works would detract from views to the Sands End Conservation Area from Wandsworth Bridge and from the opposite bank of the river. However, the effect of the construction works on the character and views within the Sands End Conservation Area would be limited by the presence of intervening modern buildings. Furthermore historic buildings and heritage make a limited contribution to the conservation area, which would moderate the effect of the construction works, including for either river transport Option A or B. The magnitude of change would therefore be medium. Given the high significance of the asset combined with the medium magnitude of change to its historic character and appearance, the construction works would have a **moderate adverse** effect.

Wandsworth Bridge

7.5.14 The construction works would be clearly visible from Wandsworth Bridge, but given the distance from the site and limited contribution of setting to its significance, the magnitude of change would be low, including for either of the river transport Options, A and B. The bridge would remain prominent in views along the River Thames from the west at Wandsworth Park. Views across the bridge from the south would not be affected. Given the medium significance of the asset combined with the low magnitude of change to its setting, the construction works would have a **minor adverse** effect.

7.5.15 The separate townscape and visual assessment (Section 11) concludes that the works would have a moderate adverse effect upon the view west from Wandsworth Bridge. The difference between the two assessments derives from their different methodologies: one considers the effect of the change to setting upon the heritage value of the bridge, of which only a part is affected by the proposals; whereas the other considers the effect upon the view westward in terms of visual amenity, which includes non-heritage factors.

Hurlingham Conservation Area

7.5.16 The construction works would be just discernable in broad reaching views from the south bank of the river to the eastern end of Hurlingham Conservation Area. However, given the relative distance of the site from the adjacent conservation area and the presence of intervening modern buildings, the construction works would not detract from its setting. Given the high significance of the asset combined with the low magnitude of change to its historic character and appearance, the construction works would have a **minor adverse** effect.

Sensitivity test for programme delays

7.5.17 In the event that the programme for the Thames Tideway Tunnel project is delayed by approximately a year, a greater proportion of Wandsworth

Riverside scheme included in the base case would already be built and occupied. However, the effects would not materially change from those assessed above.

7.6 Operational effects assessment

Effects on the historic character, appearance and setting of above ground heritage assets

Sands End Conservation Area

7.6.1 The proposed development would introduce a new focal point within this part of the Sands End Conservation Area .The inclusion of landscaping and public realm would offer visual relief along an otherwise highly developed part of the riverside. The scale and form of the proposed development would be in keeping with the height and mass of most of the surrounding buildings, and so would be in keeping with the character of the Sands End Conservation Area. The magnitude of this beneficial change would be low due to the relatively small part of the conservation area affected. Given the high significance of the asset combined with the low magnitude of change, the operational phase would have a **minor beneficial** effect on the historic character and appearance of the Sands End Conservation Area.

7.6.2 The separate townscape and visual assessment (Section 11) concludes that the works would have a negligible effect upon the conservation area. The difference between the two assessments derives from their different methodologies: the historic environment assessment considers the effect of the change to historic character and appearance upon the heritage value of the entire conservation area; whereas the townscape assessment considers the effect upon the riverside setting of the conservation area in townscape terms, which includes non-heritage factors.

Wandsworth Bridge

7.6.3 For the reasons detailed in para. 7.6.1 above, the proposed development would enhance the setting of Wandsworth Bridge. However, given the relative distance from the bridge, the magnitude of change would be low. Given the medium significance of the asset combined with the low magnitude of change, the operational phase would have a **minor beneficial** effect on the setting of Wandsworth Bridge.

Hurlingham Conservation Area

7.6.4 The proposed development would enhance views from the river towards the western end of the Hurlingham Conservation Area by creating a new focal point along the river frontage and enhancing the quality of design within the setting of the conservation area. However, given the relative distance between the two areas, the magnitude of change would be low. Given the high significance of the asset combined with the low magnitude of change, the operational phase would have a **minor beneficial** effect on the setting of Hurlingham Conservation Area.

Sensitivity test for programme delays

7.6.5 In the event that the programme for the Thames Tideway Tunnel project is delayed by approximately a year, a greater proportion of Wandsworth Riverside scheme would already be built and occupied. However, in terms of the historic environment, the operational effects would remain unchanged from those assessed.

7.7 Cumulative effects assessment

7.7.1 As detailed in the site development schedule (Vol 10 Appendix N) one scheme has been identified within 1km of the site which meets the criteria (set out in Vol 2 Section 3.8) for inclusion in the construction phase cumulative assessment. The relevant scheme is the construction of buildings 6A and 6b at the Wandsworth Riverside development. The scheme would change the character and setting of the Sands End Conservation Area. However, while the conservation area is, by its designation, an asset of high significance, the historic environment makes a small contribution to this significance. Therefore the Wandsworth Riverside development together with the Thames Tideway Tunnel construction works, would not give rise to elevated effects on the character and setting of the conservation area.

7.7.2 As detailed in para 7.3.19 no operational phase cumulative assessment has been undertaken.

Sensitivity test for programme delays

7.7.3 In the event that the programme for the Thames Tideway Tunnel project is delayed by approximately a year, a greater proportion of the Wandsworth Riverside scheme would already be built and occupied with a correspondingly reduced level of cumulative activity. However, in terms of the historic environment, the cumulative construction effects would not materially change from those assessed.

7.8 Mitigation

7.8.1 As per the NPS, (para 4.10.19), a documentary record of a heritage asset is not as valuable as retaining the heritage asset, and it should not be a factor in the decision as to whether or not development consent is given. Nevertheless, it is the most appropriate form of mitigation available and in EIA terms serves to reduce the significance of the adverse effect, as has been agreed with English Heritage.

Buried heritage assets

7.8.2 Based on this assessment, no heritage assets of high significance are anticipated that would merit a mitigation strategy of permanent preservation in situ. It is therefore considered that the minor to major environmental effects of the proposed development could be successfully mitigated by a suitable programme of archaeological investigation before and/or during construction, to achieve preservation by record (through advancing understanding of asset significance).

7.8.3 Mitigation requirements would be informed by selective site-based assessment. This could include a variety of techniques, such as geotechnical investigation, geoarchaeological deposit modelling, foreshore monitoring and survey, archaeological test pits and trial trenches. This evaluation would enable a more targeted and precise mitigation strategy to be developed for the site in advance of construction. Both evaluation and mitigation would be carried out in accordance with a scope of works *(Site Specific Archaeological Written Scheme of Investigation (SSAWSI)*, as detailed in para. 7.8.5 below.

7.8.4 Subject to the findings of field evaluation, mitigation of the adverse effects upon archaeological remains within the site would include the following:

a. An archaeological watching brief during site preparation, possible demolition of the existing 19th/20th century river wall and construction to mitigate impacts upon post-medieval remains of low asset significance, arising from service diversions and foundations for offices and welfare on the landward side of the existing river wall.

b. Archaeological survey, investigation and recording of the foreshore, within and around the footprint of the proposed campshed in order to mitigate the effects on the river side of the existing river wall. The precise approach would depend on the detailed construction methodology. For example in the case of dredging outside the footprint of the former dredged area, conventional archaeological investigation may not be feasible. In such an eventuality other techniques would be employed, such as monitoring and scanning the arisings.

c. A targeted archaeological excavation and recording of any more significant remains (carried out in advance of construction), if their presence is revealed by preliminary site based field evaluation. Due to the depth of alluvium on the site, mitigation of the impacts of the deep constructions (eg the shaft), would only become feasible following the insertion of the perimeter walls/shaft segments of each construction. For other sub-surface constructions archaeological investigation in advance of construction may be feasible.

7.8.5 Both evaluation and mitigation would be carried out in accordance with a scope of works *(Site Specific Archaeological Written Scheme of Investigation [SSAWSI]*), based on the principles in the *Overarching Archaeological Written Scheme of Investigation (OAWSI)*, to ensure that the scope and method of fieldwork are appropriate. The *SSAWSI* would be submitted in accordance with the application for development consent (the 'application') requirement.

7.8.6 Construction phase scour around the campshed and jetty would be mitigated through a programme of monitoring and the provision of scour protection if required, as detailed in the *CoCP* Part A (Section 12).

Above ground heritage assets

7.8.7 The proposed mitigation strategy for the minor adverse effect resulting from the removal of the post-medieval (probably late 19th/20th century) campshed (HEA 1E), part of which is currently visible on the foreshore and the proposed demolition of the existing 19th/20th century river wall, would comprise an English Heritage Level 1 basic archaeological visual record (English Heritage, 2006)[5].

7.8.8 All measures embedded in the proposed scheme and *CoCP* of relevance to the assessment of effects on the historic character and setting of above ground heritage assets during construction are summarised in Section 7.2. No further mitigation during construction is possible for the significant adverse effect on the Sands End Conservation Area due to the highly visible nature of the construction activities. No mitigation is required for minor adverse effects on the character, appearance and setting of heritage assets.

7.8.9 No mitigation is required during the operational phase as no significant adverse effects have been identified.

7.9 Residual effects assessment

Construction effects

7.9.1 With the mitigation described above in place, the residual construction effects on above ground and buried heritage assets within the site would be **negligible**. All residual effects are presented in Section 7.10.

7.9.2 As no mitigation measures are proposed for effects on the historic character, appearance and setting of above ground heritage assets, the residual construction effects on the setting of heritage assets remain as described in Section 7.5. All residual effects are presented in Section 7.10.

Operational effects

Above ground heritage assets

7.9.3 As no mitigation measures are required for effects on the historic character, appearance and setting of above ground heritage assets, the residual operational effects on the setting of heritage assets remain as described in Section 7.6. All residual effects are presented in Section 7.10.

7.10 Assessment summary

Vol 10 Table 7.10.1 Historic environment – summary of construction assessment

Receptor (Heritage asset)	Effect	Significance of effect	Mitigation	Significance of residual effect
Buried heritage assets				
Low to Moderate potential for palaeoenvironmental remains (Low asset significance)	Assets affected by construction of campshed (Option A). Assets removed by scour around temporary structures Asset significance reduced to negligible.	Minor adverse	Preliminary site-based field evaluation, followed if necessary by targeted archaeological excavation and/or an archaeological watching brief to achieve preservation by record, within ground works deeper than 1.0m. Includes palaeoenvironmental sampling of any alluvial sequences.	Negligible
	Assets removed by excavation for shaft, culverts and chambers. Asset significance reduced to negligible.	Minor adverse		
	Assets removed by demolition of existing river wall and construction of new strengthened river wall. Asset significance reduced to negligible.	Minor adverse		
	Assets affected by piling to strengthen river wall or for proposed jetty (Option B).	Minor adverse		

Receptor (Heritage asset)	Effect	Significance of effect	Mitigation	Significance of residual effect
	Asset significance reduced to negligible locally.			
Moderate potential for isolated redeposited prehistoric artefacts (Low asset significance) and timber structures (high asset significance)	Assets affected by construction of campshed (Option A). Assets removed by scour around temporary structures Assets removed by excavation for shaft, culverts and chambers. Asset significance reduced to negligible.	Minor adverse (artefacts) Major adverse (structures)		Negligible
	Assets removed by demolition of existing river wall and construction of new strengthened river wall. Asset significance reduced to negligible.	Minor adverse (artefacts) Major adverse (structures)		
	Assets affected by piling to strengthen river wall or for proposed jetty (Option B). Asset significance reduced to negligible locally.	Minor adverse (artefacts or structures)		

Receptor (Heritage asset)	Effect	Significance of effect	Mitigation	Significance of residual effect
Low potential for isolated Roman artefacts and features (low asset significance)	Assets affected by construction of campshed (Option A). Assets removed by scour around temporary structures Assets removed by excavation for shaft, culverts and chambers. Asset significance reduced to negligible.	Minor adverse		Negligible
	Assets removed by demolition of existing river wall and construction of new strengthened river wall. Asset significance reduced to negligible.	Minor adverse		
	Assets affected by piling to strengthen river wall or for proposed jetty (Option B). Asset significance reduced to negligible locally.	Minor adverse		
	Assets removed by construction of campshed (Option A). Assets removed by scour around temporary structures	Minor adverse		

Receptor (Heritage asset)	Effect	Significance of effect	Mitigation	Significance of residual effect
	Assets removed by excavation for shaft, culverts and chambers. Asset significance reduced to negligible.			
Low potential for evidence of later medieval remains associated with land reclamation. (Low asset significance)	Assets removed by excavation for shaft, culverts and chambers. Asset significance reduced to negligible.	Minor adverse		Negligible
	Assets removed by demolition of existing river wall and construction of new strengthened river wall. Asset significance reduced to negligible.	Minor adverse		
High potential for remains of 19th/20th century industrial buildings, wharves and warehouses, (Low asset significance) and remains of 19th/20th century ambulance station (Low asset significance)	Assets removed by site set up. Assets affected by construction of campshed (Option A). Asset significance reduced to negligible.	Minor adverse (post-medieval industrial remains) or Moderate adverse (ambulance station)		Negligible
	Assets removed by excavation for shaft, culverts and chambers.	Minor adverse (post-medieval industrial remains) or Moderate adverse (ambulance		

Receptor (Heritage asset)	Effect	Significance of effect	Mitigation	Significance of residual effect
	Asset significance reduced to negligible.	station)		
	Assets removed by demolition of existing river wall and construction of new strengthened river wall. Asset significance reduced to negligible.	Minor adverse (post-medieval industrial remains) or Moderate adverse (ambulance station)		
	Assets removed by scour around temporary structures Asset significance reduced to negligible.	Minor adverse (post-medieval industrial remains) or Moderate adverse (ambulance station)		
	Assets affected by piling to strengthen river wall or for proposed jetty (Option B). Asset significance reduced to negligible locally.	Minor adverse (post-medieval industrial remains and ambulance station)		
Above ground heritage assets				
19th/20th century campshed (Low asset significance)	Removal for new campshed construction (Option A).	Minor adverse	English Heritage Level 1 visual record and possibly intrusive archaeological investigation and recording.	Negligible

Receptor (Heritage asset)	Effect	Significance of effect	Mitigation	Significance of residual effect
19th and 20th century river wall (Low asset significance)	Section of asset demolished for the construction of a new wall.	Minor adverse	English Heritage Level 1 visual record and possibly intrusive archaeological investigation and recording.	Negligible
Sands End Conservation Area (High asset significance)	Historic buildings and heritage make a limited contribution to the conservation area, which would moderate the effect of the construction works. The construction works would have a medium impact on the character and appearance of the views to the Sands End Conservation Area from Wandsworth Bridge and from the opposite bank of the river.	Moderate adverse	No mitigation possible further to that embodied within the proposed design and the *CoCP* and environmental design principles	Moderate adverse
Wandsworth Bridge (Medium asset significance)	The construction works would have a low impact upon the setting of Wandsworth Bridge	Minor adverse	No mitigation required further to that embodied within the proposed design and the *CoCP* and environmental design principles	Minor adverse
Hurlingham Conservation Area	The construction works would have a low impact	Minor adverse	No mitigation required further to that embodied	Minor adverse

Receptor (Heritage asset)	Effect	Significance of effect	Mitigation	Significance of residual effect
(High asset significance)	from the setting of the Hurlingham Conservation Area		within the proposed design and the *CoCP* and environmental design principles	

Vol 10 Table 7.10.2 Historic environment – summary of operational assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Sands End Conservation Area (High asset significance)	The proposed development would enhance the quality of design along the riverside at a scale appropriate to the character of the Conservation Area	Minor beneficial	None	Minor beneficial
Wandsworth Bridge (Medium asset significance)	The proposed development would enhance views from Wandsworth Bridge and the setting of the bridge	Minor beneficial	None	Minor beneficial
Hurlingham Conservation Area (High asset significance)	The proposed development would enhance the setting of the conservation area	Minor beneficial	None	Minor beneficial

References

[1] National Policy Statement for Waste Water http://www.defra.gov.uk/publications/2012/02/09/pb13709-waste-water-national-policy-statement/ last accessed December 2012

[2] Communities and Local Government. *National Planning Policy Framework* (March 2012)

[3] Department of Communities and Local Government, English Heritage & Department for Culture, Media and Sport. *PPS5 Planning for the Historic Environment: Historic Environment Planning Practice Guide* (March 2010)

[4] London Borough of Hammersmith and Fulham. *Conservation Area Character Profile* (1999), 4.

[5] English Heritage. *Understanding historic buildings: a guide to good recording practice.* Swindon (2006).

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

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Volume 10: Carnwath Road Riverside site assessment

Section 8: Land quality

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Creating a cleaner, healthier River Thames

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Thames Tideway Tunnel

Environmental Statement

Volume 10: Carnwath Road Riverside site assessment

Section 8: Land quality

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8 Land quality

8.1 Introduction

8.1.1 This section presents the findings of the assessment of the likely significant land quality effects of the proposed development at the Carnwath Road Riverside site (including the Carnwath Road Riverside highway works site).

8.1.2 The scope of the land quality assessment is to:

a. describe the condition of the site in terms of contaminant history and likely presence and magnitude of soil/sediment and liquid contamination (such as groundwater or perched water within the Made Ground), in addition to unexploded ordnance (UXO) and the presence of Japanese Knotweed, an invasive plant species which can be regarded as a soil contaminant.

b. describe and assess the impacts and significant effects of the interaction between these contaminants and the built environment, human and environmental receptors as a result of construction of the proposed development (taking into account any embedded measures).

8.1.3 There are a number of interfaces between land quality and other topic sections, as summarised below:

a. Section 13 – Water resources – groundwater assesses the likely significant effects to water resources from soil, perched water and groundwater contamination. The land quality assessment considers potential risks to human health receptors (eg, construction workers) from contaminated perched water and groundwater, including free phase[i] contamination.

b. Section 4 – Air quality and odour assesses the likely significant effects to the air quality during the construction and operation of the site. The land quality assessment considers potential risks from, for example, the generation of dust and soil vapour from exposed ground and soils during construction.

c. Section 5 Ecology – aquatic and Section 14 Water resources – surface water, these sections consider the mobilisation of sediments associated with in-river construction and how this would impact upon the ecology and quality of water in the tidal Thames. The surface water section also considers the likely significant effects to controlled waters from land contamination (eg, contaminated run-off) and use of

[i] Free phase contamination – hydrocarbons that form a discrete layer within groundwater, either floating on the groundwater surface or at the base of a groundwater body.

contaminating substances during construction. No further assessment is made in the land quality section.

8.1.4 Operational land quality effects for this site have not been assessed. This is on the basis of the embedded measures adopted during the construction and operational phases (refer to Section 8.2 and Vol 2 Section 8.6). No significant operational effects are considered likely and for this reason only information relating to construction is presented in the assessment of effects on land quality.

8.1.5 Two barge berthing options have been considered: Option A would involve barges berthing on a campshed only and Option B would involve barges berthing at a jetty, which would also have a campshed. Both options would not alter the assessment of likely significant land quality effects as they would not impact on land quality at the Carnwath Road Riverside site. The options are therefore not presented or reported separately for this topic.

8.1.6 The assessment of the likely significant effects of the project on land quality has considered the requirements of the National Policy Statement for Waste Water (Defra , 2012)[1] section 4.8. The risk posed by construction on previously developed land is addressed in the following assessment and through measures embedded in the *Code of construction practice* (*CoCP*) (further details can be found in Vol 2 Section 8.3). CoCP is provided in Vol 1 Appendix A. It contains general requirements (Part A), and site specific requirements for this site (Part B).

8.1.7 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Volume 10 Carnwath Road Riverside Figures).

8.2 Proposed development relevant to land quality

8.2.1 The proposed development is described in Section 3 of this volume. The elements of the proposed development relevant to land quality are set out below.

Construction

8.2.2 The elements of the proposed development relevant to land quality would consist of the following:

a. dredging, strengthening and alteration of river walls, and construction of a temporary jetty with associate campshed or a campshed against the river wall and temporary works including construction of crane bases and other foundations

b. construction of pits, chambers, ducts and pipes for cables, pipes, utility connections and diversions and drainage

c. main tunnel shaft, the invert of which would be located at a depth of approximately 42m below ground level (bgl) and associated maintenance access

d. near surface structures including an air treatment chamber, air management plant and equipment building and associated below ground ducts, air treatment chambers

8.2.3 The above works would involve extensive below ground construction, resulting in the excavation and removal of material, including Made Ground and natural soils below.

8.2.4 In addition to the above, there would also be a minor amount of highway work located at the junction of Wandsworth Bridge Road and Carnwath Road.

8.2.5 An area would also be required within the site for construction logistics, such as materials handling and storage areas, segment storage, site welfare facilities and offices (as shown on the Carnwath Road Riverside site construction plans - see separate volume of figures).

Code of construction practice

8.2.6 The embedded design measures relevant to land quality at the site are set out in Section 9 of the *CoCP* and are summarised below. Reference should be made to the *CoCP (Part A)* for full details.

8.2.7 There are no *CoCP* Part B measures which are relevant to this land quality assessment.

8.2.8 Land quality issues would be managed in close liaison with the local authority, London Borough (LB) of Hammersmith and Fulham and the Environment Agency (EA) prior to and during construction.

Pre-construction

8.2.9 The proposed development has been characterised and assessed with respect to land quality through the application of the following steps (which are dictated by the regulatory framework outlined in Section 9 of the *CoCP Part A*):

a. completion of a desk study which includes a review of available information sources (see Vol 10 Appendix F.1) and production of an initial conceptual site model

b. undertaking of specialist site surveys, such as Japanese Knotweed and UXO, which to date has included a site-specific desk study for part of the Carnwath Road Riverside site to inform ground investigation work (see Vol 10 Appendix F.3).

8.2.10 In addition to the above, land quality would continue to be assessed via the following measures:

a. preparation of a preliminary risk assessment, design of a ground investigation rationale and ground investigation survey which would include construction of exploratory test holes (such as boreholes – a small number of which have already been drilled within the foreshore and have informed this assessment), collection of soil and water samples for laboratory chemical testing and environmental monitoring (such as soil gas and soil vapour). A phased approach would be applied to ground investigation, with additional, detailed phases of investigation implemented as necessary to supplement, target and refine the findings and conclusions of the earlier assessments

b. site-specific land quality risk assessments would identify the need for specific remediation measures. Where necessary, the risk assessment would also be used to provide re-use criteria for soil material to be permanently placed at the site.

8.2.11 Where the site-specific land quality risk assessment identifies the need, a site-specific remediation strategy would be produced and implemented, including:

a. remedial options appraisal (as required)

b. details of the remediation strategy and methodology

c. methodology for decommissioning and removal of structures, such as underground storage tanks, if and where encountered

d. details of validation requirements to document the successful clean-up works.

Construction

8.2.12 Health and safety measures for the protection of construction workers with respect to land quality issues would include:

a. the provision of adequate training for all construction site workers to recognise and appropriately respond to potential land quality issues

b. site welfare facilities and where appropriate, decontamination units (ie, dirty in, clean out welfare units)

c. use of standard construction site personal protective equipment (PPE) (eg, high visibility clothing, safety boots, hard hat, safety glasses gloves and respiratory equipment)

d. robust emergency procedures (eg, with respect to UXO, previously unidentified contamination or structures), which are periodically reviewed. In the event of previously unidentified conditions being encountered, works would be suspended, the work area evacuated and specialist advice obtained. Where appropriate, additional risk assessments would be undertaken and additional control measures implemented prior to any works recommencing.

8.2.13 During construction, effective material management procedures, such as the storage and handling of excavated soils, fuels and other chemicals (as detailed further in the surface water section (8) of the *CoCP*), would be implemented. Excavated materials with the potential to be contaminated would be removed from site as soon as practicable. Site control measures would be implemented to reduce dust (see air quality Section 7 of the *CoCP*) and the spread of mud by vehicles (see public access, the highway and river transport Section 5 of the *CoCP*).

8.2.14 Environmental monitoring, would include the following measures:

a. on-site watching brief during potentially high risk activities and an on call watching brief for all other activities. Specialist watching brief may include: UXO, contaminated land, health and safety/occupational health and ecology ie Japanese Knotweed.

b. dust and air/vapour monitoring (see *CoCP Part A* for further details). Where appropriate, this would include a combination of on-site and boundary monitoring.

8.3 Assessment methodology

Engagement

8.3.1 Volume 2 Environmental assessment methodology documents the overall engagement which has been undertaken in preparing the *Environmental Statement*. Specific comments relevant to this site for the assessment of land quality are presented here.

8.3.2 The *Scoping Report* was prepared before Carnwath Road Riverside had been identified as a preferred site. The scope for the assessment of land quality at this site has therefore drawn on the scoping response from the LB of Hammersmith and Fulham in relation to Hammersmith Pumping Station and is based on professional judgement as well as experience of similar sites.

8.3.3 As part of the phase two public consultation, some respondents commented that the site had existing contamination, including possible munitions from Second World War (WW2). This is reported at Table 10.5.15 of the *Supplementary report on phase two consultation*[2]. These reports are anecdotal and have not changed the overall assessment which assumes that some contamination may be present and could potentially include UXO.

8.3.4 The LB of Hammersmith and Fulham were specifically consulted with respect to any land quality data they hold at the site and surrounding area. A review of this data as well as the response is presented in Vol 10 Appendix F.1 and Vol 10 Appendix F.2.

Baseline

8.3.5 The baseline methodology follows the methodology described in Vol 2. There are no site-specific variations for identifying the baseline conditions for this site.

Construction

8.3.6 The assessment methodology for the construction phase follows that described in Vol 2. There are no site-specific variations for undertaking the construction assessment of this site.

8.3.7 The construction assessment area considered for the assessment of land quality includes the limits of land to be acquired or used (LLAU) plus an additional 250m buffer area. This assessment area has been selected in order to take account of any off-site sources that could impact on the land quality of the site as well as any nearby sensitive receptors.

8.3.8 The construction assessment has been undertaken for Site Year 1 of the construction phase.

8.3.9 The base case and cumulative assessment in Site Year 1 of construction take into account the schemes described in Vol 10 Appendix N. The baseline is not anticipated to change substantially between the base case year and Site Year 1 of construction (2016). There are three proposed developments within the 250m buffer area (as shown in Vol 10 Table 8.3.1) which are likely to be complete and operational before the commencement of the construction phase and as a result form part of the construction base case.

8.3.10 The developments within the 250m buffer area which are not considered as part of the construction base case are those developed during and after Site Year 1 of construction, they are included within the cumulative effect assessment and are also identified in Vol 10 Table 8.3.1.

Vol 10 Table 8.3.1 Land quality - construction base case and cumulative assessment development (2016)

Development	Distance from site	Construction base case	Cumulative impact assessment
Wandsworth Riverside Quarter, Point Pleasant/Osiers Road - Phase A Buildings 5A, 5B, 5C and 5D.	200m southwest	✓	✗
Jetty adjacent to 51 Townmead Road (Erection of single storey Environmental Education Centre	200m east	✓	✗
Townmead Road (Redevelopment of site demolition and replacement of concrete plant)	230m east	✓	✗
Western Riverside Transfer Station (Replacement of existing Civic Amenity facility)	230m south	✓	✗
Wandsworth Riverside Quarter Point Pleasant/Osiers Road – Phase 6A and 6B.	200m southwest	✗	✓

Symbols ✓ applies ✗ does not apply

8.3.11 Section 8.5 details the likely significant effects arising from the construction at the Carnwath Road Riverside site. There are no other Thames Tideway Tunnel project sites which could give rise to additional effects on land quality within the assessment area for this site, therefore no other Thames Tideway Tunnel project sites are considered in this assessment.

Development of conceptual model

8.3.12 The assessment of land quality effects is based on the development of a source-pathway-receptor (SPR) conceptual model. This model aims to understand the presence and significance of potentially complete pollutant linkages.

8.3.13 The SPR conceptual model is based on guidance given in CLR11: *Model procedures for the management of land contamination* (EA, 2004)[3]. This type of assessment specifically relates to risk assessment and management of land contamination and has been used to inform the environmental impact assessment (EIA) which seeks to identify the likely significant effects of the proposed development.

8.3.14 The impact assessment considers the anticipated level of contamination likely during Site Year 1 of construction using the categories of receptor sensitivity and impact magnitude given in Vol 2 Section 8.4 and Vol 2 Section 8.5 respectively.

8.3.15 The significance of effects has been determined using the generic matrix given in Vol 2 Section 3.7. A description of the significance criteria is presented in Vol 2 Section 8.5.

8.3.16 The methodology for undertaking both source-pathway-receptor analysis and the impact assessment is provided in Vol 2 Section 8 Land quality.

Assumptions and limitations

8.3.17 The assumptions and limitations associated with this assessment are presented in Vol 2. Assumptions and limitations specific to the site are detailed below.

Assumptions

8.3.18 It is assumed that the LLAU would have been affected by the legacy of industrial use and that contamination may be present. The assessment has assumed that a cover of Made Ground is present across the site.

8.3.19 The approach to remediation cannot be defined at this stage due to a lack of data. It is therefore assumed that some contamination would still remain on-site at the time construction commences (either because no pre-commencement remediation is deemed necessary or that following remediation of the construction area some contamination remains on the wider site).

8.3.20 The site is expected to be underlain at depth by low permeability London Clay deposits which are in turn underlain by further low permeability deposits associated with the Lambeth Group. Therefore it has been assumed that any potential contamination (if any) is likely to be restricted to the overlying shallow deposits (ie, Made Ground and River Terrace Deposits).

Limitations

8.3.21 No access to Whiffin and Hurlingham Wharf was available at the time of the walkover survey. These areas could however be viewed from the site perimeter and publicly accessible areas.

8.3.22 There is limited site-specific ground investigation data within the wider LLAU, sediment quality data has been collected from within the foreshore area of the LLAU. It is considered that there is sufficient information to provide a robust assessment.

8.4 Baseline conditions

8.4.1 The following section sets out the baseline conditions for land quality within and around the site. Future baseline conditions (base case) are also described.

Current baseline

Introduction

8.4.2 A full list of the data sets drawn upon in this assessment is presented in Vol 2.

8.4.3 A baseline report is presented in Vol 10 Appendix F.1 which details the data obtained for this site and identifies the contamination sources that may have affected the site. In addition to Vol 10 Appendix F, this section should also be read in conjunction with Vol 10 Figure F.1.1, Figure F.1.2 and Figure F.1.3 (see separate volume of figures).

Summary of baseline conditions

Geology

8.4.4 The main tunnel site is underlain by a cover of Made Ground extending to 2m bgl. This is underlain (in turn) by River Terrace Deposits and London Clay Formation (See Vol 16 Appendix F Table F.3 for the full geological succession).

Contamination

8.4.5 The site is located within a former industrial area that is now either partially derelict or has been redeveloped as retail/light industrial/commercial land use. The land to the north of the site is residential.

8.4.6 The historical map review and consultation with the LB Hammersmith and Fulham has highlighted that the main site (main tunnel shaft location and associated construction compound) has been subject to a number of potentially significant contaminative historical land-uses since the early 20th Century. Former activities include wharves, asphalt works, cement works and timber yards. The main site is also currently subject to potentially contaminative land-uses associated with the ongoing light industrial/commercial units.

8.4.7 The surrounding area immediately to the east and west has previously supported potentially highly contaminating activities including a petroleum depot and chemical works. These have been recorded by the local authority to have impacted the shallow aquifer adjacent to the site and some migration of contaminants onto the site from surrounding sources is therefore possible.

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

8.4.9 No site-specific contamination data of soils and groundwater is available for the site. However, on the basis of the reviewed information, it is reasonable to assume that soil (and groundwater) contamination may be present across the entire site which would be associated with poor quality Made Ground soils from cycles of redevelopment and local point sources of contamination (such as fuel tanks which are thought to have existed previously).

8.4.10 The main contaminants associated with the historical land-uses would include, but not be limited to, elevated levels of heavy metals, polycyclic aromatic hydrocarbons (PAHs), fuel and oil hydrocarbons, cyanide, sulphates, asbestos and volatile organic compounds (VOCs). The contaminants may be present in either soil, soil vapour and groundwater (including perched water) may be hazardous to human health (eg, as irritants, carcinogens or by their volatile or flammable properties) depending on the potential concentration of the substance, groundwater or surface water contaminants or harmful to aquatic life.

UXO

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

8.4.12 A desk based assessment for UXO threat was undertaken by 6 Alpha Associates Limited (Vol 10 Appendix F.3) for ground investigation works in the vicinity of the proposed development site. The assessment covered three areas within the Carnwath Road Riverside site, two in the wharf area and one on the highway (area a – land aspect of main work area, area b - foreshore and river of main work area and area c located in the highway, as described in Vol 10 Appendix F Table F.1).

8.4.13 Taking into account the findings of this study and the known extent of the proposed works at the Carnwath Road Riverside site, it is considered that within area a and c there is an overall low/medium threat from UXO and within area b there is a high threat.

8.4.14 Additionally, anecdotal evidence of munitions manufacture was identified during the public consultation phase2, and the possible presence of UXO has also been considered.

Summary of receptors

8.4.15 The receptors identified at this site from the baseline survey (see Vol 10 Appendix F.1) and their corresponding sensitivity following the criteria set out in Vol 2 are as follows:

a. construction workers: low sensitivity for general above ground site workers, such as staff in site offices or delivery drivers and high sensitivity for those site workers involved in below ground excavation works and associated activities

b. adjacent land-users: residents (high sensitivity) and workers in the adjacent industrial or commercial land, and Thames Path users (low sensitivity)

c. built environment: adjacent residential, light industrial and commercial buildings and river wall (low sensitivity).

Construction base case

8.4.16 For land quality, the assessment of construction effects is based on the conditions which are likely to be experienced in Site Year 1 of construction (base case).

8.5 Construction effects assessment

Construction assessment case

8.5.1 The embedded requirement for a risk assessment and potential remediation of land contamination that forms part of the proposed development (refer to the *CoCP* and summary presented in Section 8.2) mean that the land quality of the site may be different to that described in Section 8.4.

8.5.2 Where deemed necessary, problematic or gross contamination, which may substantially hinder the construction programme or which cannot be adequately dealt with in a controlled manner during construction, would be remediated prior to the commencement of the main construction works (such as the main tunnel shaft, main tunnel construction works and in other areas of proposed excavation, where necessary).

8.5.3 Since the approach to remediation cannot be defined at this stage, it is assumed that some contamination would remain. Therefore some contamination is considered to be present for the purposes of this assessment.

8.5.4 Unless there are any immediate (as yet unknown) unacceptable risks elsewhere (for instance off-site migration of mobile free phase hydrocarbons or vapour risk to adjacent properties), remediation in areas away from planned intrusive construction works would not take place prior to construction.

Development of conceptual model

Interactions between source-pathway-receptor

8.5.5 The following sections outline how the contamination sources may interact with the receptors identified during the construction phase (see para.8.4.10) following the application of the embedded measures (see Section 8.2).

8.5.6 The main land quality SPR interactions are considered to be from the exposure of potential contamination to:

a. construction workers (receptor) via dermal contact, ingestion and inhalation of dust and soil vapours/soil gas and direct contact

b. adjacent land-users, including members of the public (receptor) via off-site migration of soil vapour (by diffusion or due to wind) and wind-blown dust contaminant pathways as well as accidental UXO detonation

c. the built environment (on and off-site receptors) via the accidental detonation of previously unidentified UXO

8.5.7 The SPR interactions are summarised in Vol 10 Table 8.5.1. For simplicity the various sources identified have been grouped together into the different phases which they may be found (ie, solid, liquid, and gaseous), as these interact with receptors in a similar manner.

Vol 10 Table 8.5.1 Land quality – source-pathway-receptor summary (construction)

Receptors / Generic sources	Construction workers	Adjacent land-users	Built environment
Contaminated soils/sediment	Inhalation, dermal contact, ingestion	Wind -blown dust and vapour migration (and subsequent ingestion and inhalation)	N/A
Contaminated groundwater or liquids	Inhalation, dermal contact, ingestion	N/A	N/A
Soil gases/vapours	Inhalation	Vapour migration (and subsequent inhalation)	N/A
UXO	UXO detonation	UXO detonation	UXO detonation

N/A= Not applicable

Impacts and effects

8.5.8 The following section discusses the potential impacts and likely significant effects on receptors as a result of the land quality conditions at the site.

8.5.9 The assessment focuses on those linkages between sources, pathways and receptors that could generate significant effects and is based on available information and professional judgement.

Construction workers

8.5.10 A number of embedded measures set out in the *CoCP* are designed to effectively manage any potential land quality impacts to construction workers associated with the construction phase of the proposed development (measures are summarised in Section 8.2).

Contamination

8.5.11 The management of contamination at the site is a two stage process. The first stage comprises the assessment, quantification and if necessary the removal of the main contamination sources which could impact upon construction worker health.

8.5.12 The second stage comprises safe methods of work and management of contamination during construction (assuming either that some contaminated soils could remain, or previously unidentified contamination be found during the main construction works.

8.5.13 Both of these stages include measures such as site-specific risk assessments, watching brief, safe methods of work, use of personal protective equipment (PPE) and mitigation from a specialist contractor who is experienced at managing such risks.

8.5.14 With these measures in place, the overall magnitude of the impact to construction workers (both below and above ground) is assessed to be negligible.

8.5.15 This would result in a **negligible** effect on above ground construction workers and a **minor adverse** effect on those involved in intensive below ground works (although the effect is defined as minor adverse, it is considered unlikely that the effects would occur).

UXO

8.5.16 The management of UXO risk comprises advice from a specialist contractor who is experienced at managing such risks. This would include an initial assessment of UXO being present at the site (such as that already undertaken) and a proportional response to this risk. With a high risk site such as Carnwath Road (foreshore works) this is likely to include of site-specific risk assessments, safe methods of work/tool box talks and emergency response procedure as well as a UXO watching brief as excavations progress.

8.5.17 These measures are successfully utilised in major construction schemes within London on regular basis. Therefore with these measures in place, the overall magnitude of the impact to construction workers (both below and above ground) is assessed to be negligible.

8.5.18 This would result in a **negligible** effect on above ground construction workers and a **minor adverse** effect on those involved in intensive below ground works (although the effect is defined as minor adverse, it is considered unlikely that the effects would occur).

Adjacent land-users

Contamination

8.5.19 Impacts on adjacent land-users could occur via excavation and exposure of previously unidentified contaminated soils. This contamination could then migrate onto neighbouring sites. The pathways via which the contamination could migrate are: wind-blown dust and vapour diffusion.

8.5.20 A number of embedded measures set out in the *CoCP*, as summarised in Section 8.2, are designed to effectively manage any land quality impacts to the adjacent land-users associated with the construction phase of the proposed development.

8.5.21 These measures include:

a. the damping down of excavations, storage of potentially contaminated soils in secure (covered) areas, wheel washes at site entrance and the maintenance, construction and cleaning of hardstanding

b. dust and air/vapour monitoring to provide a check that volatile contamination or construction dusts do not significantly affect adjacent land users. Where appropriate, this would include a combination of on-site and boundary monitoring, which would provide either real time measurements or collect samples for subsequent analysis. For further detail and guidance reference should be made to the *CoCP* Part A.

8.5.22 With these measures in place the overall magnitude of the impact to all adjacent land-users is assessed to be negligible.

8.5.23 Based on the assessed impact magnitude and receptor sensitivity, it is considered that the proposed development would result in a **negligible** effect on the adjacent light industrial/commercial land-users and Thames Path users and a **minor adverse** effect on the residential land-users (although the effect is defined as minor adverse, it is considered unlikely that the effect would occur).

UXO

8.5.24 Impacts on adjacent land-users could occur via accidental detonation of UXO during below ground works. The embedded measures are set out in the *CoCP*, such as the use of specialised UXO contractors offering site-specific advice and where necessary on-site monitoring. These measures are designed to effectively manage any impacts to the adjacent land-users associated with the construction phase of the proposed development.

8.5.25 With these measures in place the overall magnitude of the impact to all adjacent land-users is assessed to be negligible.

8.5.26 Based on the assessed impact magnitude and receptor sensitivity, it is considered that the proposed development would result in a **negligible** effect on the adjacent light industrial/commercial land-users and Thames Path users and a **minor adverse** effect on the residential land-users (although the effect is defined as minor adverse, it is considered unlikely that the effect would occur).

Built environment

8.5.27 Impacts from existing land quality relate to the accidental detonation of UXO during preliminary surveys or main construction works.

8.5.28 A number of embedded design measures set out in the *CoCP*, as summarised in Section 8.2, are designed to effectively manage any land quality impacts (eg, from UXO) to the built environment associated with the construction phase of the proposed development.

8.5.29 With these measures in place, the overall magnitude of the impact to the built environment is assessed to be negligible.

8.5.30 Based on the assessed impact magnitude receptor sensitivity, it is considered that the proposed development would result in a **negligible** effect on the adjacent residential, commercial/light industrial buildings and river wall.

8.6 Operational effects assessment

8.6.1 Operational effects have not been assessed for land quality (see para 8.1.6).

8.7 Cumulative effects assessment

Construction effects

8.7.1 Of the projects described in Vol 10 Appendix N which could potentially give rise to cumulative effects with the proposed development at Carnwath Road Riverside, one development has been identified (see Vol 10 Table 8.3.1).

8.7.2 No cumulative effects of land quality are expected during the construction of the Thames Tideway Tunnel project, since impacts are constrained to the footprint of the development by the measures incorporated in the *CoCP*.

8.8 Mitigation

8.8.1 The assessment presented above does not identify the need for mitigation during construction, over and above those measures set out in the *CoCP*. No further mitigation, enhancement or monitoring is required.

8.9 Residual effects assessment

Construction effects

8.9.1 As no mitigation measures are proposed, the residual construction effects remain as described in Section 8.5. All residual effects are presented in Section 8.10.

8.10 Assessment summary

Vol 10 Table 8.10.1 Land quality – summary of construction assessment

Receptor (sensitivity)	Effect	Significance of effect	Mitigation	Significance of residual effect
Construction workers – general above ground site staff (Low)	Health effects from exposure to contaminated soils/sediment, liquids, soil gases/ vapours	Negligible	None	Negligible
	Health effects from detonation of UXO	Negligible	None	Negligible
Construction workers – below ground site staff (High)	Health effects from exposure to contaminated soils/sediment, liquids, soil gases/ vapours	Minor adverse	None	Minor adverse*
	Health effects from detonation of UXO	Minor adverse	None	Minor adverse*
Adjacent land-users, workers in the adjacent light industrial or commercial land and Thames Path users (Low)	Health effects from exposure to wind-blown dust or vapours	Negligible	None	Negligible
	Health effects from detonation of UXO	Negligible	None	Negligible
Adjacent land-users, residential properties (High)	Health effects from exposure to wind-blown dust or vapours	Minor adverse	None	Minor adverse*
	Health effects from detonation of UXO	Minor adverse	None	Minor adverse*
Built environment - adjacent residential, commercial/light industrial buildings and river wall (Low)	Damage to structures from detonation of UXO	Negligible	None	Negligible

**Although the effect is minor adverse, it is considered unlikely that the effect would occur.*

References

[1] Defra. *National Policy Statement for Waste Water* (2012)

[2] Thames Tunnel, *Supplementary report on phase two consultation,* (2012). http://www.thamestunnelconsultation.co.uk/doclib/summary-report-on-phase-two-consultation/?came_from=413&came_from_cat=phase-two-report

[3] Environment Agency. *Model procedures for the management of land contamination: Contaminated Land Report 11* (2004).

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

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Volume 10: Carnwath Road Riverside site assessment

Section 9: Noise and vibration

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Thames Tideway Tunnel

Environmental Statement

Volume 10: Carnwath Road Riverside site assessment

Section 9: Noise and vibration

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9 Noise and vibration

9.1 Introduction

9.1.1 This section presents the findings of the assessment of the likely significant effects on noise and vibration at the Carnwath Road Riverside main site and highway works site.

9.1.2 The proposed development has the potential to affect noise and vibration levels at receptors due to:

a. construction site activities (noise and vibration)

b. construction traffic on haul road and local roads outside the site (noise)

c. tugs pulling river barges conveying materials to and from the site (noise)

d. operation of the proposed development (noise and vibration).

9.1.3 Each of these is considered within the assessment.

9.1.4 Carnwath Road Riverside is the reception site for the main tunnel drive from Kirtling Street, the launch site for the main tunnel drive to Acton Storm Tanks and the reception site for the Frogmore long connection tunnel.

9.1.5 Groundborne noise and vibration from the tunnelling activities associated with the main tunnel, long connection tunnels and certain short connection tunnels are considered in Volume 3 Project-wide effects assessment.

9.1.6 The assessment of noise and vibration presented in this section has considered the requirements of the National Policy Statement for Waste Water Section 4.9 (noise and vibration) (Defra, 2012)[1]. Further details of these requirements can be found in Volume 2 Environmental assessment methodology Section 9.3.

9.1.7 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Volume 10 Carnwath Road Riverside figures).

9.2 Proposed development relevant to noise and vibration

9.2.1 The proposed development is described in Section 3 of this volume. The elements of the proposed development relevant to noise and vibration are set out below.

Construction

Construction traffic

9.2.2 During construction excavated materials from the shaft and main tunnel would be exported from the site by barge. For the noise assessment it has been assumed that 90% of these materials would be taken by river. This allows for periods that the river is unavailable and material unsuitable for river. All other materials would be transported by road. Estimated barge and vehicle numbers are presented in Vol 10 Sections 3.3 and 12.2.

Construction activities

9.2.3 Vol 10 Section 3.3 sets out the assumed construction duration and programme for the Carnwath Road Riverside site.

9.2.4 The construction works at this location would involve the following activities that have the potential to affect noise and vibration levels in the vicinity of the site:

a. utility diversions

b. hoarding and site setup

c. demolition

d. piling

e. shaft construction

f. main tunnel drive

g. secondary lining

h. near surface structure works

i. landscaping and construction of above ground structures (including construction and fit-out of permanent facility).

9.2.5 Two options for barge loading and unloading have been assessed for this site: a campshed and a piled jetty structure. The campshed option is assessed first, and any changes to the assessment as a result of the jetty option are considered at the end of the noise and vibration construction assessment sections.

9.2.6 Further detail on the plant used in these construction stages is given in Vol 10 Appendix G.2.

9.2.7 Working hours have been subject to consultation with the local authority. As part of the *Code of Construction Practice (CoCP)* requirements, Section 61 consents would be agreed with the local authority to confirm methodologies. Construction activities would be carried out during the following periods, as identified in the *CoCP*:

a. standard hours (08.00-18.00 weekdays and 08.00-13.00 Saturdays) .

b. extended working hours (18.00-22.00 weekdays, 13.00-17.00 Saturdays) to complete large concrete pours. These are assumed to occur approximately once a month.

c. continuous working (24 hours a day, 7 days a week) would be required during the main tunnel drive for a period of approximately 22 months and main tunnel secondary lining for a period of approximately seven months.

Code of Construction Practice

9.2.8 The *CoCP* is provided in Vol 1 Appendix A. It contains general requirements (Part A), and site specific requirements for this site (Part B).

9.2.9 The *CoCP Part A* (Sections 4.3 and 6.4) specifies the use of best practicable means (BPM) to reduce noise and vibration effects. Generic measures include:

a. careful selection of construction plant, construction methods and programming

b. equipment would be suitably sited so as to minimise noise impact on sensitive receptors

c. use of site enclosures, and temporary stockpiles to provide acoustic screening

d. choice of routes and programming for the transportation of construction materials, excavated material and personnel to and from the site

e. careful programming so that activities which may generate significant noise would be planned with regard to local occupants and sensitive receptors.

f. hoarding would be of a height and extent to achieve appropriate noise attenuation.

9.2.10 Site specific measures have been incorporated into the *CoCP Part B* (Sections 4 and 6) to reduce noise and vibration effects at the Carnwath Road Riverside site. These comprise:

a. the construction area around the main shaft would be covered by an enclosure/building during the main tunnel construction and secondary lining works. The building would have cladding with a specified sound reduction value. The building openings would be designed to be away from sensitive noise receptors and would be kept closed when not in use at night. There would only be essential use of openings at night.

b. Enclosure of all static plant including pumps, concrete batching plant, grout plant, conveyors to load barges and storage/handling areas.

c. The movement of vehicles on the site outside standard hours would be restricted.

d. The western boundary of the site would have a 5m high hoarding/noise barrier and the eastern boundary of the site would have a 7.5m high hoarding/noise barrier. The site hoarding on the northern boundary would be 3.6m high. The barriers on the east/west end could be office /welfare facilities.

e. 2.4m hoarding/noise barrier on river wall to screen barge loading areas

f. The excavated material handling area would be screened by a three sided enclosure and roof (with suitable noise attenuation material) with the opening orientated towards the river

g. The western site access would not be routinely used in order to reduce noise effects on adjacent properties.

h. The barge loading area would be suitably located to consider the noise impacts on riverside properties on both the east and west of the site.

Operation

9.2.11 A building to house air management plant and equipment would be constructed. Two ventilation columns would be located separately (see Site works parameter plan - separate volume of figures – Section 1). The operational plant installed would have the potential to create noise impacts, and these are considered in the assessment.

9.2.12 During tunnel filling events, water would descend via a vortex structure through the drop shaft to the connection tunnel below. The potential for noise generated by this movement of water through the shaft has been assessed.

Environmental design measures

9.2.13 Carnwath Road Riverside is a main tunnel drive and reception, and long connection tunnel reception site. The operational plant associated with the surface structures would incorporate environmental design measures to control noise emission to the nearest sensitive receptors to acceptable noise limits. These limits are as defined by the local authority in which the receptor lies: at Carnwath Road Riverside, receptors within London Borough (LB) of Hammersmith and Fulham and receptors on the opposite bank within London Borough (LB) of Wandsworth (see paragraph 9.3.15 and 9.3.16). The environmental design measures have considered the following noise sources:

a. hydraulic plant for penstock operation (pumps, motors)

b. uninterruptable power supply (UPS) plant

c. odour control ventilation plant

d. other ventilation plant within the building to house air management plant and equipment.

9.2.14 The design of the drop shaft would control the descent of water by channelling the flow into a vortex around the internal face of the drop shaft, rather than allowing the water to free fall. The vortex design allows large volumes of water to descend with less noise generation than a falling cascade design.

9.2.15 Operational environmental design measures include:

a. duct attenuators for intake and exhaust ducts.

b. acoustic enclosure over both fans to ensure noise break-out from the building facade is minimised.

c. building ventilation to include attenuators on both internal and external side of the fans to minimise external noise emission.

9.3 Assessment methodology

Engagement

9.3.1 Volume 2 Environmental assessment methodology documents the overall engagement which has been undertaken in preparing the ES. Specific comments relevant to this site for the assessment of noise and vibration are presented here.

9.3.2 A response was not received from LB of Hammersmith and Fulham with regards to the survey methodology and monitoring locations, and limits for plant noise from the operation of the site and as such monitoring locations and operational limits for plant noise were determined according to the general methodology outlined in Volume 2 (see para 9.3.15).

9.3.3 The LB of Wandsworth was also consulted with regard to limits for plant noise from the operation of the site as it is located opposite the site across the River Thames.

9.3.4 Consultation responses relevant to this site for the assessment of noise and vibration are presented in Vol 10 Table 9.3.1. There were no other site specific comments from stakeholders in relation to noise and vibration raised at scoping or other consultation stages.

Vol 10 Table 9.3.1 Noise and vibration – consultation comments

Organisation	Comment	Response
London Borough of Hammersmith and Fulham, Phase 2 response, February 2011	Response contains reference to suitability of site and impacts on the local area	All potential noise and vibration effects from the construction and operation of the development as described in Section 3 have been assessed and considered. Where significant adverse effects have been identified, all measures to mitigate the impact from noise and vibration on the local area have been considered, and where reasonably practicable, these would be implemented.

Baseline

9.3.5 The baseline methodology follows the methodology provided in Volume 2. There are no site specific variations for this site.

Construction

9.3.6 The assessment methodology for the construction phase follows that described in Volume 2. There are no site specific variations for undertaking the construction assessment of this site.

9.3.7 Section 9.5 details the likely significant effects arising from the construction at Carnwath Road Riverside. There are no other Thames Tideway Tunnel sites which could give rise to additional effects on noise and vibration within the assessment area for this site, therefore no other Thames Tideway Tunnel sites are considered in this assessment.

9.3.8 The construction noise and vibration assessment has considered the effects across the whole duration of the construction phase and the worst-case levels are reported at each receptor. The development case (with the Thames Tideway Tunnel project) has been assessed against the base case (without the Thames Tideway Tunnel project).

9.3.9 All the schemes outlined in the development schedule (Vol 10 Appendix N) are either further from the works than existing receptors considered in this assessment, or outside of the 300m assessment area and therefore no additional base case receptors have been identified for this assessment.

9.3.10 Of the schemes outlined in the development schedule (Vol 10 Appendix N) Wandsworth Riverside Quarter (buildings 6A and 6B) is considered relevant to the construction cumulative assessment as it is assumed to be under construction during the construction of the Thames Tideway Tunnel. The other schemes are either assumed to be complete and operational by Site Year 1 of construction or are outside of the 300m assessment area.

9.3.11 Traffic flows on construction traffic routes have been examined to determine if there are any routes where there is the potential for traffic noise changes of 1dB(A) or more. This is according to the flow, speed or composition change criteria specified in Volume 2. The results show that there are no traffic changes on the road network associated with this site which meet the relevant criteria. This is discussed further in the assessment section from para. 9.5.55.

9.3.12 The assessment of construction effects also considers the extent to which the effects on noise and vibration would be likely to be materially different should the programme for the Thames Tideway Tunnel project be delayed by approximately one year.

Construction assessment area

9.3.13 As described in Volume 2 the assessment area considers unscreened receptors up to a maximum of 300m from the site boundary based on professional judgement of the likelihood of significant effects. The assessment primarily concentrates on those receptors closest to the site which would generally be most affected, rather than those further away which would be well screened by intervening buildings. Effects at more distant receptors beyond those closest to the site have been considered where necessary by reference to the impacts determined at the primary (closest) receptors.

Operation

9.3.14 The operational phase assessment methodology follows the methodology provided in Volume 2. Site specific variations to this methodology are set out below.

9.3.15 A response has not been received from LB of Hammersmith and Fulham specifying their requirements for the control of noise from fixed plant noise sources to residential receptors. Volume 2 refers to a proposed approach where guidance has not been provided by the local authority. This approach is that noise emissions from this type of source are designed to meet a rating level (as defined in BS4142[2]) which is 5dB below the typical background noise level over the operational period of the plant at 1m from the facade of the nearest residential receptor. This approach has therefore been adopted for residential receptors within LB of Hammersmith and Fulham.

9.3.16 LB of Wandsworth located opposite the site across the River Thames requires that noise emissions from this type of source are designed to meet a rating level (as defined in BS4142) which is 10dB(A) below the typical background noise level over the operational period of the plant at 1m from the facade of the nearest residential receptor.

9.3.17 The operational assessment year is taken to be Year 1 of operation.

9.3.18 Section 9.6 details the likely significant effects arising from the operation of the Carnwath Road Riverside site. There are no other Thames Tideway Tunnel sites which could give rise to additional effects on noise and vibration within the assessment area for this site, therefore no other Thames Tideway Tunnel sites are considered in this assessment.

9.3.19 All the schemes outlined in the development schedule (Vol 10 Appendix N) are further from the works than the existing receptors considered in this assessment and therefore no additional base case receptors have been considered.

9.3.20 There are no schemes identified in Vol 10 Appendix N that are considered relevant for the operational cumulative assessment, because due to their use, none are expected to generate significant noise or vibration levels during their operation.

9.3.21 Based on the traffic flow, speed or composition change criteria specified in Volume 2, there are no routes where potential for operational traffic noise effects would occur.

9.3.22 The assessment of operational effects also considers the extent to which the effects on noise and vibration would be likely to be materially different should the programme for the Thames Tideway Tunnel project be delayed by approximately one year.

Operational assessment area

9.3.23 Operational effects are considered up to 300m from the site boundary, although the focus is on those receptors closest.

Assumptions and limitations

9.3.24 The generic assumptions and limitations associated with this assessment are presented in Volume 2. The site specific assumptions and limitations are presented in the following section.

Assumptions

9.3.25 The working hours assumed for the assessment are as described in para. 9.2.7

9.3.26 The operational noise assessment is based on $10m^3/s$ centrifugal ventilation fans being housed within a purpose built air management plant building and includes all aspects of noise generation such as plant noise and wind noise through ducts and vent columns. The noise emission predictions have been based on data for typical plant at the appropriate operating settings. FläktWood's HCGB 080 centrifugal fans at a pressure drop of 1170Pa and a speed of 1500rpm have been typically applied.

Limitations

9.3.27 A response has not been received from LB of Hammersmith and Fulham with regards to noise monitoring locations and the borough's limits for noise from operational plant. As discussed in para. 9.3.15 a general methodology for selecting monitoring locations and determining limits for operational noise (set out in Volume 2) has been applied and as such the assessment is considered robust.

9.4 Baseline conditions

9.4.1 The following section sets out the baseline conditions for noise and vibration within and around the site. Future baseline conditions (base case) are also described.

Current baseline

9.4.2 The current baseline noise conditions are as described in the baseline survey. The specific details of this survey, such as the measurement times, locations measured, results and local conditions are described in Vol 10 Appendix G.1. Vol 10 Table 9.4.1 below shows that the noise levels for the daytime, evening and night periods are heavily influenced by traffic noise from Carnwath Road and other roads in the vicinity.

Receptors

9.4.3 This section describes the setting and receptor characteristics of the site for the purposes of this assessment.

9.4.4 The closest noise and vibration sensitive receptors selected for the noise and vibration assessment are identified in Vol 10 Table 9.4.1 (and shown in plan view in Vol 10 Figure 9.4.1 – see separate Volume 10 Figures document). These were selected as they are considered representative of the range of noise climates where sensitive receivers are situated around the site. The approximate number of residential properties affected at each location (where known) is indicated in Vol 10 Table 9.4.2.

9.4.5 The nearest residences to the site are on Carnwath Road, the Piper Building, Philpot Square and Dymock Street, all located within LB of Hammersmith and Fulham. On the southern bank of the River Thames is the Riverside Quarter residential development located in LB of Wandsworth.

9.4.6 The only non-residential noise sensitive receptor selected for assessment is the offices at 50 Carnwath Road.

9.4.7 Beyond these closest receptors there are other residential properties which are screened from the site by intervening buildings, or are located further from the site than the buildings included in the assessment. These properties include 103-107 Carnwath Road, 137-143 Carnwath Road, John Dwight House and other residences on Hurlingham Square and Dymock Street, and have been considered as secondary receptors to the closest receptors.

Receptor sensitivity

9.4.8 The sensitivities of noise and vibration receptors have been determined using the methodology outlined in Vol 2 Section 9.4. The sensitivities of all assessed receptors are presented in Vol 10 Table 9.4.1 along with the measured average ambient noise levels at each corresponding survey location.

Vol 10 Table 9.4.1 Noise and vibration- sensitive receptors and noise levels

Ref	Receptor addresses	Sensitivity	Local authority	Measured average ambient noise level, day/ evening/ night, dBL_{Aeq*}	Noise survey location
CR1	89-101 Carnwath Road (Residential)	High	LB of Hammersmith and Fulham	61/58/40	CRR01
CR2	81-87 Carnwath Road (Residential)	High	LB of Hammersmith and Fulham	61/58/40	CRR02
CR3	50 Carnwath Road (Offices)	Medium	LB of Hammersmith and Fulham	69/66/48	CRR01
CR4	The Piper Building (Residential)	High	LB of Hammersmith and Fulham	69/66/48	CRR01
CR5	16-25 Philpot Square (Residential)	High	LB of Hammersmith and Fulham	69/56/55	CRR03
CR6	26-41 Philpot Square	High	LB of Hammersmith	69/56/55	CRR03

Ref	Receptor addresses	Sensitivity	Local authority	Measured average ambient noise level, day/ evening/ night, dBL_{Aeq*}	Noise survey location
	(Residential)		and Fulham		
CR7	1b Dymock Street (Residential)	High	LB of Hammersmith and Fulham	69/56/55	CRR03
CR8	5 Carnwath Road (Residential)	High	LB of Hammersmith and Fulham	60/53/41	CRR04
CR9	Riverside Quarter (Residential)	High	LB of Wandsworth	60/53/41	CRR04

** Noise level includes correction for façade acoustic reflection unless receptor position is an open outdoor space (eg park)*

9.4.9 The baseline noise level is considered representative of the relevant receptors. Consideration has been given to the distance of the measurement location to the receptor, the orientation of the primarily affected façade and location of the controlling noise source(s).

9.4.10 The criteria for determining the significance of noise effects at residences from construction sources are partly dependent upon the existing ambient noise levels. From the ambient noise levels measured during the baseline survey, the assessment category and assessment noise threshold levels for the residential receptors near the Carnwath Road Riverside site are as shown in Vol 10 Table 9.4.2. As described in the assessment methodology, this follows the method as defined in Vol 2 Table 8.5.1.

9.4.11 The assessment of significance at non-residential receptors is made according to the construction noise level relative to the ambient noise level (see Vol 10 Table 9.5.2) using the impact criteria described in Vol 2 Section 9.5 (where appropriate) and other factors described in Volume 2.

Vol 10 Table 9.4.2 Noise – residential receptors and assessment categories

Ref	Noise sensitive receptor* (No. of dwellings)	Ambient noise level, rounded to nearest $5dBL_{Aeq}$* day/ evening/ night	Assessment category* day/ evening/ night	Impact criterion threshold level*, day, $dBL_{Aeq\ 10hour}$/ evening $dBL_{Aeq\ 1hour}$/ night, $dBL_{Aeq\ 1hour}$

Ref	Noise sensitive receptor* (No. of dwellings)	Ambient noise level, rounded to nearest 5dBL$_{Aeq}$* day/ evening/ night	Assessment category* day/ evening/ night	Impact criterion threshold level*, day, dBL$_{Aeq\ 10hour}$/ evening dBL$_{Aeq\ 1hour}$/ night, dBL$_{Aeq\ 1hour}$
CR1	89-101 Carnwath Road (7)	60/60/40	A/C/A	65/65/45
CR2	81-87 Carnwath Road (4)	60/60/40	A/C/A	65/65/45
CR4	The Piper Building (50)	70/65/50	C/C**C	75/66/55
CR5	16-25 Philpot Square (10)	70/55/55	C/B/C	75/60/55
CR6	26-41 Philpot Square (16)	70/55/55	C/B/C	75/60/55
CR7	1b Dymock Street (5)	70/55/55	C/B/C	75/60/55
CR8	5 Carnwath Road (4)	60/55/40	A/B/A	65/60/45
CR9	Riverside Quarter (35)	60/55/40	A/B/A	65/60/45

* *From 'ABC' method – BS5228:2009*2

** *Where the ambient noise level is greater than category C levels the ambient noise level shall be used as the significance criterion threshold.*

Construction base case

9.4.12 The construction base case taking into account the schemes described in Section 9.3 would not change as there are no additional sensitive receptors of relevance to the assessment (see para. 9.3.9).

9.4.13 The noise levels, as measured during the baseline noise survey in 2011, are assumed for the base case. However, there is the potential for variations to occur in the ambient noise levels between 2011 and the base case year. If the noise levels were to vary, it is likely that they would increase compared to the measured data from 2011 (due to natural traffic growth). The estimated traffic increases for the construction base case in Site Year 1 are such that noise levels would be expected to increase by less than 1dB(A) from those measured in 2011. The assessment based on data from 2011 therefore presents a worst-case assessment.

9.4.14 It is considered that there are no other circumstances at this location that would cause the baseline noise levels at the receptor locations to change significantly between 2011 and the first year of construction.

9.4.15 No existing or future major vibration sources have been identified and therefore it is considered that vibration levels are unlikely to change between the present time and the base case.

Operational base case

9.4.16 The operational base case in Year 1 of operation taking into account the schemes described in Section 9.3 would not change since the sensitive receptors indicated have already been included in this assessment.

9.4.17 The operational base case has been estimated from traffic flow expectations for the Year 1 of the operational phase as a result of natural growth and new development in the vicinity. The estimated traffic increases for the operational base case in Year 1 of operation are such that noise levels would be expected to increase by less than 1dB(A) from those measured in 2011.

9.5 Construction effects assessment

Noise

9.5.1 The results of the assessment of construction noise are presented in Vol 10 Table 9.5.1 and Vol 10 Table 9.5.2. The tables show the range of predicted construction noise levels during the entire period of the works and a typical monthly construction noise level. The typical monthly level is the most frequently occurring monthly noise level during the works. The tables also show the total number of months across all construction stages that the noise level would be likely to exceed the impact criterion threshold level indicating potential significance. The final columns in the tables show the worst-case excess above the impact criterion together with the duration of the worst-case noise level. In cases when the impact criterion is exceeded (as marked by an asterisk in Vol 10 Table 9.5.1), further assessment of the likely noise ingress to the interior of the building has been carried out to more precisely estimate the resulting noise impact on the occupants. The noise ingress would depend on the degree of façade noise insulation of the particular buildings which is considered in further detail in these cases.

9.5.2 To illustrate the predicted variation in construction noise levels at each receptor position across the duration of the construction phase, Plates G.6 to G.14 in Vol 10 Appendix G.1 show the variation in noise levels at each receptor position across the approximate six year total duration of the construction phase. The appendix also lists the construction plant and operations assumed for the calculations. The predicted impacts at each representative receptor location are described below.

Impacts at residential receptors

9.5.3 The results for residential receptors are shown below.

Vol 10 Table 9.5.1 Noise – impacts at residential receptors (high sensitivity)

Ref/ receptor[a] (No. of noise sensitive properties)	ABC impact criterion threshold level (potential significance for residential), dBL_{Aeq}[b]	Range of construction noise levels, dBL_{Aeq}[c,d]	Typical[e] monthly construction noise levels, dBL_{Aeq}	Magnitude		
				Total duration above criterion for all works, months	Worst-case excess above criterion, dBL_{Aeq}[f] (*further assessment undertaken for excess above criterion)	Duration of worst-case excess above criterion, months
CR1 89-101 Carnwath Road (7)	65	48 – 69 (day)	57	2	+4*	1
	65	45 – 62 (eve)	54	0	-3	0
	45	37 – 44 (night)	44	0	-1	0
CR2 81-87 Carnwath Road (4)	65	47 – 63 (day)	55	0	-2	0
	65	44 – 61 (eve)	53	0	-4	0
	45	36 – 43 (night)	43	0	-2	0
CR4 The Piper Building (50)	75	64 – 71 (day)	67	0	-4	0
	66	54 – 61 (eve)	61	0	-5	0
	55	49 – 54 (night)	54	0	-1	0
CR5 16-25 Philpot Square (10)	75	59 – 69 (day)	67	0	-6	0
	60	55 – 60 (eve)	60	0	0	0
	55	45 – 54 (night)	54	0	-1	0
CR6 26-41 Philpot Square (16)	75	57 – 71 (day)	65	0	-4	0
	60	53 – 60 (eve)	60	0	0	0
	55	43 – 52 (night)	52	0	-3	0
CR7 1b Dymock Street (5)	75	48 – 60 (day)	53	0	-15	0
	60	42 – 51 (eve)	51	0	-9	0
	55	32 – 41 (night)	41	0	-14	0
CR8 5 Carnwath Road (4)	65	54 – 75 (day)	60	1	+10*	1
	60	47 – 58 (eve)	58	0	-2	0
	45	37 – 44 (night)	44	0	-1	0
CR9 Riverside Quarter (35)	65	45 – 61 (day)	55	0	-4	0
	60	46 – 53 (eve)	53	0	-7	0
	45	36 – 45	45	0	0	0

Ref/ receptor[a] (No. of noise sensitive properties)	ABC impact criterion threshold level (potential significance for residential), dBL_{Aeq}[b]	Range of construction noise levels, dBL_{Aeq}[c,d]	Typical[e] monthly construction noise levels, dBL_{Aeq}	Magnitude		
				Total duration above criterion for <u>all</u> works, months	Worst-case excess above criterion, dBL_{Aeq}[f] (*further assessment undertaken for excess above criterion)	Duration of worst-case excess above criterion, months
		(night)				

[a] *Floors subject to highest noise level assessed – not necessarily the highest floor level*

[b] *The potential significance threshold is based on the ambient noise level as defined in Volume 2*

[c] *Construction noise only, excludes ambient noise. Refer to Volume 2 Section 9.5*

[d] *Noise level includes correction for façade acoustic reflection*

[e] *Most frequently occurring monthly construction noise level during works*

[f] *Positive value indicates exceedance, negative value indicates noise below criterion*

89-101 Carnwath Road (CR1)

9.5.4 The residential properties at 89-101 Carnwath Road are four storey residential buildings. The properties are located at a distance of 5m from the site boundary and would be screened from the majority of activities by the site hoardings. The predicted noise levels at these dwellings due to construction activities are shown in Vol 10 Table 9.5.1.

9.5.5 The typical daytime noise level (most frequently occurring monthly level) is $57dBL_{Aeq}$. The activity expected to cause the worst-case noise level of $69dBL_{Aeq}$ would be the site establishment works.

9.5.6 During the evening and night time, the construction of the main tunnel is expected to cause the worst-case noise levels of $62dBL_{Aeq}$ and $44dBL_{Aeq}$ respectively.

9.5.7 The construction noise levels are estimated to exceed the potential significance criteria for a residential receptor during the day for one month only. During that period, the noise levels would vary from day to day, as the activities on site would be varied and at a number of locations.

9.5.8 As a potentially significant daytime noise effect has been identified using the ABC criterion, noise levels within the rooms most exposed to the construction works have been estimated. This has been based on conservative assumptions regarding the noise transmission through the façade with the windows closed. The approach to estimating internal noise levels is described in the methodology in Volume 2. Thermal double glazing has been assumed for this receptor (based on the age of the property and external observations) and takes into account the glazed area of the façade and a typical reverberant characteristic for a domestic room.

9.5.9 The worst-case internal noise level during the day is estimated to be 32dBL_{Aeq} for one month with windows closed or approximately 51BL_{Aeq} if windows were opened on the most exposed facade. The noise level is below the BS 8233 internal guidance noise level[3] of 40dBL_{Aeq}, with windows closed, and the noise levels would not be excessive for speech communication if windows were partially open, this is assessed **not significant**.

9.5.10 To the west of these properties lie other residences at 103-107 Carnwath Road. These are similar in height or smaller than 89-101 Carnwath Road. The screening provided by these intermediate buildings and the additional distance from the site is sufficient to reduce the noise levels experienced at these properties to well below the potential significance criterion, and as such the effect at these properties is **not significant**.

81-87 Carnwath Road (CR2)

9.5.11 The residential properties at 81-87 Carnwath Road are two storey residential buildings. The properties are located at a distance of 15m from the site boundary and would be screened from the majority of activities by the site hoardings. The predicted noise levels at these dwellings due to construction activities are shown in Vol 10 Table 9.5.1.

9.5.12 The typical daytime noise level (most frequently occurring monthly level) is 55dBL_{Aeq}.The activity expected to cause the worst-case noise level of 63dBL_{Aeq} would be the site establishment works.

9.5.13 During the evening and night time, the construction of the main tunnel is expected to cause the worst-case noise levels of 61dBL_{Aeq} and 43dBL_{Aeq} respectively.

9.5.14 The construction noise levels are not estimated to exceed the potential significance criteria for a residential receptor. The effect is therefore **not significant**.

9.5.15 To the west of these properties there are other residences (137-143 Carnwath Road). These are similar in height to 81-87 Carnwath Road. The screening provided by these intermediate buildings and the additional distance from the site is sufficient to reduce the noise levels experienced at these properties to well below the potential significance criterion, and as such the effect at these properties is **not significant**.

The Piper Building (CR4)

9.5.16 The Piper Building is a six storey residential building. At its closest point the property is located at a distance of 15m from the site boundary and would be partially screened from the majority of activities by the site hoardings, the building orientation and other structures. The building also has a section which is further away from the site boundary, but would directly overlook the works. Consideration has been given to the impact to each of these receptors. The predicted noise levels at these dwellings due to construction activities are shown in Vol 10 Table 9.5.1.

9.5.17 The typical daytime noise level (most frequently occurring monthly level) is 67dBL_{Aeq}. The activity expected to cause the worst-case noise level of 71dBL_{Aeq} would be the site establishment works.

9.5.18 During the evening and night-time, the construction of the main tunnel is expected to cause the worst-case noise levels of 61dBL_{Aeq} and 54dBL_{Aeq} respectively.

9.5.19 The construction noise levels are not estimated to exceed the potential significance criteria for a residential receptor. The effect is therefore **not significant**.

9.5.20 To the west of the Piper Building are single storey light industrial units and offices (at 74-82 Carnwath Road). These lie further from the development than the Piper building and are less sensitive to noise. The effect on these buildings would therefore be not significant.

9.5.21 To the north of the Piper Building are residences on Hurlingham Square, however these are also much further from the site than the Piper Building, and the effect on these properties would also be **not significant**.

16-25 Philpot Square (CR5)

9.5.22 16-25 Philpot Square is a five storey residential building. At is closest point the property is located at a distance of 30m from the site boundary and the upper floors would be partially screened from the majority of activities by the site hoardings. The predicted noise levels at these dwellings due to construction activities are shown in Vol 10 Table 9.5.1.

9.5.23 The typical daytime noise level (most frequently occurring monthly level) is 67dBL_{Aeq}. The activity expected to cause the worst-case noise level of 69dBL_{Aeq} would be the site establishment works.

9.5.24 During the evening and night time, the construction of the main tunnel is expected to cause the worst-case noise levels of 60dBL_{Aeq} and 54dBL_{Aeq} respectively.

9.5.25 The construction noise levels are not estimated to exceed the potential significance criteria for a residential receptor. The effect is therefore **not significant**.

9.5.26 North of 16-25 Philpot Square there are other residential buildings of a similar height. These lie further from the development and would be screened by the Piper Building and other properties on Peterborough Road. Therefore the effect at these properties is **not significant**.

26-41 Philpot Square (CR6)

9.5.27 26-41 Philpot Square is a five storey residential building. At is closest point the property is located at a distance of 25m from the site boundary and the upper floors would be partially screened from the majority of activities by the site hoardings. The predicted noise levels at these dwellings due to construction activities are shown in Vol 10 Table 9.5.1.

9.5.28 The typical daytime noise level (most frequently occurring monthly level) is 65dBL_{Aeq}. The activity expected to cause the worst-case noise level of 71dBL_{Aeq} would be the site establishment works.

9.5.29 During the evening and night time, the construction of the main tunnel is expected to cause the worst-case noise levels of 60dBL_{Aeq} and 52dBL_{Aeq} respectively.

9.5.30 The construction noise levels are not estimated to exceed the potential significance criteria for a residential receptor. The effect is therefore **not significant**.

9.5.31 The effects at the nearest properties to this address are considered in paragraph 9.5.26. There are no other residential properties in the vicinity close enough to be subject to significant adverse effects.

1b Dymock Street (CR7)

9.5.32 The residences on Dymock Street are two storey residential buildings. At its closest point the properties are located at a distance of 30m from the site boundary and all floors would be fully screened from the site activities by the site hoardings and on-site mitigation. The predicted noise levels at these dwellings due to construction activities are shown in Vol 10 Table 9.5.1.

9.5.33 The typical daytime noise level (most frequently occurring monthly level) is 53dBL_{Aeq}. The activity expected to cause the worst-case noise level of 60dBL_{Aeq} would be the site establishment works.

9.5.34 During the evening and night time, the construction of the main tunnel is expected to cause the worst-case noise levels of 51dBL_{Aeq} and 41dBL_{Aeq} respectively.

9.5.35 The construction noise levels are not estimated to exceed the potential significance criteria for a residential receptor. The effect is therefore **not significant**.

9.5.36 East of Dymock Street is John Dwight House, other residences on Dymock Street and the Hurlingham public house. These are further away from the development and would be screened by intervening buildings, and so the effect at these properties from the main construction works is also **not significant**.

9.5.37 These same properties would also be near to the highway works site. The noise levels from the activities at this site (tree removal, utilities diversions and kerb realignment) are predicted to be well below the significance criterion for these receptors, and hence assessed as **not significant**.

5 Carnwath Road (CR8)

9.5.38 The residential property at 5 Carnwath Road is a four storey residential building. The property is located at a distance of less than 5m from the site boundary and would be at least partially screened from the majority of activities by the 5m site hoardings on this side. The predicted noise levels at these dwellings due to construction activities are shown in Vol 10 Table 9.5.1.

9.5.39 The typical daytime noise level (most frequently occurring monthly level) is 60dBL_{Aeq}. The activity expected to cause the worst-case noise level of 75dBL_{Aeq} would be the site establishment works.

9.5.40 During the evening and night time, the construction of the main tunnel is expected to cause the worst-case noise levels of 58dBL_{Aeq} and 44dBL_{Aeq} respectively.

9.5.41 The construction noise levels are estimated to exceed the potential significance criteria for a residential receptor during the day for one month only. During that period, the noise levels would vary from day to day, as the activities on site would be varied and at a number of locations.

9.5.42 As a potentially significant daytime noise effect has been identified using the ABC criterion, noise levels within the rooms most exposed to the construction works have been estimated. This has been based on conservative assumptions regarding the noise transmission through the façade with the windows closed. The approach to estimating internal noise levels is described in the methodology in Volume 2. Thermal double glazing has been assumed for this receptor (based on the age of the property and external observations) and takes into account the glazed area of the façade and a typical reverberant characteristic for a domestic room.

9.5.43 The worst-case internal noise level during the day is estimated to be 38dBL_{Aeq} for one month with windows closed or approximately 57BL_{Aeq} if windows were opened on the most exposed facade. The noise level is below the BS 8233 internal guidance noise level3 of 40dBL_{Aeq}, with windows closed, and the noise levels would not be excessive for speech communication if windows were partially open, this is assessed as **not significant**.

9.5.44 There are no other residential properties in the vicinity close enough to be subject to significant adverse effects which have not already been considered.

Riverside Quarter (CR9)

9.5.45 The Riverside Quarter buildings are seven storey residential blocks, on the south side of the river Thames. The property is located at a distance of 280m from the site boundary and would be screened from the majority of activities by the site hoardings. The predicted noise levels at these dwellings due to construction activities are shown in Vol 10 Table 9.5.1.

9.5.46 The typical daytime noise level (most frequently occurring monthly level) is 55dBL_{Aeq}. The activity expected to cause the worst-case noise level of 61dBL_{Aeq} would be the site establishment works.

9.5.47 During the evening and night-time, the construction of the main tunnel is expected to cause the worst-case noise levels of 53dBL_{Aeq} and 45dBL_{Aeq} respectively.

9.5.48 The construction noise levels are not estimated to exceed the potential significance criteria for a residential receptor during the day, evening or night time. The effect is therefore **not significant**.

9.5.49 Riverside Quarter is comprised of a number of residential blocks, and adjacent to these are light industrial and commercial areas which are less sensitive to noise impacts and the effect to these is also **not significant**.

Impacts at non-residential receptors

9.5.50 The results for non-residential receptors are shown below.

Vol 10 Table 9.5.2 Noise – impacts at non-residential receptors

Ref / receptor	Receptor sensitivity[a]	Range of construction noise levels, dBL_{Aeq}[b,c,d]	Ambient baseline noise level, dBL_{Aeq}[d]	Typical[e] monthly construction noise levels, dBL_{Aeq}	Magnitude	
					Total duration above ambient for all works, months	Worst-case excess above ambient, dBL_{Aeq}
CR3/ 50 Carnwath Road	Medium	61 – 74	69 (day)	68	1	+5

[a] *Assumed typical façade transmission loss and appropriate internal noise guidelines*

[b] *Floors subject to highest level assessed – not necessarily the highest floor level*

[c] *Construction noise only, excludes ambient noise. Refer to Volume 2*

[d] *Noise level includes correction for façade acoustic reflection unless receptor position is an open outdoor space (eg park)*

[e] *Most frequently occurring monthly construction noise level during works*

50 Carnwath Road (CR3)

9.5.51 The offices/studios at 50 Carnwath Road are located 15m from the site boundary. The prediction has been made at the upper floor of the offices building.

9.5.52 The typical daytime noise level (most frequently occurring monthly level) is 68dB(A). The worst-case daytime noise level shown in Vol 10 Table 9.5.2 would occur during the site set up for approximately one month.

9.5.53 The worst-case noise level of 74dBL_{Aeq} during the daytime is greater than the current ambient noise level for the respective period. Although the noise level would increase relative to the ambient noise level and this could be noticeable inside the building, the increase in average noise levels inside the building is not expected to exceed guideline noise levels for open plan office use based on typical noise insulation designed for a façade of this type.

9.5.54 This is therefore assessed as **not significant**.

Road-based construction traffic

9.5.55 The location of the site provides direct access to the major road network through London via Carnwath Road. The construction programme would result in varying traffic generation over a period of six years. During the peak construction period the traffic generation on Carnwath Road, the link adjacent to the site is forecast to average 45 HGVs (equivalent to 90 HGV movements) per day.

9.5.56 The major road links adjacent to and leading to the site are Wandsworth Bridge Road, Carnwath Road and Trinity Road. Vehicles would not use local roads, such as Townmead Road to access the site (see Section 12.2).

9.5.57 A flow change of about 25% is required to cause a change in noise level of 1dB and by 100% to cause a change of 3dB, which is considered to be the minimum change perceptible to the human ear. A change in heavy vehicles composition (HGV) of 3% is also considered to cause a change in noise level of approximately 1dB.

9.5.58 The traffic modelling shows that the 18hr Annual Average Weekday Traffic (AAWT) flow on the link adjacent to the site, Carnwath Road, is currently just under 14,000 vehicles per day (vpd), with average speeds of 15 mph (24 kph) and 4.8 % HGVs. The total number of HGVs is therefore currently 671 per day.

9.5.59 The section of Wandsworth Bridge Road to the south of Carnwath Road currently has the highest 18hr AAWT flow of the sections assessed, with just less than 41,000 vpd and 13% HGVs. The 18hr AAWT flows on other roads are varied, with a relatively similar flow of approximately 35,000 vpd on Trinity Street but significantly lower flows observed on other links, ranging from just below 14,000 vpd to above 26,000 vpd. The HGV percentage on other links is also varied, ranging from 3.3% to 9.9%.

9.5.60 The modelling of construction traffic on these links shows that the highest percentage increase in total flow due to construction traffic would occur on Trinity Road. The average daily number of construction HGV movements on this link during the peak month of construction is 90 and the daily number of worker cars and office/operational light vehicles is 172. The number of cars and light vehicles is forecast to be consistent across the construction period. This represents a percentage increase in flow of 0.7%.

9.5.61 Additionally, the modelling of the construction traffic on these links shows that the highest increase in HGV composition would occur on Carnwath Road. The average daily number of construction HGV movements on this link during the peak month of construction is 90, which, taking into account of the number of worker cars and office/operational light vehicles. This represents an increase in HGV composition of less than 0.6%

9.5.62 Therefore, the percentage flow change and change in HGV percentage do not meet the criteria for causing even a 1dB change in noise level. The additional numbers of HGVs would cause only negligible change to the traffic noise levels and the effects are assessed as **not significant**.

River-based construction traffic

9.5.63 The use of barges for the transport of materials to and from the site could result in noise impacts at nearby receptors.

9.5.64 The movement of these barges would be at appropriate stages in the tide. In between times the moored barges would be unloaded or loaded. Noise measurements for such activity have been reported in other studies[4]. The engine noise from tugs moving barges, on the tidal River Thames is limited to 75dB(A) at 25m[5].

9.5.65 Tugs would be used, operating twice a day with the tide. The average peak daily construction barge movements would be four barges per day.

Each movement (delivery and removal) would be around 25 minutes, totalling 100 minutes over two periods in one day.

9.5.66 The operation, loading and removal of the river barges which takes place within the site boundary has been considered in the construction noise assessment in paras. 9.5.1 to 9.5.54 above.

9.5.67 The operation of the tugs on the river outside of the site boundary has been assessed in relation to the nearest residential receptors, 5 Carnwath Road to the east and 89-101 Carnwath Road to the west.

9.5.68 At 5 Carnwath Road the tugs would operate at a minimum distance of 45m. At this distance the predicted noise from this activity during the day/evening (7am until 11pm) would be 54dBL_{Aeq} and 53dB L_{Aeq} during the night time (11pm to 7am) at the dwelling. The survey indicates the noise levels at this location are 60dBL_{Aeq} during the day/evening and 56dBL_{Aeq} during the night time as indicated in Vol 10 Appendix G Table G.9. Both in the daytime and at night time the river traffic noise level is less than the ambient levels. It is assessed that noise from river based construction traffic is **not significant** at this receptor.

9.5.69 At 89-101 Carnwath Road the tugs would operate at a minimum distance of 45m. At this distance the predicted noise from this activity during the daytime (7am until 11pm) would be 52dBL_{Aeq} and 50dBL_{Aeq} during the night time (11pm to 7am) at the dwelling. The survey indicates the noise levels at this location are 52dBL_{Aeq} during the day/evening and 49dB$L_{Aeq,15mins}$ during the night-time (see Vol 10 Appendix G Table G.9). At both daytime and night-time the river traffic noise level is greater than the ambient level. River traffic currently operates on a 24 hour basis. It is concluded that noise from river based construction traffic is **significant** at this receptor.

Jetty option assessment

9.5.70 The use and construction of a jetty has been assessed as an alternative option to the use of a campshed for the loading and unloading of barges. Although the piling to construct the jetty would occur over a substantial period (approximately three months), this option requires less extensive river wall works than proposed for the construction of a campshed.

9.5.71 The assessment of this option considers the activities associated with the jetty works and the reduced river wall works required if a jetty option were adopted. The relative distances of the different type of works from the receptors is also considered. The prediction results indicate that the magnitude and duration of noise impacts to all receptors would be the same, if not very slightly less (within 1dB) than for the campshed option.

9.5.72 As such the effects of the jetty option are as presented above.

Vibration

9.5.73 The assessment of construction vibration considers events which have the potential to cause human disturbance, or damage to buildings and structures. The assessments of human disturbance and effects on building structures are carried out separately using different parameters.

9.5.74 The assessment has been conducted using the methodology defined in Volume 2.

9.5.75 The assessment of human disturbance due to construction vibration impacts at neighbouring receptors has been assessed using the predicted estimated Vibration Dose Value (eVDV). The results from the assessment are presented in Vol 10 Table 9.5.3.

Vol 10 Table 9.5.3 Vibration – impact and magnitude of human response to vibration impacts

Ref	Receptor	Impact (highest predicted eVDV across all activities, $m/s^{1.75}$)*	Value/ sensitivity	Magnitude
CR1	89-101 Carnwath Road	0.2	High	Low probability of adverse comment - No impact
CR2	81-87 Carnwath Road	0.2	High	Low probability of adverse comment -No impact
CR3	50 Carnwath Road	0.2	Medium	Low probability of adverse comment -No impact
CR4	The Piper Building	0.2	High	Low probability of adverse comment -No impact
CR5	16-25 Philpot Square	0.2	High	Low probability of adverse comment -No impact
CR6	26-41 Philpot Square	0.2	High	Low probability of adverse comment -No impact
CR7	1b Dymock Street	0.1	High	Below Low probability of adverse comment -No Impact
CR8	5 Carnwath Road	0.4	High	Low probability of adverse

Ref	Receptor	Impact (highest predicted eVDV across all activities, $m/s^{1.75}$)*	Value/ sensitivity	Magnitude
				comment -No impact
CR9	Riverside Quarter	<0.1	High	Below Low probability of adverse comment -No impact

*Most affected floor

9.5.76 The predicted eVDV levels at all receptors fall within or below the 'Low probability of adverse comment' band, as described in Vol 2 Section 2 and therefore effects are **not significant**. These predicted levels are based upon the highest anticipated exposures during the most intense vibration activities within the site.

9.5.77 The assessment of potential construction vibration effects at adjacent buildings / structures has been assessed using the predicted Peak Particle Velocity (PPV), according to the criteria given in Volume 2. The results of the assessment of construction vibration are presented in Vol 10 Table 9.5.4.

9.5.78 The highest levels of vibration are associated with the vibratory piling required to start the shaft construction which would take less than one week to complete and other vibratory compaction across the site.

Vol 10 Table 9.5.4 Vibration - building vibration impacts and their magnitudes

Ref	Receptor	Impact (highest predicted PPV across all activities, mm/s)	Value/ sensitivity	Magnitude
CR1	89-101 Carnwath Road	<0.3	High	Below threshold of potential cosmetic damage - No impact
CR2	81-87 Carnwath Road	<0.3	High	Below threshold of potential cosmetic damage - No impact

Ref	Receptor	Impact (highest predicted PPV across all activities, mm/s)	Value/ sensitivity	Magnitude
CR3	50 Carnwath Road	<0.3	Medium	Below threshold of potential cosmetic damage - No impact
CR4	The Piper Building	<0.3	High	Below threshold of potential cosmetic damage - No impact
CR5	16-25 Philpot Square	<0.3	High	Below threshold of potential cosmetic damage - No impact
CR6	26-41 Philpot Square	<0.3	High	Below threshold of potential cosmetic damage - No impact
CR7	1b Dymock Street	<0.3	High	Below threshold of potential cosmetic damage - No impact
CR8	5 Carnwath Road	<0.5	High	Below threshold of potential cosmetic damage - No impact
CR9	Riverside Quarter	<0.1	High	Below threshold of potential cosmetic damage - No impact

9.5.79 The vibration levels reported here are well below the levels likely to cause cosmetic building damage according to the criteria described in Volume 2 Section 2.

9.5.80 Vibration effects are **not significant** to any receptors.

Jetty option assessment

9.5.81 For the jetty option, the piling locations for the jetty would be further away from the nearest sensitive receptors, and as such the impact from vibration would be expected to be no greater than that identified for the campshed option. Effects for this option are therefore as presented above.

Sensitivity test for programme delay

9.5.82 For the assessment of noise and vibration effects during construction, a delay to the Thames Tideway Tunnel project of approximately one year would not be likely to materially change the assessment findings reported above for the existing and proposed receptors. Based on the development schedule (Vol 10 Appendix N), there would be no new receptors, within the assessment area, requiring assessment as a result of a one year delay.

9.6 Operational effects assessment

Impacts from potential noise and vibration sources

9.6.1 The following section describes the potential noise and vibration effects from various sources identified for assessment.

Noise from operational plant at above ground structures

9.6.2 Carnwath Road Riverside is a main shaft site where an active ventilation system would be installed. This requires plant for tunnel ventilation and odour control of air extracted from the tunnel. The ventilation columns would be located separately (see Site works parameter plan - separate volume of figures – Section 1). There would be two extraction fans each of which would be enclosed in an acoustic surround which would require a small ventilation system. This fan arrangement would be within a small low level building which, depending on the adequacy of the natural ventilation louvres, may need some nominal building ventilation system. Noise predictions for these arrangements have been carried out and the design of the systems sized to ensure that noise levels are controlled to be within the criteria established by the British Standards and the local authority where this has been provided.

9.6.3 The assessment assumes that the main plant would include two $10m^3/s$ centrifugal fans, which would draw air through carbon filters before discharging through outlet ducts at the top of the adjacent vent stack. The noise assessment is based on the ventilation fans being housed within a purpose built air management plant building and includes all aspects of noise generation such as plant noise and wind noise through ducts and vent columns.

9.6.4 The noise emission predictions have been based on data for typical plant at the appropriate operating settings. FläktWood’s HCGB 080 centrifugal fans at a pressure drop of 1170Pa and a speed of 1500rpm have been typically applied.

9.6.5 It is considered that there is sufficient potential to limit noise emissions so that receptor noise level limits are met.

9.6.6 Vol 10 Table 9.6.1 shows, for each receptor, that the estimated plant noise level is below the local authority limit or is less than ambient levels for residential and non-residential receptors respectively.

Vol 10 Table 9.6.1 Noise – operational airborne noise impacts

Ref	Receptor	Lowest baseline noise level	Impact	Value/ sensitivity	Magnitude
CR 1	89-101 Carnwath Road	Night-time: 35dB$L_{A90, 15\ minutes}$	Plant noise emission rating level at receptor less than 29dB$L_{Ar,Tr}$	High	Plant noise level below local authority limit*,– no adverse impact
CR 2	81-87 Carnwath Road	Night-time: 35dB$L_{A90, 15\ minutes}$	Plant noise emission rating level at receptor less than 29dB$L_{Ar,Tr}$	High	Plant noise level below local authority limit*,– no adverse impact
CR 3	50 Carnwath Road	Evening: 66dB$L_{Aeq, 15\ minutes}$	Plant noise emission level at receptor less than 66dBL_{Aeq}	High	Plant noise level below ambient evening level – no adverse impact
CR 4	The Piper Building	Night-time: 44dB$L_{A90, 15\ minutes}$	Plant noise emission rating level at receptor less than 39dB$L_{Ar,Tr}$	High	Plant noise level below local authority limit*,– no adverse impact
CR 5	16-25 Philpot Square	Night-time: 39dB$L_{A90, 15\ minutes}$	Plant noise emission rating level at receptor less than 34dB$L_{Ar,Tr}$	High	Plant noise level below local authority limit*,– no adverse impact
CR 6	26-41 Philpot Square	Night-time: 39dB$L_{A90,}$	Plant noise emission	High	Plant noise level below

Ref	Receptor	Lowest baseline noise level	Impact	Value/ sensitivity	Magnitude
		15 minutes	rating level at receptor less than 34dB$L_{Ar,Tr}$		local authority limit*,– no adverse impact
CR 7	1b Dymock Street	Night-time: 39dB$L_{A90,}$ 15 minutes	Plant noise emission rating level at receptor less than 34dB$L_{Ar,Tr}$	High	Plant noise level below local authority limit*,– no adverse impact
CR 8	5 Carnwath Road	Night-time: 39dB$L_{A90,}$ 15 minutes	Plant noise emission rating level at receptor less than 34dB$L_{Ar,Tr}$	High	Plant noise level below local authority limit*,– no adverse impact
CR 9	Riverside Quarter	Night-time: 39dB$L_{A90,}$ 15 minutes	Plant noise emission rating level at receptor less than 34dB$L_{Ar,Tr}$	High	Plant noise level below local authority limit*,– no adverse impact

**Limit referred to is that identified for the Local Authority in which the receptor is located (see para. 9.3.15 and 9.3.16).*

9.6.7 The results given in Vol 10 Table 9.6.1 show that there are no adverse impacts and the effects of plant noise at these emission levels is assessed as not significant. In the case of the residential receptors, this is based on compliance with the local authority and/or appropriate BS requirements to prevent disturbance. For the non-residential receptors the noise levels are below ambient noise levels and therefore considered not to result in significant effects.

9.6.8 The receptors nearest to the operational plant have been considered in this assessment and so the impact from noise to receptors further away would be lower. For other receptors in the area, meeting the criteria in Vol 10 Table 9.6.1 would ensure that there are no significant effects to other receptors.

Noise and vibration from tunnel filling

9.6.9 Measurements taken during storm and non-storm events at operational drop structures in the United States, equivalent to those being considered for the Thames Tideway Tunnel, have been used to inform the assessment of noise and vibration during tunnel filling events. These studies (Jain, SC and Kennedy, JF., 1983)[6] are described in Vol 2. The highest noise level measured on a mesh grille directly over a similar drop shaft, during this study, was 61dBL_{Aeq} during a severe storm event..

9.6.10 These events are not typical and only occur during severe rain storms. At Carnwath Road Riverside, the drop shaft would be enclosed and any noise at the surface would be attenuated by the structure or the carbon filters and vent building. At the surface the noise level would be approximately 46dB$L_{Aeq,}$ which is less than the prevailing ambient noise level at this site.

9.6.11 The highest peak particle velocity (PPV) measured directly at the existing drop shaft sites used in the case study as described in Volume 2 was 0.034mm/s. These measured PPV values are well below the levels for vibration to be just perceptible, according to the criterion given in Volume 2. Similarly, the levels are well below the transient and continuous vibration guideline criterion for building damage.

9.6.12 The noise and vibration from tunnel filling events would occur only occasionally during heavy rainfall events and, in any case, is predicted to be not perceptible/ less than the ambient noise level at the receptors. Therefore this is assessed as **not significant**.

Operational maintenance

9.6.13 As part of the operation of the tunnel, there would need to be routine but infrequent maintenance carried out at the site. Two cranes would be required for ten yearly shaft inspections. This would be carried out during normal working hours, using equipment which is likely to increase ambient noise levels. Given the infrequency of this operation, it is considered that a significant noise effect would not occur.

9.6.14 Routine inspections, lasting approximately half a day, would occur every three to six months and would not require heavy plant. As this would be carried out during the daytime with minimal noisy equipment operating over short periods of time, it is considered that further assessment of noise generated by this activity is not required.

9.6.15 As no impacts have been identified from the operation of the site, this has been assessed as **not significant**.

Noise from operational traffic

9.6.16 Additional traffic associated with operation of the site would be limited to vehicles used by maintenance and inspection workers. This is likely to be a number of light commercial vehicles used during routine inspection visits every three to six months and shaft inspections approximately every ten years.

9.6.17 As a proportion of the existing traffic on the road network these vehicles would not contribute to the traffic noise level and the noise effects of these movements are assessed as **not significant**.

Sensitivity test for programme delay

9.6.18 For the assessment of noise and vibration effects during operation, a delay to the Thames Tideway Tunnel project of approximately one year would not be likely to materially change the assessment findings reported above for the existing and proposed receptors as the operational effects of the Thames Tideway Tunnel are considered to be not significant. Based on the development schedule (Vol 10 Appendix N), there would be no new receptors, within the assessment area, requiring assessment as a result of a one year delay.

9.7 Cumulative effects assessment

Construction effects

9.7.1 Of the projects described in Section 9.5, which could potentially give rise to cumulative effects with the proposed development at Carnwath Road Riverside, the Wandsworth Riverside Quarter development is considered relevant due to the potential for cumulative effects on noise and vibration. However, because of the distance of the development to the site and the ambient noise levels , no cumulative construction noise or vibration effects are identified.

9.7.2 In the event that the programme for the Thames Tideway Tunnel project is delayed by approximately one year, a greater proportion of the Wandsworth Riverside Quarter development would be complete and occupied with a corresponding reduced level of cumulative activity. Cumulative effects would therefore be no greater than described above.

Operational effects

9.7.3 None of the projects described in Section 9.3, are considered relevant to the operational cumulative assessment at Carnwath Road Riverside because, due to their use, they are not expected to generate significant noise or vibration levels during their operation and are fully screened by existing buildings and features. As such, no cumulative operational noise or vibration effects are identified. This would also be the case if the programme for the Thames Tideway Tunnel project was delayed by approximately one year.

9.8 Mitigation and compensation

Construction

9.8.1 The above assessment has concluded that there are significant adverse noise effects at 89-101 Carnwath Road during the construction phase associated with river construction traffic . However, no further practicable on-site noise mitigation can be adopted above those measures identified in the *CoCP*.

9.8.2 The noise levels predicted at this receptor are rated as significant using method (as discussed in Section 9.5 and Volume 2) however the levels would not exceed the thresholds given in the *Thames Tideway Tunnel noise insulation and temporary re-housing policy* (see Schedule 2 of the *Statement of Reasons*, which accompanies this application) and as such these properties would not be eligible for noise insulation under this policy.

9.8.3 The residents of these properties may be eligible to apply for compensation through the Thames Tideway Tunnel compensation programme (see Schedule 2 of the *Statement of Reasons*, which accompanies this application) which has been established to address claims of exceptional hardship or disturbance. The measures set out in the programme are not considered to be mitigation as there is no guarantee that the property in question would be eligible for compensation or that the compensation would be accepted by the affected party. Therefore residual effects reported in the ES for this receptor do not take the offsetting effect of the compensation programme into account.

Operation

9.8.4 The above assessment has concluded that there are not likely to be any significant adverse effects during the operational phase that would require mitigation.

Monitoring

9.8.5 Monitoring of construction noise would be carried out as described in the *CoCP*. It is not anticipated that there would be any need for monitoring of operational noise.

9.9 Residual effects assessment

Construction effects

9.9.1 As discussed at para. 9.8.3, the noise levels at 89-101 Carnwath Road are rated as significant (due to river based construction traffic) but do not exceed the thresholds for noise insulation set out in the *Thames Tideway Tunnel noise insulation and temporary re-housing policy*. Properties within 89-101 Carnwath Road may, however, be eligible to apply for compensation under the *Thames Tideway Tunnel project compensation programme.* For the purpose of the assessment the residual effects reported in the ES do not take the offsetting effects of the compensation programme into account and therefore the construction noise effects would remain as presented in Section 9.5.

Operational effects

9.9.2 As no mitigation measures are required, the residual operational effects would remain as presented in Section 9.6.

9.10 Assessment summary

Vol 10 Table 9.10.1 Noise - summary of construction assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Surface construction noise				
CR1 - 89-101 Carnwath Road	Noise	Not significant	None	Not significant
CR2 - 81-87 Carnwath Road	Noise	Not significant	None	Not significant
CR3 - 50 Carnwath Road	Noise	Not significant	None	Not significant
CR4 - The Piper Building	Noise	Not significant	None	Not significant
CR5 - 16-25 Philpot Square	Noise	Not significant	None	Not significant
CR6 - 26-41 Philpot Square	Noise	Not significant	None	Not significant
CR7 - 1b Dymock Street	Noise	Not significant	None	Not significant
CR8 - 5 Carnwath Road	Noise	Not significant	None	Not significant
CR9 - Riverside Quarter	Noise	Not significant	None	Not significant
Road-based construction traffic				
Residential and non-residential properties adjacent to the proposed vehicle route	Noise	Not significant	None	Not significant

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
River-based construction traffic				
CR1 - 89-101 Carnwath Road	Noise	Significant	No further on site mitigation practicable	Significant, however properties may be eligible for compensation (see para. 9.9.1)
CR8 - 5 Carnwath Road	Noise	Not significant	None	Not significant

Vol 10 Table 9.10.2 Vibration - summary of construction assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
CR1 - 89-101 Carnwath Road	Vibration	Not significant	None	Not significant
CR2 - 81-87 Carnwath Road	Vibration	Not significant	None	Not significant
CR3 - 50 Carnwath Road	Vibration	Not significant	None	Not significant
CR4 - The Piper Building	Vibration	Not significant	None	Not significant
CR5 - 16-25 Philpot Square	Vibration	Not significant	None	Not significant
CR6 - 26-41 Philpot Square	Vibration	Not significant	None	Not significant
CR7 - 1b Dymock Street	Vibration	Not significant	None	Not significant
CR8 - 5 Carnwath Road	Vibration	Not significant	None	Not significant
CR9 - Riverside Quarter	Vibration	Not significant	None	Not significant

Vol 10 Table 9.10.3 Noise - summary of operational assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
CR1 - 89-101 Carnwath Road	Noise	Not significant	None	Not significant
CR2 - 81-87 Carnwath Road	Noise	Not significant	None	Not significant
CR3 - 50 Carnwath Road	Noise	Not significant	None	Not significant
CR4 - The Piper Building	Noise	Not significant	None	Not significant
CR5 - 16-25 Philpot Square	Noise	Not significant	None	Not Significant
CR6 - 26-41 Philpot Square	Noise	Not significant	None	Not significant
CR7 - 1b Dymock Street	Noise	Not significant	None	Not Significant
CR8 - 5 Carnwath Road	Noise	Not significant	None	Not significant
CR9 - Riverside Quarter	Noise	Not significant	None	Not significant

Vol 10 Table 9.10.4 Vibration - summary of operational assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
CR1 - 89-101 Carnwath Road	Vibration	Not significant	None	Not significant
CR2 - 81-87 Carnwath Road	Vibration	Not significant	None	Not significant
CR3 - 50 Carnwath Road	Vibration	Not significant	None	Not significant
CR4 - The Piper Building	Vibration	Not significant	None	Not significant
CR5 - 16-25 Philpot Square	Vibration	Not significant	None	Not Significant
CR6 - 26-41 Philpot Square	Vibration	Not significant	None	Not significant
CR7 - 1b Dymock Street	Vibration	Not significant	None	Not Significant
CR8 - 5 Carnwath Road	Vibration	Not significant	None	Not significant
CR9 - Riverside Quarter	Vibration	Not significant	None	Not significant

References

[1] Department of Environment, Food and Rural Affairs. *National Policy Statement for Waste Water* (2012). Available at: http://www.defra.gov.uk/publications/files/pb13709-waste-water-nps.pdf. Last accessed November 2012

[2] British Standards Institution, *BS 4142 Method for rating industrial noise affecting mixed residential and industrial areas* (1997)

[3] British Standards Institution, *BS 8233 Code of Practice for Sound insulation and noise reduction for buildings* (1999)

[4] Peter Brett Associates on behalf of Lafarge Cement UK, *Northfleet Works Bulk Aggregates Import Terminal. Document 2h: Environmental Statement Volume 3 Appendices*: Appendix D.3.

[5] Port of London Authority, *Draft Thames Freight Operations Vessel Standards*

[6] Jain, SC and Kennedy, JF. *Vortex-Flow Drop Structures for the Milwaukee Metropolitan Sewerage District Inline Storage System*. Iowa Institute of Hydraulic Research. IIHR Report No 264 (Jul 1983).

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

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Volume 10: Carnwath Road Riverside site assessment

Section 10: Socio-economics

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Thames Tideway Tunnel

Environmental Statement

Volume 10: Carnwath Road Riverside site assessment

Section 10: Socio-economics

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10 Socio-economics

10.1 Introduction

10.1.1 This section presents the findings of the assessment of the likely significant socio-economic effects of the proposed development at Carnwath Road Riverside (main site) on socio-economics. At this site effects during construction are considered on businesses located on the proposed construction site, users of the Thames Path and the River Thames, and nearby residents, and the results presented apply to both site options (campshed or jetty with associated campshed). During the operational phase, effects are considered on users of the Thames Path National Trail and Right of Way (Thames Path) and the associated future public amenity space that would be created as a result of the project.

10.1.2 Operational effects on socio-economics for this site relating to a reduction in designated employment land have not been assessed, as since production of the *Scoping Report* the employment land designation afforded to the site under local planning policy has been removed.

10.1.3 Two options for the mooring of barges

10.1.4 The likely significant project-wide socio-economic effects, including employment generation, stimulation of the freight-by-water industry and leisure, recreation and health related effects on users of the River Thames are described in Volume 3 Project-wide effects assessment.

10.1.5 The assessment of socio-economics presented in this section has considered the requirements of the National Policy Statement for Waste Water Sections 4.8 (land use) and 4.15 (socio-economic) (Defra, 2012)[1]. Further details of these requirements can be found in Volume 2 Environmental assessment methodology Section 10.3.

10.1.6 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Volume 10 Carnwath Road Riverside Figures).

10.1.7 This assessment has drawn on the findings of the air quality and odour, noise and vibration and townscape and visual assessments (Sections 4, 9 and 11 respectively within this volume).

10.2 Proposed development relevant to socio-economics

10.2.1 The proposed development is described in Section 3 of this volume. The elements of the proposed development relevant to socio-economics are set out below.

Construction

10.2.2 Works at the site would involve the demolition of the Carnwath Road Industrial Estate, which currently accommodates five businesses. Works would also involve use of Hurlingham Wharf, which is safeguarded for wharf uses by the London Plan (GLA, 2005)[2], and Whiffin Wharf, which is not safeguarded. Parts of these wharves are in temporary use by a removals business for storage.

10.2.3 The section of the Thames Path which runs along the eastern and southern boundaries of the Carnwath Road Industrial Estate would be temporarily diverted for the duration of the construction period.

10.2.4 Works at the site are expected to last approximately six years. See Section 3.3 of this volume for further details of the construction working hours.

10.2.5 Construction related activities, including traffic and lorry movements, could result in amenity effects (caused by air quality impacts, construction dust, noise, vibration, and visual impacts) being experienced by a range of sensitive socio-economic receptors in proximity to the proposed activities (refer to Volume 2 Environmental assessment methodology for further information on the amenity assessment methodology).

Direct employment creation on site

10.2.6 Construction is expected to require a maximum workforce of approximately 165 workers at any one time, ie, during the daytime shift. The number and type of workers is shown in Vol 10 Table 10.2.1.

Vol 10 Table 10.2.1 Socio-economics – construction worker numbers

Contractor					Client	
Staff*		Labour**			Staff***	
08:00-18:00	18:00-08:00	0800-1500	1500-2300	2300-0800	08:00-18:00	18:00-08:00
60	15	60	60	45	45	4

** Staff Contractor – engineering and support staff to direct and project manage the engineering work and site.*
*** Labour – those working on site doing engineering, construction and manual work.*
**** Staff Client – engineering and support staff managing the project and supervising the Contractor.*

Code of construction practice

10.2.7 Measures applicable to all sites incorporated into the *Code of construction practice* (*CoCP*)[i] *Part A* to limit significant air quality / construction dust (see Section 7), noise and vibration (see Section 6), and visual impacts (see Section 4) would also reduce socio-economic effects, particularly amenity effects.

10.2.8 The *CoCP Part A* also confirms that all land, including highways, footpaths, public open spaces, river embankments / waterways, loading facilities or other land occupied temporarily would be made good to the

[i] The Code of Construction Practice (CoCP) is provided in Vol 1 Appendix A. It contains general requirements (Part A), and site specific requirements for this site (Part B)

satisfaction of Thames Water[ii] and the local authority where required. This would be in accordance with the *Ecology and landscape management plan* and the approved landscape design for the site (see Section 4 within the *CoCP Part A*).

10.2.9 Further site specific measures, which would reduce socio-economic effects and particularly amenity effects, are incorporated into the *CoCP Part B*. See the *CoCP* sections in the air quality and odour, noise and vibration, and townscape and visual construction effect assessments (Sections 4.2, 9.2 and 11.2 respectively within this volume) for details on the type of measures that may be employed.

10.2.10 The *CoCP Part B* also makes provision for the Thames Path diversion to be adequately signed and for the new eastern route section to have high quality lighting for safety and security. Also the western site access route would be only used as an entry for emergency access or specific deliveries and not routinely used due to proximity of adjacent properties (see Section 5 within the *CoCP Part B*).

Operation

10.2.11 The requirement for above ground structures in the operational phase, as described in Section 3, would result in an area being set aside to provide access for maintenance. This would create a small new area of landscaped public realm within Whiffin Wharf, available for passive recreation use by the public.

Environmental design measures

10.2.12 Measures which have been incorporated into the design of the proposed development (described in the design principles) include the:

a. incorporation of the shaft surface area into the new area of landscaped public space

b. provision of lighting along the Thames Path and within the public area

c. the planting of London Plane Trees to enhance the area

d. replacement of trees which would be removed, as close as possible to their original location

e. provision of a riverside walkway of a minimum width of six metres, except where the ventilation column would encroach this width

10.3 Assessment methodology

Engagement

10.3.1 Volume 2 documents the overall engagement which has been undertaken in preparing the *Environmental Statement*. Specific comments relevant to

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[ii] Thames Water Utilities Ltd (TWUL). The Draft Development Consent Order (DCO) contains an ability for TWUL to transfer powers to an Infrastructure Provider (as defined in article 2(1) of the DCO) and / or, with the consent of the Secretary of State, another body.

this site for the assessment of socio-economics are presented in Vol 10 Table 10.3.1.

Vol 10 Table 10.3.1 Socio-economics – stakeholder engagement

Organisation	Comment	Response
London Borough (LB) of Hammersmith and Fulham, February 2012	Proposed closing of the river walk part of the Thames Path and diverting it along the footway on Carnwath Road. The road is already heavily used by industrial and commercial vehicles and diverting pedestrians into this less amenable would place them at greater risk.	The *CoCP* includes measures (eg, signage) related to the safety of pedestrians and cyclists using the Thames Path during the construction works. Both the transport and socio-economics assessments have taken account of these measures.
London Councils, February 2012	Additionally the noise, pollution and congestion caused by site traffic will impact on quality of life for local residents and on the viability of local businesses. For example, LB of Hammersmith and Fulham is concerned that the Carnwath Road Riverside site, while being a brownfield site, is in a densely populated residential area next to five local schools.	The potential for amenity related effects on residents has been considered in this assessment. The potential for amenity related effects on local schools was investigated, however, as per the assessment methodology, set out in Volume 2, none of the five schools referred to meet the criteria set out in Volume 2 for being identified as amenity effect receptors for the purposes of this assessment. This is because they are either more than 250m from the proposed construction site or, although they have been assessed by one other topic, that topic assessment has concluded that effect on the school would be negligible. Therefore, an amenity effect assessment is not considered to be required. With regard to amenity related effects on businesses, it is considered that the businesses in the vicinity of the site are not of the type which would be particularly sensitive to

Organisation	Comment	Response
		amenity related impacts. In regard to effects related to traffic congestion, these are considered in Section 12 Transport of this volume.

Baseline

10.3.2 The baseline methodology follows the methodology described in Volume 2. There are no site specific variations for identifying the baseline conditions for this site.

Construction

10.3.3 For this site, the base case is the peak year of construction works. The assessment area is as set out in Vol 2 Table 9.5.1.

10.3.4 The assessment methodology for the construction phase follows that described in Volume 2. There are no site specific variations for undertaking the construction assessment of this site.

10.3.5 Section 10.5 details the likely significant effects arising from the construction at Carnwath Road Riverside. There are no other Thames Tideway Tunnel project sites which could give rise to additional effects on socio-economics within the assessment area for this site, therefore no other project sites are considered in this assessment.

10.3.6 Of the developments listed in the site development schedule (see Vol 10 Appendix N), there are none which are considered relevant to the construction assessment base case as they are beyond the respective assessment areas for the assessments on socio-economic receptors that are applicable for this site. Therefore, they would not result in any new receptors appearing in the construction base case.

10.3.7 Of the developments listed in the site development schedule (see Vol 10 Appendix N), one would be under development within 250m of the project site at the same time as the Thames Tideway Tunnel project and has therefore been considered relevant to the cumulative effect assessment. This is the development at Wandsworth Riverside Quarter, which is located approximately 200m southwest of the site. Phase B Buildings 6A and 6B of this development would be under construction in Site Year 1 and the peak year of construction of the project and therefore it could give rise to cumulative amenity effects with the construction of the Thames Tideway Tunnel project on nearby sensitive receptors.

10.3.8 No additional receptors are required to be included as the other developments are further from the Carnwath Road Riverside site than existing sensitive receptors.

Operation

10.3.9 The base case is Site Year 1 of operation. The assessment area is as set out in Vol 2 Table 9.5.1.

10.3.10 The assessment methodology for the construction phase follows that described in Volume 2. There are no site specific variations for undertaking the operation assessment of this site.

10.3.11 Section 10.6 details the likely significant effects arising from the operation of the proposed development at Carnwath Road Riverside. There are no other project sites which could give rise to additional effects on socio-economics within the assessment area for this site, therefore no other project sites are considered in this assessment.

10.3.12 Of the developments listed in the site development schedule (see Vol 10 Appendix N), there are none which would introduce new receptors into the operational base case; significantly alter circumstances for those receptors covered by the operational assessment; or give rise to cumulative effects. This is because the only receptor covered in the operational assessment is users of the new public amenity space, the catchment for which would be limited to 400m. While these developments may increase the population within the catchment area for the new open space, none of the developments would affect the sensitivity of such users as a receptor.

Assumptions and limitations

10.3.13 The assumptions and limitations associated with this assessment are presented in Volume 2. The assumptions specific to the assessment of this site are presented below.

Assumptions

10.3.14 The following assumption is specific to the assessment of this site. Hurlingham Wharf and Whiffin Wharf would remain vacant and unused in the construction base case year (at present, a portion of this part of the site is in temporary use by a removals business for open storage).

Limitations

10.3.15 There are no limitations specific to the assessment of this site

10.4 Baseline conditions

Current baseline

10.4.1 The following section sets out the baseline conditions for socio-economics within and around the site, including a description of the local social and economic context, and a description of the receptors relevant to this assessment. Future baseline conditions (base case) are also described.

Local context

10.4.2 The River Thames forms the southern boundary of the site and the immediate area (within 250m) to the north and east contains a mix of terraced and medium rise residential developments. Commercial office and leisure (gym) uses are located to the immediate north beyond Carnwath Road, with large retail units found to the east. The wider area (within 1km) contains further residential development and public open spaces on both sides of the river, as well as the private Hurlingham Park.

There are also retail and industrial uses, along both the north and south of the river and further inland as shown in Vol 10 Figure 2.1.2 (see separate volume of figures).

Community profile

10.4.3 A detailed community profile is outlined in Vol 10 Appendix H.1[iii]. The following points provide a summary of the community profile and provide context for this socio-economic assessment:

a. The resident population was approximately 1,975 within 250m of the site and approximately 28,600 within 1km at the time of the last census for which data is available[iv].

b. The proportion of younger residents (ie, under 16 year olds) within 250m (18.3%) and 1km (17.5%) of the site is somewhat higher than across the borough (16.5%), and somewhat lower than across Greater London (20.2%).

c. The proportion of over 65 year olds within 250m of the site (6.8%) is almost half the Greater London level, and the proportion within 1km (9.2%) is a quarter lower than for Greater London.

d. Within 250m and 1km of the site, White residents comprise around 80% of the population, broadly in line with the borough-wide proportion (77.8%), and somewhat higher than for Greater London (71.2%) as whole.

e. Black residents make up the largest minority ethnic group within 250m, accounting for 10.4% of all residents, only slightly lower than at a borough-wide level (11.1%) and across Greater London (10.9%). The proportion of Asian residents within 250m (4.0%), 1km (3.6%) and at a borough-wide level (4.5%) is considerably lower than that recorded for Greater London (12.1%).

f. Within 250m of the site, the proportion of residents suffering from a long term or limiting illness (11.1%) is lower than within 1km (12.1%), the LB of Hammersmith and Fulham (14.7%) and Greater London (15.5%). The proportion of residents who claim disability living allowance within 250m (4.1%) and 1km (3.7%) is slightly lower in both instances than the borough (4.4%) and Greater London averages (4.5%).

g. At a borough level, although levels of adult obesity are low or very low relative to the Greater London average, by comparison child obesity rates are high. Despite this, the borough local borough records high levels of physical activity for both adults and children relative to Greater London.

h. Death rates caused by heart disease, circulatory disease and strokes within the vicinity of the site are low relative to Greater London, though in contrast rates of cancer are high. Locally, male life expectancy is

[iii] Information sources are provided in the appendix.

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

very high but female life expectancy is low relative to the rest of Greater London.

i. Income deprivation[v] within 250m of the site (71.0%) is considerably higher than that recorded within 1km (32.2%), the borough (31.7%), and Greater London (30.8%) as a whole. Overall deprivation within 250m (50.4%) is considerably higher than within 1km (14.3%) and somewhat higher than the LB of Hammersmith and Fulham (24.6%) and Greater London (24.5%) averages.

10.4.4 The above community profile suggests that the local community is made up of predominantly White residents, who generally experience moderate to good health, with life expectancy standards varying between the sexes. A significant proportion of residents within 250m of the site experience deprivation.

Economic profile

10.4.5 An economic profile (based on 2012 data) is presented in Vol 10 Appendix H.2. The following points provide a summary of the profile and provide context for this socio-economic assessment:

a. Within 250m of the site there are approximately 2,700 jobs and 390 businesses[vi].

b. The three largest sectors as measured by employment within approximately 250m are: Wholesale and Retail Trade / Repair of Motor Vehicles and Motorcycles; Transportation and Storage Activities; and Professional, Scientific and Technical Activities.

c. The three largest sectors as measured by number of businesses at locations / units within approximately 250m are: Wholesale Retail and Trade / Repair of Motor Vehicles and Motorcycles; Professional, Scientific and Technical Activities; and Administrative and Support Services Activities.

d. At all geographical levels, most businesses fall within the smallest size band (one to nine employees). However, in terms of lead sectors, the size of businesses within approximately 250m varies somewhat across these. For example, small businesses (ten to 24 employees) account for 4% within the Other Service Activities sector, compared with 17% within Administrative and Support Service Activities and 19% within Manufacturing.

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[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.

[vi] Source: Experian 2012. Data is aggregated for seven digit post-code units falling wholly or partially within a 250m boundary of the LLAU, including post code units on the opposite side of the River Thames if relevant. Employee data reflect a head count of workers on-site rather than Full Time Equivalent (FTE) jobs. The count of businesses relates to business 'locations' or 'units'; an enterprise may have a number of business locations / units. Businesses as defined here include private sector, public sector and voluntary / charitable entities.

Receptors

Businesses – Carnwath Road Industrial Estate

10.4.6 The Carnwath Road Industrial estate (Vol 10 Figure 10.4.1, see separate volume of figures) contains eight industrial units, currently occupied by five businesses in total comprising:

a. a furniture manufacturer's warehouse and small showroom selling discontinued and damaged stock

b. a women's fashion retailer

c. two retailers of tiles and related products

d. a trade counter business selling construction related materials.

10.4.7 All of the businesses are part of companies that have operations at other sites as well as at the Carnwath Road Industrial Estate.

10.4.8 The precise number of people employed at the businesses in Carnwath Road Industrial Estate is not known. Based on the nature of the businesses at the site and the size of the units that they occupy, it is estimated that each business would be a micro (one to nine employees) or a small (ten to 49 employees) size enterprise. The number of employees can alternatively be estimated based on the estimated available floorspace area and the Homes and Communities Agency (HCA)'s benchmark average employment densities[3]. This indicates that the site could support approximately 71 employees if it were used for storage and warehousing (B8 use) or 127 employees if used for general industrial purposes (B2 use). The employment densities assumed for both B8 and B2 uses are higher than those assumed for retail warehousing. This means, given that there are three retail warehouse / trade counter type operations at the site, that the number of employees is likely to be slightly lower than the above estimates.

10.4.9 Vol 10 Figure 10.4.1 (see separate volume of figures) shows the location of this receptor.

10.4.10 The main factors affecting the sensitivity of the businesses at Carnwath Road Industrial Estate to displacement of their activities are as follows:

a. It is likely that the existing businesses within the industrial estate derive some benefit from being in their current location, as it would give them access to an existing customer and supplier base in the local area and inner western London.

b. In terms of alternative locations, a land use survey undertaken by LB of Hammersmith and Fulham recorded that in 2007, 13.4% of industrial floorspace was vacant – the most recent available figure. It was also noted within the land use survey that many of the borough's industrial sites comprised older style buildings not appropriate for more modern users without adaptation (LB of Hammersmith and Fulham, 2009)[4]. This level of vacancy compares to 11% recorded for Greater London in 2006. More recent available data for the neighbouring LB of Hounslow indicates that vacancy rates in 2010 were in excess of 10% (LB of Hounslow, 2011)[5].

c. However, it is understood that finding alternative premises for trade counter businesses is difficult in London. Therefore, given the nature of the activities taking place on the site, especially those which fit within the trade counter definition, the businesses at the site could face some difficulties in finding alternative premises within LB of Hammersmith and Fulham or within the wider west London area.

d. While reasonably specialised, the businesses in question are not unique in terms of the goods and services which they provide to customers. Similarly, the sectors (retail, furniture manufacturing, and trade counter retail) in which the businesses operate and the nature of the skills that staff would have, would mean that their skills are likely to be transferrable to other alternative sources of employment.

10.4.11 On the basis of the factors considered above, the sensitivity of the businesses and their employees to displacement is considered to be medium.

Thames Path

10.4.12 The Thames Path is a recreational asset and national trail. It follows the river for almost its entire length, and in west and central London it typically runs along both sides of the river with some relatively minor exceptions. At this location, it follows the riverfront except at Whiffin Wharf and Hurlingham Wharf where it is routed along Carnwath Road. To the west, the route also diverts away from the River Thames to go around Hurlingham Park. The existing route of the path bisects the proposed construction site.

10.4.13 Pedestrian and cycle surveys undertaken as part of Section 12 of this volume, recorded a peak usage of 133 pedestrians travelling in the westbound direction and 27 eastbound (ie, approximately 160 movements in total), on the Carnwath Road section during the AM peak hour. On the basis of this data, it is concluded that the Thames Path is lightly used at this location.

10.4.14 Vol 10 Figure 10.4.1 (see separate volume of figures) shows the location of this receptor.

10.4.15 Factors affecting the sensitivity of users of the Thames Path to access restrictions and amenity impacts are as follows:

a. The Thames Path is a metropolitan wide recreational asset, and users have access to other alternative and comparable stretches of the Thames Path on both sides of the river across west and central London. Specifically at this location, this includes the stretch of the Thames Path on the south side of the River Thames routed through and around Wandsworth Riverside Quarter (including where it runs away from the river around Smugglers Way Waste Transfer Station).

b. With regards to the availability of alternative routes more locally, Carnwath Road provides an easily accessible alternative route. As stated above, part of the Thames Path adjacent to the site is already routed along this road where it passes Whiffin Wharf and Hurlingham Wharf.

c. Part of the Thames Path at this location does not run along the riverside. As such it is considered that the recreational amenity the route provides is less than typically experienced at riverside sections of the Thames Path further east and west of this location.

d. At this location users are only likely to be near the site for the time that it takes them to walk past (likely to be up to five minutes for most users).

10.4.16 Taking the above factors into account, it is considered that users of the Thames Path in this location would have a low level of sensitivity to impacts that would cause a loss of access to a section of the path, or a reduction in amenity.

Landscaped public realm (future)

10.4.17 In the operational phase, a new area of landscaped public realm would be created within Whiffin Wharf.

10.4.18 This space would be equivalent in size to a pocket park as categorised by the London Plan's Open Space Hierarchy. Open spaces of pocket park size typically serve a catchment area of "less than 400m" (GLA, 2005)[6].

10.4.19 In terms of the value of the additional area of landscaped public realm, and the consequent sensitivity of users, the availability of alternative similar space is a key factor to consider. The site is not situated within an area of public open space deficiency as defined in the LB of Hammersmith and Fulham Core Strategy (2011)[7]. However, with the exception of South Park and the northern (publicly accessible) part of Hurlingham Park, both of which are largely dedicated to providing for active recreation and sporting fields and pitches, there are only limited existing opportunities for passive recreation within 400m of the proposed new civic space public realm. These opportunities primarily exist not within public open spaces but along the riverside sections of the Thames Path.

10.4.20 Taking these factors into account, it is considered that users of the future riverside public amenity space would have a medium level of sensitivity to the creation of additional public amenity space.

Residential

10.4.21 There are existing and base case residential developments near the proposed site as identified in the air quality, noise and vibration and townscape and visual assessments.

10.4.22 Land that is predominantly used for residential development is shown in the land use plan for this site (Vol 10 Figure 2.1.2, see separate volume of figures).

10.4.23 It is considered that the sensitivity of nearby residents to overall amenity effects would vary by time of day, with residents being somewhat less sensitive to amenity effects, particularly noise, during the day and more sensitive to such effects during the evening and night.

10.4.24 Therefore, as outlined in the methodology for this socio-economic impact assessment (see Volume 2) the sensitivity of nearby residential receptors to amenity impacts would be medium during the day and high during the evening and night.

River Thames (recreational users)

10.4.25 The River Thames flows past the construction site, and at this point is approximately 200m wide. On the north bank within the immediate vicinity of the site, the river is flanked by a mixture of residential, open space, vacant industrial and commercial uses. On the opposite bank, the river is flanked by a mixture of mostly residential and industrial uses, including Smugglers Way Waste Transfer Station.

10.4.26 Generally, the River Thames is used more for recreational purposes upstream of Putney Bridge and for commercial activities in downstream stretches. While the construction site is some distance downstream of Putney Bridge, some recreational river use does take place within close proximity of the site.

10.4.27 The river usage survey carried out in May 2012 recorded a peak daily usage of 61 river craft per day during the week and 238 river craft per day at the weekend, passing by the Wandsworth River Quarter pier on the opposite bank just a short distance upstream of the construction site. The predominant vessels which use the river at this point are rowers, motor dinghies and private cruisers. The survey identifies that, on average, the number of river craft passing the pier per hour in this stretch within close proximity to the construction site is very low.

10.4.28 Factors affecting the sensitivity of users of the River Thames to amenity impacts are as follows:

a. The River Thames is a metropolitan wide recreational asset, and users have access to alternative and comparable stretches in west and central London.

b. River Thames users are only likely to be near the site for the time that it takes them to pass by (likely to be a few minutes for most users). Therefore, the duration for which users would experience any adverse amenity effects would be limited.

10.4.29 Taking the above factors into account, including the duration of time that would be spent close to the site and the existing nature of the river at this point, it is considered that recreational users of the River Thames in this location would have a low level of sensitivity to impacts that could arise at the site and which could cause a reduction in amenity.

Summary

10.4.30 A summary of receptors as described in the baseline and their sensitivity is provided in Vol 10 Table 10.4.1.

Vol 10 Table 10.4.1 Socio-economics – receptors values / sensitivities

Receptor	Value / sensitivity and justification
Businesses – Carnwath Road	Medium – recorded moderate to

Receptor	Value / sensitivity and justification
Industrial Estate	high availability of alternative premises within LB Hammersmith and Fulham, although the businesses, in particular the trade counter businesses, may face difficulty finding suitable alternative premises. While reasonably specialised, the businesses in question are not unique.
Users of the Thames Path	Low – route is a metropolitan wide recreational asset and users would have access to alternative, comparable stretches on both sides of the river. A local alternative route is available along Carnwath Road albeit away from the river and exposed to local traffic. Users would be near the site for a short duration only.
Users of the landscaped public realm (future)	Medium – future users would have access to only a limited amount of comparable space, primarily along the riverside Thames Path.
Residents	Medium / High – residents would have limited opportunity to avoid effects. They would have medium sensitivity to amenity effects overall during the day but would have high sensitivity to amenity effects overall during the evening and night.
Users of the River Thames (recreational users)	Low – the River Thames is a metropolitan wide recreational asset, and users have access to alternative and comparable stretches of the river. River users would only be by the site for a relatively short time period.

Construction base case

10.4.31 The construction assessment year and area are as set out in para. 10.3.3.

10.4.32 There may be changes in the number and type of employment activities and businesses located on the Carnwath Road Industrial Estate, eg, businesses may open or close and industrial units that are currently occupied may become unoccupied. It is not possible however to forecast this with accuracy.

10.4.33 The base case in the peak year of construction, taking into account the schemes described in Section 10.3, would differ from the baseline in the following way:

a. The base case would include additional residential receptors within 250m of the site that would potentially be affected by amenity impacts arising from the proposed development. These new residential receptors are identified in the air quality, noise and vibration and townscape and visual assessments.

10.4.34 Other than the above differences, it is assumed that the base case socio-economic conditions at the site would remain largely the same as the existing baseline conditions.

Operational base case

10.4.35 The operational assessment year and area are as set out in para. 10.3.9.

10.4.36 As described in para. 10.3.12, there are no developments relevant to the operational assessment within the assessment area that would alter the base case.

10.5 Construction effects assessment

Displacement of businesses

10.5.1 The construction works would result in the demolition of premises at, and thus displacement of businesses from, the Carnwath Road Industrial Estate in the eastern section of the site.

10.5.2 As both Hurlingham Wharf and Whiffin Wharf are currently vacant land (though are partly in temporary use by a removals business for storage that is understood to be an unauthorised use on a short lease) there are no other businesses that would be considered to be impacted by the proposed construction works. Therefore only the impact on businesses at Carnwath Road Industrial Estate has been considered.

10.5.3 The magnitude of the impact is influenced by the following factors:

a. It is estimated that the five businesses currently on site are all micro or small size enterprises in terms of the number of people they employ.

b. Although the construction is temporary, the displacement and impact for the businesses would be likely to be permanent as once settled at their new premises, it is considered unlikely that the businesses would choose to return to the existing site. This conclusion is based on the recent redesignation of the land they occupy for non industrial uses (LB of Hammersmith and Fulham)[8] which would most likely make returning to the site more difficult.

c. Alternative locations for the businesses have not yet been identified. Accordingly, it is not possible to take the new location(s) of the businesses into consideration for the purposes of this assessment.

d. While it is assumed that the businesses may derive at least some benefit from their current location at this site, they may be able to 'carry' their customers with them to a new location within LB of Hammersmith and Fulham or Greater London.

e. The effect on the businesses of relocating would be potentially significant as there would be costs and expenditure associated with the move including but not limited to removal expenses, legal and surveyor fees, taxes, costs of securing and adapting new premises, temporary loss of profits during the period of the move, and potential diminution of goodwill following the move (reflected in reduced profits). If the businesses failed as a result of the relocations, their employees could lose their jobs.

f. However, in accordance with the Thames Tideway Tunnel compensation programme (included in Schedule 2 of the *Statement of Reasons*, which accompanies the application), compensation would be available. Given that Thames Water would comply with the provisions of the programme, it is assumed for the purposes of this assessment that reasonable costs and expenditure incurred in association with relocation would be met.

g. There is a possibility that the requirement to relocate would result in the extinguishment of some businesses if it were not economically viable for them to relocate or because they were entitled under [the development consent order] to choose not to relocate[vii]. However, it has been considered for the purposes of this site specific assessment that these conditions would not apply given the medium sensitivity of the businesses in question at this site and because the businesses on the site are part of larger companies that also have operations in other locations.

h. It is understood that all the companies have operations at other sites. This increases the likelihood that, if the companies were not able to find comparable alternative premises elsewhere, they could reconfigure their operations at other sites to accommodate the activities being displaced from this site.

10.5.4 Taking account of the above, it is considered that the magnitude of the impact arising from the relocation of the businesses to new locations would be low.

10.5.5 Given the low magnitude of the impact and the medium sensitivity of the businesses, it is assessed that there would be a **minor adverse** effect on the businesses and the employment provided by those businesses.

Temporary diversion of the Thames Path

10.5.6 The construction works would require the temporary diversion of the Thames Path.

10.5.7 The magnitude of the impact is influenced by the following factors:

[vii] There are certain limited criteria, which if fulfilled, statutorily entitle certain businesses to choose compensation based on extinguishment if they wish to take that option.

a. The diversion would occur over a long term period but it would be temporary and reinstated at the completion of the proposed works.

b. The baseline indicates that a relatively low number of people would be affected by the diversion.

c. A section of the Thames Path would be diverted away from the river and along a relatively busy road (Carnwath Road). However, Carnwath Road already forms part of the existing Thames Path route in this section.

d. The diversion route would not be any longer than the existing route, nor would it be circuitous or difficult to comprehend. It is unlikely therefore that users would experience inconvenience or significant delays.

e. As the diversion requires users to walk along Carnwath Road, they would be exposed to traffic and related effects, though only for up to a five minutes longer or less than they already are at present based on the existing route.

f. Adequate signage and safety measures (ie, lighting), as set out in the *CoCP Part B*, would ensure that the Thames Path diversion would be clearly navigable and fully accessible.

10.5.8 Taking account of the above factors, the impact magnitude arising from the diversion of the Thames Path is assessed as negligible.

10.5.9 Given the negligible magnitude of the impact and the low sensitivity of users the overall effect on users of the Thames Path is considered to be **negligible**.

Effect on the amenity of residents

10.5.10 Assessments have been undertaken to examine the likelihood of significant air quality, construction dust, noise, vibration, and visual effects of the project arising during construction. For further information refer to the respective construction effects sections within this volume (see Section 4 Air quality and odour, Section 9 Noise and vibration, and Section 11 Townscape and visual). The following points summarise the residual effect findings of those assessments in relation to residential receptors:

a. Local air quality effects would be **minor adverse** at all five residential receptors identified. Construction dust effects would be **minor adverse** at two receptors and **negligible** at the remaining three receptors identified.

b. Noise effects would be **not significant** at the eight receptors identified. In regard to road-based construction traffic, the noise assessment found that the additional numbers of HGVs would cause negligible change to the traffic noise levels and that the effects are assessed as **not significant**. In relation to river-based construction traffic, the noise assessment found that noise effects would be **significant** at one (89-101 Carnwath Road) of two receptors identified in relation to river-based construction traffic and **not significant** at the other receptor. Vibration (human response) effects would be **not significant** at any of the eight receptors.

c. Visual effects would be **major adverse** during the day and **minor adverse** during the night from the one residential receptor viewpoint identified on the same side of the river and within 250m of the site (viewpoint 1.1). Viewpoint 2.6, a recreational viewpoint on which effects would be **moderate adverse** during the day and **minor adverse** during the night, is also considered, as it is representative of oblique views from the west of the site.

10.5.11 In assessing the overall magnitude of impact, the above findings have been taken into consideration together with the following factors that are considered relevant to the receptor's overall experience of amenity at the site:

a. Given the six year construction programme, the effects noted above would be likely to be experienced over a long term period. The exceptions are:

   i For local air quality, the effects may not be minor adverse over the whole construction period as the assessment is based on the peak construction year and the effects may be negligible in other years.

b. While it is estimated that there would be significant adverse visual effects from two viewpoints during the day, it is considered that views from a residential property form one of many elements that contribute to the quality of a residential environment. Many of the dwellings at the receptors represented by these viewpoints are also likely to have views in other directions that are either not as severely affected or not affected at all.

c. It is also noted that in light of the commercial and industrial nature of the site the amenity experience of users would not be dramatically changed from the base case[viii].

10.5.12 On the basis of the above findings and factors, it is considered that the magnitude of overall amenity impacts would be low.

10.5.13 Given the low magnitude of the impact and the high sensitivity of residents during the night, the effect on the amenity of residents would be **moderate adverse**.

10.5.14 This assessment relates primarily to those residential receptors that would experience significant adverse local noise and visual effects. For residential receptors not subject to these effects, it is considered that there would be a lower effect on their amenity.

10.5.15 This amenity effect finding also represents a peak year scenario which is relevant at a sole residential receptor during the night at this site. As noted, there would be a significant noise effect at 89-101 Carnwath Road based on an estimated exceedance during the night due to river based

[viii] It is acknowledged that the air quality, noise and vibration and visual assessments have accounted for this within their methodologies.

construction traffic. Outside of periods when river based construction traffic is giving rise to noise exceedance and significant effects on that receptor, the significance is considered to be lower, given the lower sensitivity of residents during the day. Similarly for all other residential receptors which would not experience significant noise effects during the night; the significance is considered to be lower, given the lower sensitivity of residents during the day.

Effect on the amenity of Thames Path users

10.5.16 Assessments have been undertaken to examine the likelihood of significant air quality, construction dust, noise, vibration, and visual effects of the project arising during construction. For further information, refer to the respective construction effects sections within this volume (see Section 4 Air Quality, Section 9 Noise and vibration, and Section 11 Townscape and visual). The following points summarise the residual effect findings of those assessments in relation to the Thames Path:

a. Local air quality effects would be **negligible**. Construction dust effects would be **minor adverse**.

b. No noise or vibration (human response) receptors were identified for assessment in relation to the Thames Path.

c. From the viewpoints identified on the same side of the river and within 250m of the site, visual effects during the day would be **moderate adverse** from viewpoint 2.1 on Wandsworth Bridge, and viewpoint 2.6 along the Thames Path, and **minor adverse** during the night. Visual effects would be **minor adverse** from viewpoint 2.5 along the Thames Path during the day and **negligible** at night.

10.5.17 In assessing the overall magnitude of impact, the above findings have been taken into consideration together with the following factors that are considered relevant to the receptor's overall experience of amenity at this site:

a. Given the six year construction programme, the effects noted above would be likely to be experienced over a long term period.

b. The relatively light use of the Thames Path at this site means any impacts would affect a relatively low number of users.

c. Given that the Thames Path, in terms of its function as a recreational asset, is mostly used for walking, jogging and cycling, the time taken to pass by the site would be a relatively short period of time (eg, up to five minutes) for most users.

d. It is also noted that in light of the commercial and industrial nature of the site the amenity experience of users would not be dramatically changed from the base case[ix].

[ix] It is acknowledged that the air quality, noise and vibration and visual assessments have accounted for this within their methodologies.

e. The above findings in relation to visual effects do not include viewpoints along the section of the Thames Path that diverts away from the river and along Carnwath Road.

10.5.18 On the basis of the above findings and factors, it is considered that the magnitude of impact would be low.

10.5.19 Taking account of the low impact magnitude and the low sensitivity of the receptor, it is considered that the effect on the amenity of Thames Path users would be **negligible**.

Effect on the amenity of River Thames users

10.5.20 Assessments have been undertaken to examine the likelihood of significant air quality, construction dust, noise, vibration, and visual effects of the project arising during construction. For further information, refer to the respective construction effects sections within this volume (see Section 4 Air Quality, Section 9 Noise and vibration, and Section 11 Townscape and visual). The following points summarise the residual effect findings of those assessments in relation to the River Thames:

a. Local air quality effects would be **negligible**. Construction dust effects would be **minor adverse**.

b. No noise or vibration (human response) receptors were identified for assessment in relation to the River Thames.

c. No visual receptors were identified for assessment in relation to the River Thames at this location.

10.5.21 In assessing the overall magnitude of impact, the above findings have been taken into consideration together with the following factors that are considered relevant to the receptor's overall experience of amenity at this site:

a. Given the six year construction programme, the effects noted above would be likely to be experienced over a long term period.

b. The relatively low use of the River Thames adjacent to this site means any impacts would affect a relatively limited number of users.

c. Given that users of the River Thames would generally be passing the site rather than staying stationary alongside it, the time taken to pass by the site would be relatively short for most users.

d. It is also noted that the effect assessments have been conducted having regard to the base case, whereby the site is a designated safeguarded wharf. In light of this, the commercial and industrial nature of the site is such that the amenity experience of users would not be dramatically changed from the base case.

10.5.22 On the basis of the above findings and factors, it is considered that the magnitude of impact would be low.

10.5.23 Taking account of the low impact magnitude and the low sensitivity of the receptor, it is considered that the effect on the amenity of River Thames users would be **negligible**.

10.6 Operational effects assessment

Operational effects

Permanent gain of new landscaped public realm

10.6.1 The existing route of the Thames Path would be re-established. An area of civic space (ie, landscaped public realm) would also be provided.

10.6.2 The magnitude of the impact is influenced by the following factors:

a. The impact would be permanent.

b. The new area of public realm would provide for new, predominantly passive, recreational opportunities.

c. The new landscaped public realm would provide improved amenity for users in the form of opportunities to take in views of the River Thames to a greater degree than they can at present.

d. Given the low numbers of people that use this section of the Thames Path at most times of day, the rerouting and associated new public realm is likely to benefit a small number of users, including local residents and workers. However, it is considered that the provision of a high quality public realm space, such as that which is proposed, could increase the number of people who make use of the Thames Path and enjoy the public realm in this location.

10.6.3 Taking account of the above factors, in particular the permanent legacy that would arise, it is considered that the magnitude of the impact would be medium.

10.6.4 Given the medium impact magnitude and the medium sensitivity of users it is considered that the permanent gain of a new landscaped public realm would have a **moderate beneficial** effect.

10.7 Cumulative effects assessment

Construction effects

10.7.1 For the purposes of this cumulative assessment, the assessment year is the peak construction year.

10.7.2 Of the projects described in Section 10.3, a single development, Wandsworth Riverside Quarter, would be under construction during the peak construction year at the Carnwath Road Riverside site.

10.7.3 As this development is on the south side of the river, it would not be possible for this development to give rise to cumulative effects in respect of the displacement of the businesses situated at Carnwath Road Industrial Estate or the diversion of the Thames Path nearby the site.

10.7.4 In respect of the amenity assessments reported in Section 10.5, the development could give rise to cumulative effects on the amenity of potentially sensitive receptors such as residents, Thames Path users and River Thames recreational users. The air quality, construction dust, noise, vibration and visual cumulative effect assessments (see Section 4, Section

9 and Section 11 respectively) have concluded that there would not be any elevated effects which would affect the significance of the effect assessment made in each respective assessment. Therefore, it is considered that the Wandsworth Riverside Quarter development would not elevate or alter the significance of the effects of the Thames Tideway Tunnel project on the amenity of sensitive receptors located near the site.

10.7.5 Therefore the effects on socio-economics would remain as described in Section 10.5.

Operational effects

10.7.6 Of the projects described in Section 10.3, none would have the same type of effect as that considered in Section 10.5 and therefore there would not be any cumulative effects on socio-economics.

10.7.7 Therefore, the effects on socio-economics would remain as described in Section 10.5.

10.8 Mitigation and compensation

Mitigation

Construction

10.8.1 The above assessment has found that there is potential for a major adverse effect on the amenity of residents.

10.8.2 The assessment relating to amenity effects is based on the residual findings of the air quality, construction dust, noise, vibration and visual effect assessments. Where practicable and applicable, mitigation has been included and no further practicable mitigation can be adopted above those methods identified in the *CoCP*.

10.8.3 The above assessment has concluded that there would be no other major or moderate adverse socio-economic effects at the site requiring additional mitigation.

Operation

10.8.4 The above assessment has concluded that operational effects would be beneficial and therefore mitigation is not needed.

Compensation

Construction effects

10.8.5 A compensation programme (see Schedule 2 of the *Statement of Reasons*, which accompanies the application) has been established relating to construction disturbance - for example, noise, dust, vibration, and / or light disturbance from worksites at night. The programme has been established to address claims of exceptional hardship or disturbance.

10.8.6 In relation to the effects on residential amenity, the programme measures are not considered to be mitigation as there is no guarantee that the properties in question would be eligible for compensation or that the compensation would be accepted by the affected party. The residual effects reported in this *Environmental Statement* do not therefore take the offsetting effects of these measures into account. Further information is contained in the Thames Tideway Tunnel Compensation Programme (see Schedule 2 of the *Statement of Reasons*, which accompanies the application).

10.9 Residual effects assessment

Construction effects

10.9.1 As no further mitigation for amenity effects is practicable beyond those measures which have already been included in the *CoCP*, and as compensation only offsets rather than mitigates (ie, reduces) a significant adverse effect, the amenity effects on the nearby residents would remain as described in Section 10.5. All residual effects are presented in Section 10.10.

Operational effects

10.9.2 As no mitigation measures are proposed, the residual operational effects remain as described in Section 10.6. All residual effects are presented in Section 10.10.

10.10 Assessment summary

Vol 10 Table 10.10.1 Socio-economics – summary of construction assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect	Compensation
Businesses – Carnwath Road Industrial Estate	Displacement of businesses	Minor adverse	None	Minor adverse	
Users of the Thames Path	Temporary diversion of the Thames Path	Negligible	None	Negligible	
Residents	Effect on the amenity of residents (see para. 10.5.10 to para. 10.5.14 for detail)	Moderate adverse	No further on site mitigation practicable	Moderate adverse	Compensation mechanisms available for amenity related disturbance during the construction phase
Users of the Thames Path	Effect on the amenity of Thames Path users	Negligible	None	Negligible	
Users of the River Thames	Effect on the amenity of River Thames users	Negligible	None	Negligible	

Vol 10 Table 10.10.2 Socio-economics – summary of operational assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Future users of the landscaped public realm (future)	Permanent gain of new landscaped public realm	Moderate beneficial	None	Moderate beneficial

References

[1] Department of Environment, Food and Rural Affairs. National Policy Statement for Waste Water (2012). Available from: http://www.defra.gov.uk/publications/files/pb13709-waste-water-nps.pdf. Accessed November 2012

[2] Greater London Authority (GLA). *Safeguarded Wharves on the River Thames London Plan Implementation Report* (2005)

[3] Homes and Communities Agency. *Employment Densities Guide*, 2nd Edition (2010).

[4] LB of Hammersmith and Fulham. *Background Paper: Employment Land Assessment – Updating Statement* (May 2009)

[5] LB of Hounslow. *London Borough of Hounslow Employment Land Review* (2011)

[6] GLA. *The London Plan 2011* (2011), p. 234

[7] LB of Hammersmith and Fulham. *Local Development Framework: Core Strategy* (2011), p. 114

[8] LB of Hammersmith and Fulham. *Local Development Framework: Core Strategy* (2011), p. 85-86

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.10**

Volume 10: Carnwath Road Riverside site assessment

Section 11: Townscape and visual

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Thames Tideway Tunnel

Environmental Statement

Volume 10: Carnwath Road Riverside site assessment

Section 11: Townscape and visual

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11 Townscape and visual

11.1 Introduction

11.1.1 This section presents the findings of the assessment of the likely significant effects on townscape and visual amenity of the proposed development at the Carnwath Road Riverside site. Construction activities at the Carnwath Road Riverside highway works site would be small scale in nature and would not give rise to significant townscape and visual effects. Therefore the findings of the assessment presented here relate to the main site only. The assessment describes the current conditions found within and around the site – the nature and pattern of buildings, streets, open space and vegetation and their interrelationships within the built environment – and the changes that would be introduced as a result of the proposed development during construction and operation.

11.1.2 The effects of these changes during construction and operation are assessed. The construction phase assessment includes effects on townscape character areas, and visual effects during daytime and also night time to take account of effects arising from additional lighting. The operational phase assessment includes effects on townscape character areas, and visual effects during daytime for both winter and summer of Year 1 and summer only for Year 15. The assessment also identifies mitigation measures where appropriate.

11.1.3 Effects arising from lighting during the operational phase have not been assessed. This is on the basis that there would not be any significant effects (this is further explained in para. 11.3.18).

11.1.4 Each section of the assessment is structured so that townscape aspects are described first, followed by visual.

11.1.5 The assessment of the likely significant townscape and visual effects of the project has considered the requirements of the National Policy Statement (NPS) for Waste Water[1]. In line with these requirements, the townscape and visual assessment considers effects during construction and operation on townscape components, townscape character and visual receptors. The construction and design of the proposed development also takes account of townscape and visual considerations in line with the NPS recommendations. Vol 2 Section 11 provides further details on the methodology.

11.1.6 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Volume 10 Carnwath Road Riverside Figures).

11.1.7 A separate but related assessment of effects on the setting of heritage assets is included in Section 7 Historic environment.

11.2 Proposed development relevant to townscape and visual

11.2.1 The proposed development is described in Section 3 of this volume. The elements of the proposed development relevant to the townscape and visual assessment are set out below.

Construction

11.2.1 The specific construction works which may give rise to effects on townscape character and visual receptors are listed as follows, with the activities most likely to give rise to the most substantial townscape and visual effects described first:

a. clearance of the main site in advance of works, including demolition of buildings

b. presence of a noise shed enclosing the shaft site during the main tunnel drive and secondary lining of the tunnel

c. use of cranes during shaft sinking, the main tunnel drives and secondary lining of the tunnel

d. either construction of campsheds along the river wall (Option A) or construction of a jetty with campsheds alongside (Option B). There would be 24 hour loading of barges during the main tunnel drive for both options

e. provision of welfare facilities, assumed to be a maximum of three storeys in height

f. establishment of 3.6m high hoardings around the northern boundary of the main site, 5m high and 7.5m high hoardings (or stacked welfare facilities/site offices) on the western and eastern boundaries respectively, and 2.4m high hoardings along the river frontage to the south of the site

g. vehicular construction access to the site off Carnwath Road

h. lighting of the site when required (continuously during the main tunnel drive and secondary lining, lasting approximately 29 months).

Code of Construction Practice

11.2.2 Measures incorporated into the *Code of construction practice (CoCP) Part A* (Section 4) to reduce townscape and visual impacts include:

a. installation of well-designed visually attractive hoardings

b. the use of appropriate capped and directional lighting when required.

11.2.3 Measures incorporated into the *CoCP Part B* to reduce townscape and visual impacts include:

a. provision for incorporating suitable art work on public facing sections of hoarding (*CoCP Part B* Section 4)

b. use of 3.6m high hoardings around the boundary of the site (excluding the river frontage), 5m high hoardings at the western end of the site

(*CoCP Part B* Section 4) and the use of three storeys of welfare facilities to provide noise attenuation at the eastern end of the site (*CoCP Part B* Section 6).

Operation

11.2.4 The particular components of importance to this topic include the following:

a. design, siting and materials used for the building to house air management plant and equipment and the zones within which this may be located (Site works parameter plan, see separate volume of figures – Section 1)

b. design, siting and materials used for the ventilation column and the zones within which this above ground structure may be located (see Site works parameter plan – Section 1)

c. design, layout and materials used in the public realm including the treatment of paving, planting, seating, railings and lighting (see Proposed landscaping plan, separate volume of figures – Section 1).

Environmental design measures

11.2.5 Figures illustrating the proposed development during operation are contained in a separate volume (Volume 10 Carnwath Road Riverside figures). Where photomontages have been prepared to assist the assessment of effects, these are referenced in the appropriate viewpoint in Section 11.6.

11.2.6 Measures which have been incorporated into the design of the proposed development (described in the *Design Principles* report in Vol 1 Appendix B) include:

a. the surface of the shaft would be incorporated into a new landscaped public space, with the top of the shaft slab buried 1m below the finished surface level to enable tree planting

b. the architectural treatment of the building to house air management plant and equipment would coordinate with and complement the landscape design of the open space

c. the design of the ventilation column would mark it as a local landmark when viewed from the river and would be designed to enhance the local townscape

d. the building and boundary to the eastern edge of Whiffin Wharf would be clad in high quality materials that comply with the Sands End Conservation Area Appraisal

e. London plane trees would be used where appropriate to supplement native planting to enhance the landscape design of the site

f. the building to house air management plant and equipment would incorporate a high quality biodiverse roof, designed to be attractive when viewed from above

g. high quality hoardings would be left around the boundary of Hurlingham Wharf and the Carnwath Road industrial area

h. a riverside walkway would be provided along the frontage of Whiffin Wharf, with a minimum width of 6m

i. use of low level lighting which is capped and directional to minimise light spill.

11.3 Assessment methodology

Engagement

11.3.1 Volume 2 Environmental assessment methodology documents the overall engagement which has been undertaken in preparing the *Environmental Statement*. Specific comments relevant to this site for the assessment of townscape and visual effects are presented here.

11.3.2 The London Borough (LB) of Hammersmith and Fulham, LB of Wandsworth (located on the opposite side of the river) and English Heritage have been consulted on the detailed approach to the townscape and visual impact assessment, including the number and location of viewpoints. The LB of Wandsworth (May 2011) and English Heritage (May 2011) have confirmed acceptance of the proposed viewpoints. The LB of Hammersmith and Fulham have not commented on the proposed viewpoints.

11.3.3 In March 2011, English Heritage and the Environment Agency were consulted on the scope of the townscape and visual and ecology assessments through a site visit. English Heritage provided feedback on the proposed design, particularly in relation to its relationship with the adjacent listed Piper Building. English Heritage also indicated their agreement of the proposed visual assessment viewpoints prior to their formal acceptance (described in para. 11.3.2 above).

11.3.4 The stakeholders were also consulted on proposed changes to the viewpoints following the preliminary assessment findings, including removing some viewpoints from the operational assessment. The LB of Wandsworth (October 2012) have confirmed acceptance of the proposed changes. The LB of Hammersmith & Fulham and English Heritage have not commented on the proposed viewpoints.

11.3.5 A description of how the on-site alternatives to the proposed approach have been considered and the main reasons why these alternatives have not been adopted is included in Section 3.6.

Baseline

11.3.6 The baseline methodology follows the methodology described in Vol 2. In summary, the following surveys have been undertaken to establish baseline data for this assessment:

a. Preliminary site visit to check the zone of theoretical visibility (ZTV), establish the extents of townscape character areas and identify locations for visual assessment viewpoints (August 2011).

b. Photographic surveys of townscape character areas (August 2011).

c. Winter photographic survey of the view from each visual assessment viewpoint (December 2011).

d. Summer photographic survey of the view from visual assessment viewpoints considered in the operational assessment (August 2011).

e. Verifiable photography (December 2012) and verifiable surveying (December 2012) for the viewpoints requiring a photomontage to be produced, as agreed with the stakeholders (described in para. 11.3.2).

11.3.7 With specific reference to the Carnwath Road Riverside site, baseline information on open space distribution and type, conservation areas and townscape character has been gathered through a review of:

a. The Core Strategy for the LB of Hammersmith and Fulham (LB of Hammersmith and Fulham, 2011)[2]

b. The Core Strategy for the LB of Wandsworth (LB of Wandsworth, 2010) [3]

c. Sands End (LB of Hammersmith and Fulham, 1999) Conservation Area Character Profile, produced by the LB of Hammersmith and Fulham[4]

d. Draft South Fulham Riverside Supplementary Planning Document, produced by the LB of Hammersmith and Fulham (LB of Hammersmith and Fulham, 2011)[5]

e. The Thames Strategy: Kew to Chelsea (Atkins, 2002)[6].

Construction

11.3.8 The assessment methodology for the construction phase follows that described in Vol 2. Site specific variations are described below.

11.3.9 With reference to the Carnwath Road Riverside site, the peak construction phase relevant to this topic would be from Site Year 3 to Site Year 5 of construction, during the main tunnel drive and subsequent secondary lining, including 24 hour working, the presence of cranes at the site, and export and import of material by road, and export of materials by river. Site Year 3 has been used as the assessment year for townscape and visual effects.

11.3.10 Two verifiable photomontages have been prepared for this site to assist the assessment of construction effects. These are shown in Vol 10 Figure 11.5.1 and 11.5.2 (see separate volume of figures).

11.3.11 The assessment area, defined using the methodology provided in Vol 2, is indicated in Vol 10 Figure 11.4.5 for townscape and Vol 10 Figure 11.4.6 for visual (see separate volume of figures). The scale of the townscape assessment area has been set by the maximum extents of all character areas located partially or entirely within the construction phase ZTV, except in those locations up and downstream of the site where the construction works would be barely perceptible. The scale of the visual assessment area has been set by the maximum extents of the construction phase ZTV, except in those locations up and downstream of the site where the construction works would be barely perceptible. All visual assessment viewpoints are located within the ZTV.

11.3.12 Section 11.5 details the likely significant effects arising from the construction at the Carnwath Road Riverside site. There are no other Thames Tideway Tunnel project sites which could give rise to additional effects on the townscape and visual topic within the assessment area for this site, therefore no other Thames Tideway Tunnel project sites are included in this assessment.

11.3.13 For the construction base case for the assessment of effects arising from the proposed development at the Carnwath Road Riverside site, it is assumed that the following developments relevant to the townscape and visual assessment and within the assessment area would be complete and occupied by Site Year 3 of construction:

a. phase A of the Wandsworth Riverside Quarter mixed use development, 200m southwest of the site

b. mixed use development at Units 1-20 Enterprise Way 350m south of the site, comprising eight buildings ranging from 2-21 storeys in height

c. Osiers Road mixed use development comprising buildings up to eight storeys high, approximately 380m southwest of the site

d. Battersea Reach mixed use development 400m southeast of the site, comprising five buildings ranging from 6-15 storeys in height.

11.3.14 For the purposes of the cumulative effects assessment, it is assumed that phase B of the Wandsworth Riverside Quarter mixed use development would be under construction during Site Year 3 of construction at the Carnwath Road Riverside site.

11.3.15 The assessment of construction effects also considers the extent to which the assessment findings would be likely to be materially different, should the programme for the Thames Tideway Tunnel project be delayed by approximately one year.

Operation

11.3.16 The assessment methodology for the operational phase follows that described in Vol 2. Any site specific variations are described below.

11.3.17 Two verifiable photomontages have been prepared for this site to assist the assessment of operational effects. These are shown in Vol 10 Figure 11.6.1 and 11.6.2 (see separate volume of figures).

11.3.18 The operational phase assessment has been undertaken for Year 1 of operation and Year 15 of operation. The operation of the proposed development would have no substantial lighting requirements apart from low level lighting associated with the area of public realm. Therefore, no assessment of effects on night time character is made for this site during operation.

11.3.19 The assessment area, defined using the methodology provided in Vol 2, is indicated in Vol 10 Figure 11.4.5 for townscape and Vol 10 Figure 11.4.6 for visual (see separate volume of figures). The scale of the townscape assessment area has been set by the maximum extents of all character areas located partially or entirely within the operational phase ZTV, except in those locations up and downstream of the site where the proposed development would be barely perceptible. The scale of the visual assessment area has been set by the maximum extents of the operational phase ZTV, except in those locations up and downstream of the site where the proposed development would be barely perceptible. All visual assessment viewpoints are located within the ZTV.

11.3.20 Section 11.6 details the likely significant effects arising from the operation at the Carnwath Road Riverside site. There are no other Thames Tideway Tunnel project sites which could give rise to additional effects on the townscape and visual topic within the assessment area for this site, therefore no other Thames Tideway Tunnel project sites are considered in this assessment.

11.3.21 In terms of the operational base case for the assessment of effects on the Carnwath Road Riverside site, no further developments within the operational phase assessment area have been identified over and above that described in para 11.3.13 that meet the criteria for inclusion in the base case. Therefore, no other developments are reflected in the base case for the operational phase.

11.3.22 As detailed in the site development schedule (Vol 10 Appendix N) no schemes have been identified within 1km of the site which meet the criteria for inclusion in the cumulative assessment. Therefore no assessment of cumulative effects has been undertaken for effects on Carnwath Road Riverside site in the operational phase.

11.3.23 As with construction (para. 11.3.15), the assessment of operational effects also considers the extent to which the assessment findings would be likely to be materially different, should the programme for the Thames Tideway Tunnel project be delayed by approximately one year.

Assumptions and limitations

11.3.24 The assumptions and limitations associated with this assessment are presented in Vol 2. Site specific assumptions and limitations are detailed below.

Assumptions

11.3.25 For the purposes of the construction phase assessment, it is assumed that the construction activities and plant, noise shed, site hoardings, welfare facilities and access points are in the location shown on the construction phase 2 (shaft construction and tunnelling) plan, separate volume of figures – Section 1. The assessment of effects would be no worse if these elements of the proposed development were in different locations within the maximum extent of working area (Construction phase plans, separate volume of figures – Section 1), with the permanent structures under construction located within the zones shown on Site works parameter plan (separate volume of figures – Section 1).

11.3.26 For the purposes of the operational phase assessment, it is assumed that the above ground structures are in the location shown on the landscape plan (see Proposed landscape plan, separate volume of figure s – Section 1). The assessment of effects would be no worse if these elements of the proposed development were in different locations within the zones (shown on the Site works parameter plan, separate volume of figures – Section 1).

Limitations

11.3.27 There are no limitations specific to the assessment of this site.

11.4 Baseline conditions

11.4.1 The following section sets out the baseline conditions for the townscape and visual assessment within and around the site as follows:

a. Information on the physical elements that make up the overall townscape character of the assessment area (topography, land use, development patterns, vegetation, open space and transport routes), which inform the identification of townscape character areas. These form the receptors for the townscape assessment.

b. Information on the townscape character (including setting), condition, tranquillity, value and sensitivity of the site and each townscape character area.

c. Information on the nature of the existing views towards the site from all visual assessment viewpoints, during both daytime and night time and in both winter and summer where relevant. This is ordered beginning with the most sensitive receptors through to the least sensitive.

d. Future baseline conditions (base case) are also described.

Current baseline

Townscape baseline

Physical elements

11.4.2 The physical elements of the townscape in the assessment area are described below.

Topography

11.4.3 The site is located on relatively flat ground on the north bank of the river, with no notable topographic features in the wider assessment area. The land rises gently to the south, away from the river.

Land use

11.4.4 In the vicinity of the site, the river frontage of the north bank is dominated by disused wharves and industrial / commercial premises, set in front of a substantial residential area.

11.4.5 The land use on the south bank is dominated by new residential development alongside residual commercial uses including a waste transfer station and the large open space of Wandsworth Park.

Development patterns and scale

11.4.6 Vol 10 Figure 11.4.1 (see separate volume of figures) illustrates the pattern and scale of development and building heights within the assessment area.

11.4.7 The assessment area is characterised by a mix of development patterns. The river frontage along the north bank is characterised by open wharves and a mix of small and large scale commercial warehouses including a supermarket. The residential area further away from the river is characterised by a mix of two to three storey residential properties and larger apartment blocks, including the Piper building adjacent to the site, which includes a 12 storey tower. The residential areas are set out in a grid pattern of streets, and are influenced by the presence of the river.

11.4.8 On the south bank, the river frontage is characterised by recent large scale residential developments set amongst communal open spaces. This development is surrounded by commercial and industrial warehouses and industrial workings including a waste transfer directly opposite the site, and a cement batching plant adjacent to Wandsworth Bridge.

Vegetation patterns and extents

11.4.9 Vol 10 Figure 11.4.2 (see separate volume of figures) illustrates the pattern and extent of vegetation, including tree cover, within the assessment area.

11.4.10 Street tree planting is a common feature within the immediate surroundings of the site, including a line of young trees along Carnwath Road to the north of the site. Areas of planting are apparent within car parks, around residential buildings and in private gardens. In general, there is a strong green character along the north bank of the river, excluding the industrial and disused areas which are generally hard paved.

11.4.11 To the south of the river, with the exception of Wandsworth Park, vegetation cover is limited to small areas of planting within car parks and private gardens, along the railway line and along the River Wandle/ Bell Lane Creek corridor. Wandsworth Park, on the riverside, is characterised by dense bands of mature trees.

Open space distribution and type

11.4.12 Vol 10 Figure 11.4.3 (see separate volume of figures) illustrates the distribution of different open space types within the assessment area, indicating all relevant statutory, non-statutory and local plan designations.

11.4.13 The assessment area is characterised by several communal green spaces that are set amongst the new residential blocks, and large numbers of private rear gardens. Wandsworth Park represents the only main public open space within the assessment located 400m to the southwest on the opposite side of the river. This large riverfront park (categorised as a District Park in the GLA open space assessment) is characterised by large areas of amenity grassland with scattered trees and planting beds. The park is designated as a grade II Registered Historic Park and Garden and as Metropolitan Open Land.

Transport routes

11.4.14 Vol 10 Figure 11.4.4 (see separate volume of figures) illustrates the transport network within the assessment area, including cycleways, footpaths and Public Rights of Way.

11.4.15 The site is located to the west of Wandsworth Bridge Road, which represents the only strategic road in close proximity to the site on the north bank of the river.

11.4.16 The south bank is dominated by major transport routes, including Trinity Road (running north-south), the South Circular Road (running east-west) and the railway between Putney and Clapham Junction (running east-west, forming the southern boundary of the assessment area).

11.4.17 The Thames Path is located inland from the river on the north bank, diverting around the site and the disused Fulham Wharf to the east. On the south bank, the majority of the route follows the river, in front of new residential developments, although it is diverted inland around the waste transfer station.

Site character assessment

11.4.18 The site is located on the north bank of the River Thames, over three distinct areas:

a. Whiffin Wharf, a disused wharf currently cleared and surrounded by hoardings

b. Hurlingham Wharf, a safeguarded wharf, currently cleared and surrounded by hoardings

c. Carnwath Road Industrial Estate, characterised by a number of two storey industrial units.

11.4.19 The site is located within Sands End Conservation Area, designated by the LB of Hammersmith and Fulham.

11.4.20 The character of the site is illustrated by Vol 10 Plate 11.4.1, Vol 10 Plate 11.4.2 and Vol 10 Plate 11.4.3, and the components of the site are described in more detail in Vol 10 Table 11.4.1.

Vol 10 Plate 11.4.1 The character of the western part of the site (Whiffin Wharf)

Date taken: 25 August 2011. 50mm lens.

Vol 10 Plate 11.4.2 The character of the central part of the site (Hurlingham Wharf)

Date taken: 25 August 2011. 18mm lens.

Vol 10 Plate 11.4.3 The character of the eastern part of the site (Carnwath Road Industrial Estate)

Date taken: 25 August 2011. 50mm lens.

Vol 10 Table 11.4.1 Townscape – site components

ID	Component	Description	Condition
01	Semi-mature trees	Small number of semi-mature trees to the south of Carnwath Road close to existing buildings and at the entrance to Carnwath Road Industrial Estate.	Fair condition
02	Warehouse buildings	Two storey brick built commercial units with profiled sheet cladding to the top and roof.	Fair condition
03	Brick substation building	Low brick built substation within the Carnwath Road Industrial Estate.	Fair condition
04	Boundary walls	A combination of masonry, brick built and concrete post and plank walls along the north, east and west boundaries of the site.	Poor condition
05	Concrete block substation building	Low concrete block substation, accessed by a metal locked gate on Carnwath Road.	Poor condition
06	River wall	Predominantly steel sheet piled walls with a section of concrete wall along the river edge at the south of the site.	Fair condition

11.4.21 A baseline description of Sands End Conservation Area as a heritage asset is provided in Section 7.4 Historic environment.

11.4.22 The condition of the townscape within the site is fair to poor, due to the disused nature of some components and the limited maintenance undertaken on others.

11.4.23 Due to the industrial use of part of the site, dominance of hardstanding and location opposite the waste transfer station, the site has a low level of tranquillity.

11.4.24 The location of the site within the Sands End Conservation Area, would suggest a value at borough level, however the site has limited townscape value due to the industrial and disused nature of the area.

11.4.25 Due to its poor condition and limited townscape value, the site has a low sensitivity to change.

Townscape character assessment

11.4.26 The townscape character areas surrounding the site are identified in Vol 10 Figure 11.4.5 (see separate volume of figures). Townscape character areas are ordered beginning with the river reach, then to the north of the site and continuing around the site in a clockwise direction. Each area is described below.

River Thames – Wandsworth and Sands End Reach TCA

11.4.27 This reach of the river extends from Wandsworth Park in the west to the railway bridge south of Chelsea Creek. The reach is largely characterised by industrial uses interspersed with recent riverfront residential developments such as Imperial Wharf to the east of the site. The character of this area is illustrated by Vol 10 Plate 11.4.4.

Vol 10 Plate 11.4.4 River Thames – Wandsworth and Sands End Reach TCA

Date taken: 5 August 2011. 38mm lens.

11.4.28 The river is characterised by numerous jetties associated with current or past industrial uses. Both north and south banks have a relatively wide area of foreshore at low tide. The overall character is dominated by a changing environment from post-industrial to modern residential apartments.

11.4.29 With the exception of new developments, whereby new jetties and river walls have been constructed or renovated, the overall townscape condition is relatively poor.

11.4.30 Despite the surrounding industrial uses, the area has moderate levels of tranquillity due to the mix of industrial and residential uses along the frontage.

11.4.31 This reach is a regionally valued stretch of the river, providing the setting to a sizeable regeneration area along both banks.

11.4.32 On this basis and despite the relatively poor condition of the townscape, this character area has a medium sensitivity to change.

Sands End Conservation Area TCA

11.4.33 This area comprises part of Sands End Conservation Area, designated by the LB of Hammersmith and Fulham. This area is characterised by a mix of commercial/industrial warehouses, large scale retail units and disused wharf frontages. The commercial and large scale retail buildings form the character closest to the site and are one to two storeys high, set amongst large areas of hardstanding used for storage and car parking. The development pattern is enclosed in character, with no strong relationship with the character of the river. The character of this area in the vicinity of the site is illustrated by Vol 10 Plate 11.4.5.

Vol 10 Plate 11.4.5 Sands End Conservation Area TCA

Date taken: 25 August 2011. 18mm lens.

11.4.34 A baseline description of Sands End Conservation Area as a heritage asset is provided in Section 7.4 Historic environment.

11.4.35 The buildings and open spaces within the area are well maintained, although disused areas are in poor condition. The overall townscape condition is considered to be fair.

11.4.36 Due to the industrial/commercial use of the area and the dominance of hardstanding, this area has a low level of tranquillity.

11.4.37 The location within the Sands End Conservation Area would suggest a value at borough level, however this area has limited townscape value due to its industrial and disused nature.

11.4.38 Due to the fair condition, low level of tranquillity and limited townscape value, this character area has a low sensitivity to change.

Fulham Commercial TCA

11.4.39 This area is characterised by a cluster of one and two storey commercial premises, dominated by the footprint of the grade II listed Piper building in the east of the character area. The area is characterised by the buildings and surrounding areas of hardstanding, with limited levels of vegetation present. The area is enclosed in character. The character of this area is illustrated by Vol 10 Plate 11.4.6.

Vol 10 Plate 11.4.6 Fulham Commercial TCA

Date taken: 25 August 2011. 18mm lens.

11.4.40 The buildings and public realm within the area are well maintained. The overall townscape condition is good.

11.4.41 Due to the industrial and commercial uses, with regular HGV movements along Carnwath Road, this area has a low level of tranquillity.

11.4.42 In addition, due to the type of use, with an inherent lack of public amenity or vegetation, the area has limited townscape value.

11.4.43 Due to the low level of tranquillity and limited townscape value, this character area has a low sensitivity to change.

Fulham Residential TCA

11.4.44 This area is characterised by 19th century residential terraces with a similar pattern of density, building scale (two to three storeys) and architectural style across the area. Properties have small front gardens with on-street parking, although streets are softened by street trees and planting within gardens. The area is largely enclosed in character. The area falls partly within Hurlingham Conservation Area, designated by the LB of Hammersmith and Fulham. The character of this area is illustrated by Vol 10 Plate 11.4.7.

Vol 10 Plate 11.4.7 Fulham Residential TCA

Date taken: 25 August 2011. 18mm lens.

11.4.45 The buildings and public realm within the area are well maintained. The overall townscape condition is good.

11.4.46 Due to the residential use of the area, presence of vegetation throughout and the location adjacent to Hurlingham Park and South Park, this area has a high level of tranquillity.

11.4.47 The majority of the area is valued at the borough level by virtue of the conservation area designation.

11.4.48 Due to the good condition and borough value of the townscape, and the high level of tranquillity, this area has a high sensitivity to change.

Sherwood Wharf Residential TCA

11.4.49 This area is characterised by two new mixed use developments along the south bank of the river. The area is bounded by York Road to the east and a large waste transfer station to the west. The development pattern is heavily influenced by the river, with buildings orientated to maximise riverside views. Both developments are similar in scale, pattern and design detailing. Vegetation within the area is limited to occasional amenity shrubs and semi-mature trees. The character of this area is illustrated by Vol 10 Plate 11.4.8.

Vol 10 Plate 11.4.8 Sherwood Wharf Residential TCA

Date taken: 5 August 2011. 55mm lens.

11.4.50 The buildings and public realm within the area are well maintained. The overall townscape condition is good.

11.4.51 The tranquillity of the residential area located alongside the river is slightly diminished by the presence of some industrial premises and busy traffic along York Road. Therefore, this area has a moderate level of tranquillity.

11.4.52 The area is likely to be locally valued by residents within the character area.

11.4.53 Due to the good condition and local value of the townscape, and the moderate levels of tranquillity, this area has a medium sensitivity to change.

Osiers Road and Smugglers Way Industrial TCA

11.4.54 This character area comprises a large waste transfer station, large scale warehouse units and commercial offices, large areas of hardstanding used for car parking and some areas of disused land along the river frontage. The Thames Path passes through the area along Osiers Road and Smugglers Way, which are characterised by intermittent semi-mature trees. However, the majority of the area is dominated by large industrial / commercial buildings, internal roads and areas of hardstanding. The area is enclosed in character. The character of this area is illustrated by Vol 10 Plate 11.4.9.

Vol 10 Plate 11.4.9 Osiers Road and Smugglers Way Industrial TCA

Date taken: 5 August 2011. 18mm lens.

11.4.55 The buildings and streetscape of the area are relatively poorly maintained, including along the boundaries of the area. The condition of the townscape is therefore poor.

11.4.56 The area has low levels of tranquillity due to the industrial use of the area, the lack of open spaces or vegetation and the presence of the elevated railway line along the southern boundary of the character area.

11.4.57 The townscape has limited amenity value to the community due to the type of land use, and the lack of vegetation or open space.

11.4.58 Therefore due to the industrial land use, enclosed pattern of the development, limited amenity value of the townscape and the limited tranquillity of the area, the character area has a low sensitivity to change.

Point Pleasant Residential TCA

11.4.59 This area is characterised by a modern development of four to six storey residential apartments with privately owned and managed open spaces between the buildings. The area fronts onto the south bank of the river and provides a wide frontage which features the Thames Path. The character of the area is highly focused on the river. The character of this area is illustrated by Vol 10 Plate 11.4.10.

Vol 10 Plate 11.4.10 Point Pleasant Residential TCA

Date taken: 25 August 2011. 18mm lens.

11.4.60 The buildings and streetscape of the area are well maintained. The condition of the townscape is therefore good.

11.4.61 The area has moderate levels of tranquillity due to the residential land use, riverside frontage and limited volumes of traffic throughout the character area. This is moderated to a degree by the presence of commercial and industrial uses in the vicinity.

11.4.62 The townscape of the character area is likely to be locally valued by residents within the area.

11.4.63 Due to the good condition and local value of the townscape, and the importance of the riverside setting, this character area has a high sensitivity to change.

Wandsworth Park TCA

11.4.64 This area comprises Wandsworth Park, which is designated as Metropolitan Open Land and a grade II Registered Historic Park and Garden. The area is located along the river frontage, east of Putney Railway Bridge, and is characterised by open amenity grassland and sports pitches with mature tree planting along the river front and park boundaries. The park is one of only two grade II listed parks within the LB of Wandsworth, the other being Battersea Park. The character area is almost entirely surrounded by residential development, apart from the long river frontage. The character of this area is illustrated by Vol 10 Plate 11.4.11.

Vol 10 Plate 11.4.11 Wandsworth Park TCA

Date taken: 25 August 2011. 18mm lens.

11.4.65 The landscape, buildings and structures within the area are well maintained. The overall townscape condition is good.

11.4.66 Due to the extensive areas of green open space, the widespread presence of mature planting and the seclusion afforded from the dense urban development surrounding the character area, this area has a high level of tranquillity.

11.4.67 By virtue of the Metropolitan Open Land and Historic Park and Garden designations, this area is regionally valued.

11.4.68 Due to the good condition of the townscape, its regional value, and high levels of tranquillity, this character area has a high sensitivity to change.

Visual baseline

11.4.69 Vol 10 Figure 11.4.6 (see separate volume of figures) indicates the location of viewpoints referenced below. All residential and recreational receptors have a high sensitivity to change. For each viewpoint, the first part of the baseline description relates to the view during winter, the second part relates to the summer view for viewpoints considered in the operational assessment and the final part relates to the view at night time for the purposes of undertaking the assessment of effects arising from additional lighting during construction.

Residential

11.4.70 Residential receptors have a high sensitivity to change, as attention is often focused on the townscape surrounding the property rather than on another focused activity (as would be the case in predominantly employment or industrial areas). The visual baseline for residential receptors (represented by a series of viewpoints, agreed with consultees) is described below.

Viewpoint 1.1: View southwest from residences on Carnwath Road close to Dymock Street

11.4.71 This viewpoint is representative of the typical view from the residential properties on Carnwath Road adjacent to the site, close to the junction with Dymock Street.

Vol 10 Plate 11.4.12 Viewpoint 1.1: winter view

Date taken: 8 December 2011. 18mm lens.

11.4.72 The foreground of the view (illustrated in Vol 10 Plate 11.4.12) is dominated by the existing commercial units in the Carnwath Road Industrial Estate. Views of the site are unobstructed from this location.

Vol 10 Plate 11.4.13 Viewpoint 1.1: summer view

Date taken: 25 August 2011. 18mm lens.

11.4.73 In summer, the view towards the site (illustrated in Vol 10 Plate 11.4.13) is largely unchanged.

11.4.74 At night, the view is lit by street lighting, traffic and light spill from surrounding buildings.

Viewpoint 1.2: View northwest from residences on Smugglers Way close to Jews Row

11.4.75 This viewpoint is representative of the typical view from residential apartments in the most eastern block of the development on Smugglers Way, close to Jews Row.

Vol 10 Plate 11.4.14 Viewpoint 1.2: winter view

Date taken: 8 December 2011. 18mm lens.

11.4.76 The view (illustrated in Vol 10 Plate 11.4.14) is an open panorama over the river, focused on the industrial and disused frontage of the site, with the Piper building dominating the skyline behind the site. Views of the site are unobstructed from this location.

Vol 10 Plate 11.4.15 Viewpoint 1.2: summer view

Date taken: 25 August 2011. 18mm lens.

11.4.77 In summer, the view towards the site (illustrated in Vol 10 Plate 11.4.15) is largely unchanged.

11.4.78 At night, the view across the river is largely unlit. The view of the opposite river bank is characterised by low levels of light spill from commercial buildings along the frontage and the Piper building. The majority of the site (Whiffin Wharf and Hurlingham Wharf) is unlit.

Viewpoint 1.3: View northwest from residences on the junction of Tonsley Road and Tonsley Place

11.4.79 This viewpoint is representative of the distant view from residential properties at the junction of Tonsley Road and Tonsley Place.

Vol 10 Plate 11.4.16 Viewpoint 1.3: winter view

Date taken: 8 December 2011. 18mm lens.

11.4.80 The glimpsed view (illustrated in Vol 10 Plate 11.4.16) towards the site is framed between foreground buildings towards the river and the site. The river and north bank are intermittently visible due to the gradual rise in ground levels away from the river, creating an area with panoramic views over the townscape. Views of the site from this location are largely obstructed by intervening buildings.

11.4.81 At night, the foreground of the view is lit by street lighting, traffic and light spill from surrounding residential buildings.

Viewpoint 1.4: View northeast from residences on Eastfields Avenue

11.4.82 This viewpoint is representative of the typical view from residential apartments in the most eastern block of the development on Eastfields Avenue, close to Bell Lane Creek.

Vol 10 Plate 11.4.17 Viewpoint 1.4: winter view

Date taken: 8 December 2011. 18mm lens.

11.4.83 The view (illustrated in Vol 10 Plate 11.4.17) is an open panorama over the river towards Wandsworth Bridge in the east. The view across the river is characterised by the industrial and retail premises, and derelict cleared wharves along Carnwath Road to the east (the majority of which fall within the site boundary). The Piper building, immediately north of the site, forms a dominant skyline feature in the background of the view. Views of the site are unobstructed from this location.

Vol 10 Plate 11.4.18 Viewpoint 1.4: summer view

Date taken: 25 August 2011. 18mm lens.

11.4.84 In summer, the view towards the site (illustrated in Vol 10 Plate 11.4.18) is largely unchanged.

11.4.85 At night, the view across the river is largely unlit. The view of the opposite river bank is characterised by low levels of light spill from commercial buildings along the frontage and the Piper building. The majority of the site (Whiffin Wharf and Hurlingham Wharf) is unlit.

Viewpoint 1.5: View northeast from residences on Point Pleasant

11.4.86 This viewpoint is representative of the typical view from residential apartments in the riverside development on Point Pleasant, close to Wandsworth Park.

Vol 10 Plate 11.4.19 Viewpoint 1.5: winter view

Date taken: 8 December 2011. 18mm lens.

11.4.87 The view (illustrated in Vol 10 Plate 11.4.19) is an open panorama over the river towards Wandsworth Bridge in the east (in the background of the image shown above). The view across the river is characterised by (from left to right) the green frontage of Hurlingham Gardens, residential properties and, in the far background, the industrial and retail premises, and derelict cleared wharves located within the site boundary. The Piper building, immediately north of the site, forms a skyline feature in the background of the view. Views of the site from this location are largely obscured by intervening buildings.

11.4.88 At night, the view across the river is largely unlit. The view of the opposite river bank is characterised by low levels of light spill from commercial buildings along the frontage and the Piper building. The majority of the site (Whiffin Wharf and Hurlingham Wharf) is unlit.

Recreational

11.4.89 Recreational receptors (apart from those engaged in active sports) generally have a high sensitivity to change, as attention is focused on enjoyment of the townscape. Tourists engaged in activities whereby attention is focused on the surrounding townscape also have a high sensitivity to change. The visual baseline in respect of recreational receptors, including tourists, is discussed below.

Viewpoint 2.1: View west from Wandsworth Bridge

11.4.90 This viewpoint is representative of the typical view for pedestrians crossing Wandsworth Bridge.

Vol 10 Plate 11.4.20 Viewpoint 2.1: winter view

Date taken: 8 December 2011. 18mm lens.

11.4.91 This linear view (illustrated in Vol 10 Plate 11.4.20) is focused up the river and is framed by a mix of residential high-rise and industrial development to the south (left hand side of the image), and largely commercial uses and derelict wharves to the north (right hand side of the image). Wandsworth Park and Hurlingham Gardens form the background of the view, with Putney railway bridge in the far distance. The Piper building, immediately north of the site, forms a skyline feature in the middle ground of the view. Views of the site are largely unobstructed from this location.

Vol 10 Plate 11.4.21 Viewpoint 2.1: summer view

Date taken: 25 August 2011. 18mm lens.

11.4.92 In summer, the view towards the site (illustrated in Vol 10 Plate 11.4.21) is largely unchanged.

11.4.93 At night, the view across the river is largely unlit. The view of the opposite river bank is characterised by low levels of light spill from commercial buildings along the frontage and the Piper building. The majority of the site (Whiffin Wharf and Hurlingham Wharf) is unlit.

11.4.94 A baseline description of Wandsworth Bridge as a heritage asset is provided in Section 7.4 Historic environment.

Viewpoint 2.2: View northwest from the garden of The Ship public house

11.4.95 This viewpoint is representative of the typical view for recreational users of the riverside garden of The Ship public house on Jews Row, close to Wandsworth Bridge.

Vol 10 Plate 11.4.22 Viewpoint 2.2: winter view

Date taken: 8 December 2011. 18mm lens.

11.4.96 The view (illustrated in Vol 10 Plate 11.4.22) is an open panorama over the river towards Putney railway bridge in the west, in the distant background of the view. The view across the river is characterised by the industrial and retail premises, and derelict cleared wharves along Carnwath Road, the majority of which fall within the site boundary. The Piper building, immediately north of the site, forms a dominant component in the background of the view. Views of the site are largely unobstructed from this location.

Vol 10 Plate 11.4.23 Viewpoint 2.2: summer view

Date taken: 25 August 2011. 18mm lens.

11.4.97 In summer, the view towards the site (illustrated in Vol 10 Plate 11.4.23) is largely unchanged.

11.4.98 At night, the view across the river is largely unlit. The view of the opposite river bank is characterised by low levels of light spill from commercial buildings along the frontage and the Piper building. The majority of the site (Whiffin Wharf and Hurlingham Wharf) is unlit.

Viewpoint 2.3: View north from Bell Lane Spit

11.4.99 This viewpoint is representative of the typical view for recreational users of the small open space at the confluence of the River Wandle and Bell Lane Creek.

Vol 10 Plate 11.4.24 Viewpoint 2.3: winter view

Date taken: 8 December 2011. 18mm lens.

11.4.100 The view (illustrated in Vol 10 Plate 11.4.24) is focused down the River Wandle to the River Thames. The waste transfer station forms a dominant component in the foreground of the view, largely obscuring views towards the site. The Piper building forms a skyline feature in the background of the view.

Vol 10 Plate 11.4.25 Viewpoint 2.3: summer view

Date taken: 25 August 2011. 18mm lens.

11.4.101 In summer, the view towards the site (illustrated in Vol 10 Plate 11.4.25) is largely unchanged despite the presence of mature trees on the periphery of the foreground view.

11.4.102 At night, the foreground of the view is dimly lit by intermittent light spill from the waste transfer station. The background view across the river is dimly lit by light spill from residential buildings on the opposite bank, adjacent to the site.

Viewpoint 2.4: View northeast from the Thames Path in Wandsworth Park

11.4.103 This viewpoint is representative of the typical view for recreational users of the Thames Path within Wandsworth Park.

Vol 10 Plate 11.4.26 Viewpoint 2.4: winter view

Date taken: 8 December 2011. 18mm lens.

11.4.104 The view (illustrated in Vol 10 Plate 11.4.26) is an open panorama over the river towards Wandsworth Bridge to the east. The view across the river is characterised by (from left to right) the green frontage of Hurlingham Gardens, residential blocks and in the background the industrial and retail premises, and derelict cleared wharves along Carnwath Road to the east (the majority of which fall within the site boundary). The Piper building, immediately north of the site, forms a skyline feature in the background of the view. Views of the site from this location are partially obscured by intervening buildings.

11.4.105 At night, the view across the river is largely unlit. The view of the opposite river bank is characterised by low levels of light spill from commercial buildings along the frontage and the Piper building. The majority of the site (Whiffin Wharf and Hurlingham Wharf) is unlit.

Viewpoint 2.5: View east from the Thames Path at the junction of Broomhouse Lane and Carnwath Road

11.4.106 This viewpoint is representative of the typical view for recreational users of the Thames Path at the junction of Broomhouse Lane and Carnwath Road, adjacent to Hurlingham Gardens.

Vol 10 Plate 11.4.27 Viewpoint 2.5: winter view

Date taken: 8 December 2011. 18mm lens.

11.4.107 The linear view (illustrated in Vol 10 Plate 11.4.27) looking along Carnwath Road is framed by commercial premises to the north, and residential properties to the south. The site is partially visible in the background of the view.

Vol 10 Plate 11.4.28 Viewpoint 2.5: summer view

Date taken: 25 August 2011. 18mm lens.

11.4.108 In summer, deciduous trees partially screen the view towards the site (illustrated in Vol 10 Plate 11.4.28).

11.4.109 At night, the foreground of the view is lit by street lighting, traffic and light spill from surrounding buildings.

Viewpoint 2.6: View east from the Thames Path alongside residences on Carnwath Road

11.4.110 This viewpoint is representative of the typical view for recreational users of the Thames Path in front of residences along the western end of Carnwath Road.

Vol 10 Plate 11.4.29 Viewpoint 2.6: winter view

Date taken: 8 December 2011. 18mm lens.

11.4.111 The view across the river (illustrated in Vol 10 Plate 11.4.29) towards Wandsworth Bridge is characterised by high-rise residential developments and the waste transfer station (just beyond the field of view shown), either side of Bell Lane Creek on the opposite side of the river. The linear view down the Thames Path is framed by residences lining the route, with the existing site hoardings forming the background of the view.

Vol 10 Plate 11.4.30 Viewpoint 2.6: summer view

Date taken: 25 August 2011. 18mm lens.

11.4.112 In summer, mature trees in the middle ground of the view (illustrated in Vol 10 Plate 11.4.30) partially screen views towards the site.

11.4.113 At night, the foreground of the view is lit by public realm lighting along the Thames Path and light spill from adjacent residential properties. The site, in the middle ground of the view, is unlit.

Construction base case

11.4.114 The base case in Site Year 3 of construction, taking into account the schemes described in para. 11.3.13, would change the character of the following receptors:

a. Sherwood Wharf Residential TCA – The Battersea Reach mixed use development would be located in an area of currently disused land, reinforcing the residential character. However, the medium sensitivity of the area would remain unchanged.

b. Osiers Road and Smugglers Way Industrial TCA – The character of this area would be altered by the assumed completion of the Wandsworth Quarter, Enterprise Way and Osiers Road mixed use developments. Despite some industrial premises remaining, including the waste transfer station, the overall character of the area would be predominantly residential. Therefore, the majority of the area would be likely to be in a good condition, with moderate levels of tranquillity and likely to be valued locally by residents within the area. Therefore, the change in character would alter the sensitivity of the area from low to medium by Site Year 3 of construction.

11.4.115 All other receptors would remain as detailed in the baseline. The base case schemes described above would introduce new visual receptors, but the views from these locations are represented by viewpoints 1.2 and 1.4.

Operational base case

11.4.116 For the purposes of the Year 1 and Year 15 assessments, it is assumed that there would be no further substantial change in the townscape and visual baseline between 2012 and the assessment years.

11.5 Construction effects assessment

11.5.1 The following section describes the likely significant effects arising from construction at Carnwath Road Riverside site.

11.5.2 Due to the scale of the construction activities proposed across what are, in many cases, prominent locations in London, construction works would be highly visible. In policy terms, the NPS for waste water[7] recognises that nationally significant infrastructure projects are likely to take place in mature urban environments, with adverse construction effects on townscape and visual receptors likely to arise. In addition, construction works are a commonplace feature across London, and therefore the following assessment should be viewed in this context. It should also be noted that construction effects are temporary in nature and relate to the peak construction year defined in Section 11.3. Effects during other phases of works are likely to be less due to fewer construction plant being required at the time and a reduced intensity of construction activity.

11.5.3 Plans of the possible layout of the site during construction are contained in a separate volume (see Construction phase plans, separate volume of figures – Section 1). Where photomontages have been prepared to assist the assessment of effects, these are referenced in the appropriate viewpoint below.

Site character assessment

11.5.4 Effects on the character of the site would arise from the clearance of the site including demolition of buildings and structures, installation of site hoardings, welfare facilities and the noise shed, construction activity associated with the construction of the shaft and ventilation equipment (standard working hours), and the main tunnel drive and secondary lining (24 hour working). The impacts on specific components of the site are described in Vol 10 Table 11.5.1

Vol 10 Table 11.5.1 Townscape – impacts on existing site components during construction

ID	Component	Impacts
01	Semi-mature trees	The majority of trees within the area would be felled prior to construction, apart from those located close to the existing entrance to Carnwath Road Industrial Estate, which would be retained and protected during construction.
02	Warehouse buildings	Demolished during construction.
03	Brick substation building	Retained and protected during construction.
04	Boundary walls	Demolished during construction.
05	Concrete block substation building	Retained and protected during construction.
06	River wall	The river wall along Hurlingham Wharf and the Carnwath Road industrial estate would be replaced by a new steel sheet pile wall.

11.5.5 The low level of tranquillity at the site would be affected to a limited extent due to introduction of construction vehicles, plant equipment and high levels of activity in an area not currently intensively used.

11.5.6 Due to the clearance of the site and the level of activity substantially affecting character and also affected tranquillity to a limited extent, the magnitude of change is considered to be high.

11.5.7 The high magnitude of change, assessed alongside the low sensitivity of the site, would result in **minor adverse** effects.

11.5.8 The assessment of specific effects on the setting of Sands End Conservation Area as a heritage asset is set out in Section 7 Historic environment. The historic environment assessment identifies a moderate adverse effect on the setting of this asset due to differences between the townscape and visual and historic environment methodologies.

Townscape character areas assessment

River Thames – Wandsworth and Sands End Reach TCA

11.5.9 The proposed site is located adjacent to this reach of the river. The proposed development would introduce high levels of construction activity alongside and within the river, albeit on a stretch characterised by wharves and industrial uses. The proposed campsheds (Option A) or jetty with campsheds alongside (Option B) would form an additional projection into the river in front of the safeguarded wharf.

11.5.10 The moderate levels of tranquillity within the area would be affected by continuous construction activity, demolition and loading of barges.

11.5.11 Due to the change in character, set against the existing presence of wharves and industrial uses, and the changes to tranquillity, the magnitude of change is considered to be medium.

11.5.12 The medium magnitude of change, assessed alongside the medium sensitivity of this character area, would result in **moderate adverse** effects.

Sands End Conservation Area TCA; and Fulham Commercial TCA

11.5.13 The proposed site forms part of the immediate setting for these character areas. The setting would be affected by the demolition of buildings and presence of site hoardings, construction activity, the noise shed and road transport.

11.5.14 The low levels of tranquillity in the areas would be affected to a limited extent by continuous construction activity at the site.

11.5.15 Due to the substantial changes to the immediate setting, the magnitude of change is considered to be high.

11.5.16 The high magnitude of change, assessed alongside the low sensitivity of these character areas, would result in **minor adverse** effects.

11.5.17 The assessment of specific effects on the setting of Sands End Conservation Area as a heritage asset is set out in Section 7 Historic environment. The historic environment assessment identifies a moderate adverse effect on the setting of this asset due to differences between the townscape and visual and historic environment methodologies.

Fulham Residential TCA

11.5.18 The proposed site forms part of the immediate setting for a small part of this character area. The setting would be affected to a limited extent by the demolition of buildings and presence of construction activity and plant. However, the presence of site hoardings and road transport would be largely contiguous with the existing setting of this area. Furthermore, the majority of the setting would be unaffected.

11.5.19 The moderate levels of tranquillity in the area would be affected to a limited extent by continuous construction activity at the site.

11.5.20 Due to the changes to a small part of the areas setting and the limited changes to tranquillity, the magnitude of change is considered to be low.

11.5.21 The low magnitude of change, assessed alongside the high sensitivity of the character area, would result in **minor adverse** effects.

Sherwood Wharf Residential TCA

11.5.22 The proposed site forms part of the riverside setting of this character area, particularly the area west of Wandsworth Bridge. The setting of the area would be affected by demolition and the presence of the noise shed, construction activity and construction plant. However, the majority of the riverside setting, located east of Wandsworth Bridge, would be largely unaffected.

11.5.23 The moderate levels of tranquillity in the area would be largely unaffected.

11.5.24 Due to the changes in part of the riverside setting, the magnitude of change is considered to be low.

11.5.25 The low magnitude of change, assessed alongside the medium sensitivity of this character area, would result in **minor adverse** effects.

Osiers Road and Smugglers Way Industrial TCA

11.5.26 The proposed site forms part of the riverside setting for this character area. The setting would be affected by the demolition of buildings and presence of construction activity, construction plant and continuous loading of barges on either campsheds (Option A) or a jetty with campsheds alongside (Option B). However, part of the riverside setting is formed by high rise residential developments in neighbouring character areas, and the waste transfer station, which would remain unchanged.

11.5.27 The low level of tranquillity in the area would be largely unaffected, due to the wider presence of construction activity set against the presence of the waste transfer station within the character area.

11.5.28 Due to the changes to part of the riverside setting of the character area, set against the context of the existing waste transfer station, the magnitude of change is considered to be low.

11.5.29 The low magnitude of change, assessed alongside the medium sensitivity of this character area, would result in **minor adverse** effects.

Point Pleasant Residential TCA

11.5.30 The proposed site forms part of the riverside setting for this character area. The setting would be affected by the demolition of buildings and presence of construction activity, construction plant and continuous loading of barges on either campsheds (Option A) or a jetty with campsheds alongside (Option B). However, part of the riverside setting, focused on Hurlingham Gardens, would be unaffected.

11.5.31 The moderate levels of tranquillity would be largely unaffected by construction activity at the site.

11.5.32 Due to changes in the wider riverside setting, the magnitude of change is considered to be low.

11.5.33 The medium magnitude of change, assessed alongside the high sensitivity of this character area, would result in **moderate adverse** effects.

Wandsworth Park TCA

11.5.34 The proposed site forms part of the wider riverside setting for this character area. The setting would be affected by the demolition of buildings and presence of construction activity, construction plant and continuous loading of barges on either campsheds (Option A) or a jetty with campsheds alongside (Option B). However, the majority of the riverside setting, focused on Hurlingham Gardens, would be largely unaffected.

11.5.35 The high levels of tranquillity would be largely unaffected by construction activity at the site.

11.5.36 Due to changes in part of the wider riverside setting, the magnitude of change is considered to be low.

11.5.37 The low magnitude of change, assessed alongside the high sensitivity of these character areas, would result in **minor adverse** effects.

Townscape – sensitivity test for programme delay

11.5.38 For the assessment of townscape effects during construction, a delay to the Thames Tideway Tunnel project of approximately one year would not be likely materially to change the assessment findings reported above (paras. 11.5.4 to 11.5.37). The area opposite the site (on the south bank of the river) is subject to ongoing and long term change, and a delay to the Thames Tideway Tunnel project is not likely to change the sensitivity to change of the townscape character areas already presented (paras. 11.4.2 to 11.4.68).

Visual assessment

11.5.39 The visual assessment for the construction phase has been undertaken during winter, in line with best practice guidance, to ensure a robust assessment. However, in some cases, visibility of construction activities may be reduced during summer when vegetation, if present in a view, would be in leaf.

Residential

Viewpoint 1.1: View southwest from residences on Carnwath Road close to Dymock Street

11.5.40 The foreground of the view from this location would be characterised by site hoardings, welfare facilities, construction activity and construction traffic movements along Carnwath Road. Tall construction plant, the noise shed and cranes would be visible in the background of the view. Therefore, the magnitude of change is considered to be high.

11.5.41 The high magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **major adverse** effects.

11.5.42 At night, 24 hour lighting of the site would be visible in the foreground of the view partially screened by the site hoardings. However, due to the use of capped and directional lighting (set out in the *CoCP*, described in para. 11.2.2), and the existing brightly lit character of the view, the magnitude of change to the receptor at night is considered to be low, resulting in **minor adverse** effects.

Viewpoint 1.2: View northwest from residences on Smugglers Way close to Jews Row; and Viewpoint 1.4: View northeast from residences on Eastfields Avenue

11.5.43 The view across the river from these locations would encompass construction activity, the noise shed, welfare facilities, construction plant and continuous loading of barges on either campsheds (Option A) or a jetty with campsheds alongside (Option B). The views would also be affected by the demolition of the existing commercial units in Carnwath Road Industrial Estate. However, the construction activities would be set in the context of the existing industrial use of the site. Therefore, the magnitude of change is considered to be medium.

11.5.44 The medium magnitude of change, assessed alongside the high sensitivity of these receptors, would result in **major adverse** effects.

11.5.45 At night, 24 hour lighting of the site would be visible in the views across the river. The view of the proposed development at night from viewpoint 1.4 is illustrated in Vol 10 Plate 11.5.1 (Option A) and Vol 10 Plate 11.5.2 (Option B) below. A larger scale print of the photomontage, including the wider context and annotations, is provided in Vol 10 Figure 11.5.1 (Option A) and Vol 10 Figure 11.5.2 (Option B) (see separate volume of figures). The verifiable photomontage shows an illustration of how the construction site may be set up during phase 2 (shaft construction and tunnelling), for both Option A and B. The layout of the construction activities may change within the maximum extent of working area (see Construction phases – phase 2 shaft construction and tunnelling plan, separate volume of figures – Section 1). The foreground of the views would remain largely unaffected, but the lighting at the site would be visible against what is at present a predominantly unlit frontage. However, due to the use of capped and directional lighting (set out in the *CoCP*, described in para. 11.2.2), the magnitude of change to the receptors at night is considered to be low, resulting in **minor adverse** effects.

Vol 10 Plate 11.5.1 Viewpoint 1.4 – illustrative night time construction phase photomontage (Option A)

Date taken: 12 December 2011. 50mm lens.

Vol 10 Plate 11.5.2 Viewpoint 1.4 – illustrative night time construction phase photomontage (Option B)

Date taken: 12 December 2011. 50mm lens.

Viewpoint 1.3: View northwest from residences on the junction of Tonsley Road and Tonsley Place

11.5.46 Views from this location towards the site would be largely obscured by intervening buildings in the foreground and middle ground of the view. Cranes would be intermittently visible above the roofline, forming barely perceptible components of the wider view. Therefore, the magnitude of change is considered to be negligible.

11.5.47 The negligible magnitude of change, assessed alongside the high sensitivity of the receptor, would result in a **negligible** effect.

11.5.48 At night, due to the use of capped and directional lighting (refer to para. 11.2.2), 24 hour lighting of the site would be barely perceptible from this viewpoint. The magnitude of change to this receptor at night is therefore considered to be negligible, resulting in a **negligible** effect.

Viewpoint 1.5: View northeast from residences on Point Pleasant

11.5.49 Views from residences towards the site would be affected during construction. Construction activity, the noise shed, welfare facilities and continuous loading of barges would be visible in the periphery of the panoramic view over the river on either campsheds (Option A) or a jetty with campsheds alongside (Option B). However, the majority of the river panorama would be unaffected. Therefore, the magnitude of change is considered to be low.

11.5.50 The low magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **minor adverse** effects.

11.5.51 At night, due to the use of capped and directional lighting (refer to para. 11.2.2), 24 hour lighting of the site would be barely perceptible from this viewpoint. The magnitude of change to this receptor at night is therefore considered to be negligible, resulting in a **negligible** effect.

Recreational

Viewpoint 2.1: View west from Wandsworth Bridge; and Viewpoint 2.2: View northwest from the garden of The Ship public house

11.5.52 Views from these locations towards the site would be affected during construction. Construction activity, welfare facilities, construction plant, demolition of buildings and continuous loading of barges would be visible in the foreground of the view on either campsheds (Option A) or a jetty with campsheds alongside (Option B), while tall construction plant and the noise shed would be visible in the background of the view. However, the construction activities would be set in the context of the existing industrial use of the site. The view of the proposed development from viewpoint 2.1 is illustrated in Vol 10 Plate 11.5.3 (Option A) and Vol 10 Plate 11.5.4 (Option B) below. A larger scale print of the photomontage, including the wider context and annotations, is provided in Vol 10 Figure 11.5.3 (Option A) and Vol 10 Figure 11.5.4 (Option B) (see separate volume of figures). The verifiable photomontage shows an illustration of how the construction site may be set up during phase 2 (shaft construction and tunnelling). The layout of the construction activities may change within the maximum extent of working area (see Construction phases – phase 2 shaft construction and tunnelling plan, separate volume of figures – Section 1).

Vol 10 Plate 11.5.3 Viewpoint 2.1 – illustrative construction phase photomontage (Option A)

Date taken: 5 December 2011. 50mm lens.

Vol 10 Plate 11.5.4 Viewpoint 2.1 – illustrative construction phase photomontage (Option B)

Date taken: 5 December 2011. 50mm lens.

11.5.53 Due to the visibility of construction activities, set against the existing industrial use of the site, the magnitude of change is considered to be medium.

11.5.54 The medium magnitude of change, assessed alongside the high sensitivity of these receptors, would result in **moderate adverse** effects.

11.5.55 At night, 24 hour lighting of the site would be visible in the views across the river. The foreground of the views would remain largely unaffected, but the lighting at the site would be visible against what is at present a predominantly unlit frontage. However, due to the use of capped and directional lighting (set out in the CoCP, described in para. 11.2.2), the magnitude of change to the receptors at night is considered to be low, resulting in **minor adverse** effects.

11.5.56 The assessment of specific effects on the setting of Wandsworth Bridge as a heritage asset is set out in Section 7 Historic environment. The historic environment assessment identifies a minor adverse effect on the setting of this asset as the setting is wider than the field of view experienced by a pedestrian crossing the bridge in this location. Therefore, much of the setting of the bridge would be unchanged, as opposed to the substantial change visible from this specific viewpoint.

Viewpoint 2.3: View north from Bell Lane Spit

11.5.57 Views from this location towards the site would be affected to a limited extent during construction. Construction activity, the noise shed, continuous leading of barges, on either campsheds (Option A) or a jetty with campsheds alongside (Option B), and other construction plant towards the western end of the site (where the shaft would be located) would be visible in the background of the view, set against the foreground context of the waste transfer station. Wider views of the site would be obstructed by the waste transfer station. Therefore, the magnitude of change is considered to be low.

11.5.58 The low magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **minor adverse** effects.

11.5.59 At night, due to the use of capped and directional lighting (refer to para. 11.2.2), 24 hour lighting of the site would be barely perceptible from this viewpoint. The magnitude of change to this receptor at night is therefore considered to be negligible, resulting in a **negligible** effect.

Viewpoint 2.4: View northeast from the Thames Path in Wandsworth Park

11.5.60 Views from this location towards the site would be affected to a limited extent during construction. Construction activity, the noise shed, tall construction plant and continuous loading of barges would be visible in the periphery of the panoramic view over the river on either campsheds (Option A) or a jetty with campsheds alongside (Option B). The majority of the river panorama would be unaffected. Therefore, the magnitude of change is considered to be low.

11.5.61 The low magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **minor adverse** effects.

11.5.62 At night, due to the use of capped and directional lighting (refer to para. 11.2.2), 24 hour lighting of the site would be barely perceptible from this viewpoint. The magnitude of change to this receptor at night is therefore considered to be negligible, resulting in a **negligible** effect.

Viewpoint 2.5: View east from the Thames Path at the junction of Broomhouse Lane and Carnwath Road

11.5.63 The linear view along Carnwath Road would be affected, although to a limited extent, by road transport. Site hoardings would be visible in the background of the view, but would represent a barely perceptible change to the existing hoardings surrounding the site. Tall construction plant and cranes would be intermittently visible in the background of the view and above the roofline of foreground buildings. Therefore, the magnitude of change is considered to be low.

11.5.64 The low magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **minor adverse** effects.

11.5.65 At night, due to the use of capped and directional lighting (refer to para. 11.2.2), 24 hour lighting of the site would be barely perceptible from this viewpoint. The magnitude of change to this receptor at night is therefore considered to be negligible, resulting in a **negligible** effect.

Viewpoint 2.6: View east from the Thames Path alongside residences on Carnwath Road

11.5.66 The linear view from this location along the Thames Path would be affected by the visibility of the noise shed above the site hoardings, and the continuous loading of barges in front of the existing river wall on either campsheds (Option A) or a jetty with campsheds alongside (Option B). Wider views across the river would be unaffected. Therefore, the magnitude of change is considered to be medium.

11.5.67 The medium magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **moderate adverse** effects.

11.5.68 At night, 24 hour lighting of the site would be visible in the view across the river. The foreground of the view would remain largely unaffected, but the lighting at the site would be visible against what is at present a predominantly unlit frontage. However, due to the use of capped and directional lighting (set out in the CoCP, described in para. 11.2.2), the magnitude of change to the receptor at night is considered to be low, resulting in **minor adverse** effects.

Visual effects – sensitivity test for programme delay

11.5.69 For the assessment of visual effects during construction, a delay to the Thames Tideway Tunnel project of approximately one year would not be likely materially to change the assessment findings reported above (paras. 11.5.40 to 11.5.68). This is on the basis that there are no known schemes within the assessment area that would introduce new visual receptors, or alter visibility of the proposed development from the viewpoints described in paras. 11.4.70 to 11.4.113.

11.6 Operational effects assessment

11.6.1 The following section describes the likely significant effects arising during the operational phase at the Carnwath Road Riverside site.

11.6.2 Effect on tranquillity is one factor which informs the overall assessment of effects on townscape character. Since the operation of the proposed development would have little above-ground activity associated with it, apart from infrequent maintenance visits, it is considered that the proposed development would have a negligible effect on tranquillity for all townscape character areas. This conclusion is not repeated for each character area discussed below.

11.6.3 For the site itself and all surrounding townscape character areas and all viewpoints considered in the operational assessment, the proposed development is considered to comprise an enhancement. This is on the basis that a high quality design, in line with the principles described in para. 11.2.5, would replace existing disused wharves and a number of active commercial/industrial units.

11.6.4 Plans of the proposed development during operation are contained in a separate volume (Volume 10 Carnwath Road Riverside Figures) and design principles describing the environmental design measures are set out in Vol 1 Appendix B. Where photomontages have been prepared to assist the assessment of effects, these are referenced in the appropriate viewpoint below.

Operational effects Year 1

Site character assessment

11.6.5 The proposed development would have a permanent effect on the character of the site. The permanent works layout would result in the majority of the site being reinstated as a safeguarded wharf, ready for use by others. The remainder of the site, on which the permanent engineering works would be located, would form a new area of riverside public realm set in front of a high quality building to house air management plant and equipment. The 5.5m high building would incorporate a visually attractive biodiverse roof and high quality concrete cladding. The public realm would contain high quality planting, paving, seating and railings in line with the design principles summarised in Section 11.2. The design intent for the building is illustrated on the Ventilation building design intent figure (see separate volume of figures – Section 1). There would be capacity for the building to be partially incorporated into developments by others in the future. A 5.5m high wall would complete the boundary between Whiffin Wharf and Hurlingham Wharf. A 15m high ventilation column would become a feature along the river frontage of the area of public realm. The form and design of the column would make visual reference to the signature column design (see Ventilation column design intent plan, separate volume of figures – Section 1). The western section of Whiffin Wharf would be hoarded off for future development by others, using high quality hoardings incorporating public art on public facing sections. The campsheds (Option A) or jetty with campsheds alongside (Option B) installed during construction would be removed and the foreshore fully reinstated. The impacts on specific components of the site are described in Vol 10 Table 11.6.1.

Vol 10 Table 11.6.1 Townscape – impacts on baseline components in Year 1 of operation

ID	Component	Impacts
01	Semi-mature trees	Trees lost during construction would be within the western part of the site, which would be left as a cleared future development plot. New trees would be established around the shaft in the western part of the site.
02	Warehouse buildings	Left cleared for future development.
03	Brick substation building	No operational impacts.
04	Boundary walls	Left cleared for future development.
05	Concrete block substation building	No operational impacts.
06	River wall	The newly constructed river wall would remain in place in operation.

11.6.6 The magnitude of change is considered to be medium due to improvements to parts of the site, alongside the reinstatement of the safeguarded wharf in keeping with its existing overall character.

11.6.7 Due to the commitment to a high quality design for the components of the proposed development, the medium magnitude of change, assessed alongside the low sensitivity of the site, would result in **minor beneficial** effects.

11.6.8 The assessment of specific effects on the setting of Sands End Conservation Area as a heritage asset is set out in Section 7 Historic environment.

Townscape character areas assessment

11.6.9 No assessment of townscape effects has been made for Wandsworth Park TCA, as the components of the operational scheme would not alter its setting.

River Thames – Wandsworth and Sands End Reach TCA

11.6.10 The proposed development would affect the setting of this reach of the river through improving the character of an existing disused wharf by creating a publicly accessible riverside open space. The setting would be affected principally by the new high quality building to house air management plant and equipment towards the rear of the space, well designed ventilation column along the river frontage, and new tree planting throughout the public realm. However, the majority of the areas setting would remain unaffected, particularly beyond Wandsworth Bridge. Therefore, the magnitude of change is considered to be low.

11.6.11 The low magnitude of change, assessed alongside the medium sensitivity of the character area, would result in **minor beneficial** effects.

Sands End Conservation Area TCA; and Fulham Commercial TCA

11.6.12 The setting of these areas would be affected by the introduction of a new high quality building to house air management plant and equipment along Carnwath Road, improving the immediate setting in the vicinity of the western part of the site. The remainder of the site would be reinstated as a cleared site ready for use as a working wharf or as a future development plot by others. This would remain characteristic of the existing setting. Furthermore, the majority of the wider setting would remain unaffected. Therefore, the magnitude of change is considered to be low.

11.6.13 The low magnitude of change, assessed alongside the low sensitivity of these character areas, would result in a **negligible** effect.

11.6.14 The assessment of specific effects on the setting of Sands End Conservation Area as a heritage asset is set out in Section 7 Historic environment. The historic environment assessment identifies a minor beneficial effect on the setting of this asset due to differences between the townscape and visual and historic environment methodologies.

Fulham Residential TCA

11.6.15 The setting of this area would be affected by the introduction of a new high quality building to house air management plant and equipment along Carnwath Road, improving the immediate setting in the vicinity of the western part of the site. The remainder of the site would be reinstated as a cleared site ready for use as a working wharf or as a future development plot by others. This would remain characteristic of the existing setting. Furthermore, the majority of the wider setting would remain unaffected. Therefore, the magnitude of change is considered to be low.

11.6.16 The low magnitude of change, assessed alongside the high sensitivity of this character area, would result in **minor beneficial** effects.

Sherwood Wharf Residential TCA; Osiers Road and Smugglers Way Industrial TCA; and Point Pleasant Residential TCA

11.6.17 The proposed development would affect the riverside setting of these areas through improving the character of an existing disused wharf by creating a publicly accessible riverside open space. The riverside setting would be affected principally by the new high quality building to house air management plant and equipment towards the rear of the space, well designed ventilation column along the river frontage, and new tree planting throughout the public realm. Therefore, the magnitude of change is considered to be medium.

11.6.18 The medium magnitude of change, assessed alongside the medium (Osiers Road and Smugglers Way Industrial TCA, and Sherwood Wharf Residential TCA) and) and high (Point Pleasant Residential TCA) sensitivity of these character areas, would result in **moderate beneficial** effects.

Townscape – sensitivity test for programme delay

11.6.19 For the assessment of townscape effects during operation, a delay to the Thames Tideway Tunnel project of approximately one year would not be likely materially to change the assessment findings reported above (paras. 11.6.5 to 11.6.18). This is on the basis that there are no known schemes that would change the sensitivity to change of the townscape character areas already presented (paras. 11.4.2 to 11.4.68).

Visual assessment

11.6.20 For each viewpoint, an assessment of the visual effects during Year 1 of operation has been made. In each instance, the first part of the assessment relates to visual effects during winter, while the second part relates to visual effects during summer.

11.6.21 No assessment of visual effects has been made for the following viewpoints, as the components of the operational scheme would not be visible or would be barely perceptible in the background of the view:

a. Viewpoint 1.3: View northwest from residences on the junction of Tonsley Road and Tonsley Place

b. Viewpoint 1.5: View northeast from residences on Point Pleasant

c. Viewpoint 2.4: View northeast from the Thames Path in Wandsworth Park.

Residential

Viewpoint 1.1: View southwest from residences on Carnwath Road close to Dymock Street

11.6.22 The foreground of views from residences towards the site would be affected by visibility of the site hoardings surrounding the cleared development site and the background visibility of the new high quality building to house air management plant and equipment. Therefore, the magnitude of change is considered to be low.

11.6.23 The low magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **minor beneficial** effects.

11.6.24 There would be no change to the assessment during summer.

Viewpoint 1.2: View northwest from residences on Smugglers Way close to Jews Row; and Viewpoint 1.4: View northeast from residences on Eastfields Avenue

11.6.25 Views from residences towards the site would be affected by the visibility of the cleared development plot and the new area of public open space in the view across the river. The cleared development plot would represent a change that would be compatible and contiguous with the existing character of Hurlingham Wharf, while the new area of public open space and high quality building to house air management plant and equipment beyond would improve the views from these receptors. The majority of the wider views would be largely unchanged, and the Piper building would remain the dominant component on the skyline. The view of the proposed development from viewpoint 1.4 is illustrated in Vol 10 Plate 11.6.1 below. A larger scale print of the photomontage, including the wider context and annotations, is provided in Vol 10 Figure 11.6.1 (see separate volume of figures). The layout of the proposed development illustrated in this photomontage may change within the zones shown on the Site works parameter plan (see separate volume of figures – Section 1), however the assessment of effects would be no worse than that described here.

Vol 10 Plate 11.6.1 Viewpoint 1.4 – illustrative operational phase photomontage

Date taken: 5 December 2011. 50mm lens.

11.6.26 Due to the visibility of the new area of public space and cleared development plot, the magnitude of change is considered to be low.

11.6.27 The low magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **minor beneficial** effects.

11.6.28 There would be no change to the assessment during summer.

Recreational

Viewpoint 2.1: View west from Wandsworth Bridge; and Viewpoint 2.2: View northwest from the garden of The Ship public house

11.6.29 Views from these locations towards the site would be affected by the visibility of the cleared development plot in the foreground of the views across the river, and the new area of public open space, high quality building to house air management plant and equipment and well designed ventilation column in the middle ground. The cleared development plot would represent a change that would be compatible and contiguous with the existing character of Hurlingham Wharf, while the new area of public open space would improve the views from these receptors. The majority of the wider views would be largely unchanged, and the Piper building would remain the dominant component on the skyline. The view of the proposed development from viewpoint 2.1 is illustrated in Vol 10 Plate 11.6.2 below. A larger scale print of the photomontage, including the wider context and annotations, is provided in Vol 10 Figure 11.6.2 (see separate volume of figures). The layout of the proposed development illustrated in this photomontage may change within the zones shown on the Site works parameter plan (see separate volume of figures – Section

1), however the assessment of effects would be no worse than that described here.

Vol 10 Plate 11.6.2 Viewpoint 2.1 – illustrative operational phase photomontage

Date taken: 5 December 2011. 50mm lens.

11.6.30 Due to the visibility of the new public space and cleared development plot, the magnitude of change is considered to be low.

11.6.31 The low magnitude of change, assessed alongside the high sensitivity of these receptors, would result in **minor beneficial** effects.

11.6.32 There would be no change to the assessment during summer.

11.6.33 The assessment of specific effects on the setting of Wandsworth Bridge as a heritage asset is set out in Section 7 Historic environment.

Viewpoint 2.3: View north from Bell Lane Spit

11.6.34 Views from this location towards the site would be affected to a limited extent by the visibility of tree planting in the area of public realm, and the new high quality building to house air management plant and equipment and column in the background of the view across the river. The majority of the proposed development would be screened by the waste transfer station in the foreground of the view. The foreground and wider views of the river would remain unaffected. Therefore, the magnitude of change is considered to be low.

11.6.35 The low magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **minor beneficial** effects.

11.6.36 There would be no change to the assessment during summer.

Viewpoint 2.5: View east from the Thames Path at the junction of Broomhouse Lane and Carnwath Road

11.6.37 Views from this location towards the site would be affected to a limited extent by the background visibility of the high quality building to house air management plant and equipment. However, the foreground of the view would remain unchanged, and the majority of the proposed development would be obscured by intervening buildings. Therefore, the magnitude of change is considered to be negligible.

11.6.38 The negligible magnitude of change, assessed alongside the high sensitivity of the receptor, would result in a **negligible** effect.

Viewpoint 2.6: View east from the Thames Path alongside residences on Carnwath Road

11.6.39 Views from this location towards the site would be affected by the extension of the Thames Path along the river frontage of Whiffin Wharf, set within a new landscaped riverside open space around the shaft and building to house air management plant and equipment and column. While the foreground of the view would remain largely unaltered, the linear view down the river would be improved, taking in components of the design such as the high quality ventilation column and new tree planting. Views of the wider site would be obscured by intervening residential buildings in the foreground of the view. Therefore, the magnitude of change is considered to be low.

11.6.40 The low magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **minor beneficial** effects.

11.6.41 There would be no change to the assessment during summer.

Visual effects – sensitivity test for programme delay

11.6.42 For the assessment of visual effects during operation, a delay to the Thames Tideway Tunnel project of approximately one year would not be likely materially to change the assessment findings reported above (paras. 11.6.21 to 11.6.41). This is on the basis that there are no known schemes within the assessment area that would introduce new visual receptors, or alter visibility of the proposed development from the viewpoints described in paras. 11.4.70 to 11.4.113.

Operational effects Year 15

11.6.43 In Year 15 of operation, the tree planting established as part of the scheme would have matured, further improving the benefits of the high quality area of public realm created within the site.

11.6.44 Operational effects for the site and surrounding townscape character areas would remain unchanged in Year 15 compared to Year 1 because of the limited additional change in character and setting arising from the matured planting.

Visual assessment – Year 15

11.6.45 With the exception of Viewpoint 2.6 (described below) the effects on all viewpoints would remain unchanged in Year 15 compared to Year 1, because of the limited additional change matured planting would have on the characteristics of the views

Recreational

Viewpoint 2.6: View east from the Thames Path alongside residences on Carnwath Road

11.6.46 In Year 15, the trees planted within the area of public realm created on the site would have matured, strengthening the new green character of the space in the foreground of the view. Therefore, the magnitude of change is considered to be medium.

11.6.47 The medium magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **moderate beneficial** effects.

11.6.48 This assessment would also apply in the event of a programme delay to the Thames Tideway Tunnel project of approximately one year.

11.7 Cumulative effects assessment

Construction effects

11.7.1 As described in para. 11.3.14, it is assumed that phase B of the Wandsworth Riverside Quarter development, to the southeast of the site, would be under construction during Site Year 3 of construction at the Carnwath Road Riverside site.

11.7.2 Cumulatively, construction activity at these two sites would elevate effects on Sherwood Wharf Residential TCA and Osiers Road and Smugglers Way Industrial TCA.

11.7.3 Effects on these receptors, which are considered not significant from the Thames Tideway Tunnel development alone would be elevated to significant when taking into account phase B of the Wandsworth Riverside Quarter development.

11.7.4 This assessment would also apply in the event of a programme delay to the Thames Tideway Tunnel project of approximately one year, as it is assumed that phase B of the Wandsworth Riverside Quarter development would still be under construction.

Operational effects

11.7.5 As detailed in the site development schedule (Vol 10 Appendix N) no schemes have been identified within 1km of the site which meet the criteria for inclusion in the cumulative assessment. Therefore no assessment of cumulative effects has been undertaken. This would also apply in the event of a programme delay to the Thames Tideway Tunnel project of approximately one year.

11.8 Mitigation

11.8.1 All measures embedded in the proposed scheme and *CoCP* of relevance to the townscape and visual assessment are summarised in Section 11.2. No further mitigation is possible for residual effects due to the highly visible nature of the construction activities.

11.8.2 No mitigation is required during operation as all effects are assessed to be negligible or beneficial.

11.9 Residual effects assessment

Construction effects

11.9.1 As no mitigation measures are proposed, the residual construction effects remain as described in Section 11.5. All residual effects are presented in Section 11.10.

Operational effects

11.9.2 As no mitigation measures are proposed, the residual operational effects remain as described in Section 11.6. All residual effects are presented in Section 11.10.

11.10 Assessment summary

11.10.1 The assessment has considered both Options A and B for the loading of barges and given that there are not anticipated to be any substantial differences, the assessment summary table reflects both options.

Vol 10 Table 11.10.1 Townscape – summary of construction assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
The site	Change to character due to clearance of the site, presence of hoardings, welfare facilities and the noise shed, and the intensity of construction activity.	Minor adverse	Not required	Minor adverse
River Thames – Wandsworth and Sands End Reach TCA	Change to setting due to the presence of construction activity and continuous loading of barges in a stretch of river characterised by industrial uses.	Moderate adverse	No mitigation possible	Moderate adverse
Sands End Conservation Area TCA	Change to setting due to the demolition of buildings, presence of site hoardings, construction activity, the noise shed and road transport.	Minor adverse	Not required	Minor adverse
Fulham Commercial TCA	Change to setting due to the demolition of buildings, presence of site hoardings, construction activity, the noise shed and road transport.	Minor adverse	Not required	Minor adverse
Fulham Residential TCA	Change to setting due to the demolition of buildings, presence of site hoardings, construction activity and construction plant.	Minor adverse	Not required	Minor adverse
Sherwood Wharf Residential TCA	Change to part of the riverside setting due to the demolition of buildings and the presence of the noise shed, construction activity and construction plant.	Minor adverse	Not required	Minor adverse
Osiers Road and Smugglers Way	Change to an immediate part of the riverside setting due to the demolition of buildings and the presence of the	Minor adverse	Not required	Minor adverse

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Industrial TCA	noise shed, construction activity and construction plant, set against the context of the existing waste transfer station which forms part of the character of this area.			
Point Pleasant Residential TCA	Wider change to setting due to the demolition of buildings and presence of construction activity, construction plant and continuous loading of barges.	Moderate adverse	No mitigation possible	Moderate adverse
Wandsworth Park TCA	Wider change to setting due to the demolition of buildings and presence of construction activity, construction plant and continuous loading of barges, in the context of the existing industrial nature of the site.	Minor adverse	No mitigation possible	Minor adverse

Vol 10 Table 11.10.2 Visual – summary of construction assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Residential				
Viewpoint 1.1: View southwest from residences on Carnwath Road close to Dymock Street	Foreground visibility of site hoardings, welfare facilities, construction activity and road transport. Background visibility of tall construction plant and the noise shed.	Major adverse	No mitigation possible	Major adverse
	At night, foreground visibility of 24 hour capped and directional lighting, partially screened by site hoardings.	Minor adverse	Not required	Minor adverse
Viewpoint 1.2: View northwest from residences on Smugglers Way	Visibility of construction activity, the noise shed, welfare facilities, construction plant and	Major adverse	No mitigation	Major adverse

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
close to Jews Row	continuous loading of barges.		possible	
	At night, visibility of 24 hour capped and directional lighting across the river.	Minor adverse	Not required	Minor adverse
Viewpoint 1.3: View northwest from residences on the junction of Tonsley Road and Tonsley Place	Intermittent visibility of cranes.	Negligible	Not required	Negligible
	At night, lighting would be barely perceptible.	Negligible	Not required	Negligible
Viewpoint 1.4: View northeast from residences on Eastfields Avenue	Visibility of construction activity, the noise shed, welfare facilities, construction plant and continuous loading of barges.	Major adverse	No mitigation possible	Major adverse
	At night, visibility of 24 hour capped and directional lighting across the river.	Minor adverse	Not required	Minor adverse
Viewpoint 1.5: View northeast from residences on Point Pleasant	Peripheral visibility of construction activity, the noise shed, welfare facilities and continuous loading of barges.	Minor adverse	Not required	Minor adverse
	At night, lighting would be barely perceptible.	Negligible	Not required	Negligible
Recreational				
Viewpoint 2.1: View west from Wandsworth Bridge	Foreground visibility of construction activity, welfare facilities, construction plant, demolition of buildings and continuous loading of barges. Background visibility of tall construction plant and the noise shed. Construction activities set against the existing industrial context.	Moderate adverse	No mitigation possible	Moderate adverse

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
	At night, visibility of 24 hour capped and directional lighting across the river.	Minor adverse	Not required	Minor adverse
Viewpoint 2.2: View northwest from the garden of The Ship public house	Foreground visibility of construction activity, welfare facilities, construction plant, demolition of buildings and continuous loading of barges. Background visibility of tall construction plant and the noise shed. Construction activities set against the existing industrial context.	Moderate adverse	No mitigation possible	Moderate adverse
	At night, visibility of 24 hour capped and directional lighting across the river.	Minor adverse	Not required	Minor adverse
Viewpoint 2.3: View north from Bell Lane Spit	Background visibility of construction activity, the noise shed, continuous loading of barges and other construction plant in the west of the site.	Minor adverse	Not required	Minor adverse
	At night, lighting would be barely perceptible.	Negligible	Not required	Negligible
Viewpoint 2.4: View northeast from the Thames Path in Wandsworth Park	Peripheral visibility of construction activity, the noise shed, tall construction plant and continuous loading of barges.	Minor adverse	Not required	Minor adverse
	At night, lighting would be barely perceptible.	Negligible	Not required	Negligible
Viewpoint 2.5: View east from the Thames Path at the junction of Broomhouse Lane and Carnwath Road	Background visibility of road transport, site hoardings, tall construction plant and cranes.	Minor adverse	Not required	Minor adverse
	At night, lighting would be barely perceptible.	Negligible	Not required	Negligible

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Viewpoint 2.6: View east from the Thames Path alongside residences on Carnwath Road	Visibility of the noise shed above the site hoardings and continuous loading of barges.	Moderate adverse	No mitigation possible	Moderate adverse
	At night, visibility of 24 hour capped and directional lighting.	Minor adverse	Negligible	Minor adverse

Vol 10 Table 11.10.3 Townscape – summary of Year 1 and Year 15 operational assessment[i]

Receptor[ii]	Effect	Significance of effect	Mitigation	Significance of residual effect
The site	Change in character through the creation of a new public open space and a high quality building to house air management plant and equipment and column.	Minor beneficial	Not required	Minor beneficial
River Thames – Wandsworth and Sands End Reach TCA	Change to setting through the creation of a riverside public open space alongside a high quality building to house air management plant and equipment and column.	Minor beneficial	Not required	Minor beneficial
Sands End Conservation Area TCA	Slight change to setting through the introduction of a new high quality building to house air management plant and equipment.	Negligible	Not required	Negligible
Fulham Commercial	Slight change to setting through the introduction of a new high	Negligible	Not	Negligible

[i] Operational effects have been assessed to be the same in both Year 1 and Year 15 of operation

[ii] Townscape character areas not assessed during operation (refer to para. 11.6.7) are not included in the summary table

Receptor[ii]	Effect	Significance of effect	Mitigation	Significance of residual effect
TCA	quality building to house air management plant and equipment.		required	
Fulham Residential TCA	Slight change to setting through the introduction of a new high quality building to house air management plant and equipment.	Minor beneficial	Not required	Minor beneficial
Sherwood Wharf Residential TCA	Change to riverside setting through creation of a new public open space and a high quality building to house air management plant and equipment and column.	Moderate beneficial	Not required	Moderate beneficial
Osiers Road and Smugglers Way Industrial TCA	Change to riverside setting through creation of a new public open space and a high quality building to house air management plant and equipment and column.	Moderate beneficial	Not required	Moderate beneficial
Point Pleasant Residential TCA	Change to riverside setting through creation of a new public open space and a high quality building to house air management plant and equipment and column.	Moderate beneficial	Not required	Moderate beneficial

Vol 10 Table 11.10.4 Visual – summary of Year 1 operational assessment

Receptor[iii]	Effect	Significance of effect	Mitigation	Significance of residual effect
Residential				
Viewpoint 1.1: View southwest from residences on Carnwath Road close to Dymock Street	Foreground visibility of the cleared development plot and background visibility of the high quality building to house air management plant and equipment.	Winter – Minor beneficial	Winter – Not required	Winter – Minor beneficial
		Summer – Minor beneficial	Summer – Not required	Summer – Minor beneficial
Viewpoint 1.2: View northwest from residences on Smugglers Way close to Jews Row	Visibility of the new riverside public open space and high quality building to house air management plant and equipment and column.	Winter – Minor beneficial	Winter – Not required	Winter – Minor beneficial
		Summer – Minor beneficial	Summer – Not required	Summer – Minor beneficial
Viewpoint 1.4: View northeast from residences on Eastfields Avenue	Visibility of the new riverside public open space and high quality building to house air management plant and equipment and column.	Winter – Minor beneficial	Winter – Not required	Winter – Minor beneficial
		Summer – Minor beneficial	Summer – Not required	Summer – Minor beneficial
Recreational				
Viewpoint 2.1: View west from Wandsworth Bridge	Visibility of the new riverside public open space, high quality building to house air management plant and equipment and column and cleared development plot.	Winter – Minor beneficial	Winter – Not required	Winter – Minor beneficial
		Summer – Minor beneficial	Summer – Not required	Summer – Minor beneficial

[iii] Viewpoints not assessed during operation (refer to para. 11.6.17) are not included in the summary table

Receptor[iii]	Effect	Significance of effect	Mitigation	Significance of residual effect
Viewpoint 2.2: View northwest from the garden of The Ship public house	Visibility of the new riverside public open space, high quality building to house air management plant and equipment and column and cleared development plot.	Winter – Minor beneficial	Winter – Not required	Winter – Minor beneficial
		Summer – Minor beneficial	Summer – Not required	Summer – Minor beneficial
Viewpoint 2.3: View north from Bell Lane Spit	Background visibility of the new riverside public open space, high quality building to house air management plant and equipment and column.	Winter – Minor beneficial	Winter – Not required	Winter – Minor beneficial
		Summer – Minor beneficial	Summer – Not required	Summer – Minor beneficial
Viewpoint 2.5: View east from the Thames Path at the junction of Broomhouse Lane and Carnwath Road	Background visibility of the high quality building to house air management plant and equipment.	Winter – Negligible	Winter – Not required	Winter - Negligible
		Summer – Negligible	Summer – Not required	Summer - Negligible
Viewpoint 2.6: View east from the Thames Path alongside residences on Carnwath Road	Visibility of the extension of the Thames Path, the newly created area of public open space on the riverfront and the high quality ventilation column.	Winter – Minor beneficial	Winter – Not required	Winter – Minor beneficial
		Summer – Minor beneficial	Summer – Not required	Summer – Minor beneficial

Vol 10 Table 11.10.5 Visual – summary of Year 15 operational assessment

Receptor[iv]	Effect	Significance of effect	Mitigation	Significance of residual effect
Recreational				
Viewpoint 2.6: View east from the Thames Path alongside residences on Carnwath Road	Foreground visibility of matured trees within the new area of public realm, strengthening the new green character of the space.	Winter – Moderate beneficial	Winter – Not required	Winter – Moderate beneficial

[iv] Only viewpoints where the assessment differs in Year 15 compared to Year 1 are included in the summary table

References

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

[2] LB of Hammersmith and Fulham. *LDF Core Strategy* (October 2011).

[3] LB of Wandsworth. *LDF Core Strategy* (October 2010).

[4] LB of Hammersmith and Fulham. *Sands End Conservation Area Character Profile* (February 1999).

[5] LB of Hammersmith and Fulham. *South Fulham Riverside Supplementary Planning Document – second consultation draft* (March 2011).

[6] Atkins. *Thames Strategy: Kew to Chelsea* (June 2002).

[7] Department of Environment, Food and Rural Affairs (2012). See citation above.

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.10**

Volume 10: Carnwath Road Riverside site assessment

Section 12: Transport

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Environmental Statement

Volume 10: Carnwath Road Riverside site assessment

Section 12: Transport

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12 Transport

12.1 Introduction

12.1.1 This section presents the findings of the assessment of the likely significant transport effects of the proposed development at the Carnwath Road Riverside site. The project-wide transport effects are described in Volume 3 Project-wide effects assessment.

12.1.2 Construction of the proposed development at the site (both main site and highway works site) has the potential to affect the following transport elements:

a. pedestrian routes

b. cycle routes

c. bus routes and patronage

d. London Underground and London Overground services

e. river passenger services and river navigation

f. car parking

g. highway layout, operation and capacity.

12.1.3 The assessment considers the effects on each of these elements during construction, as well as effects on specific receptors including nearby residents and users of commercial properties.

12.1.4 The operation of the Carnwath Road Riverside site has the potential to affect car parking and highway layout and operation and therefore effects on these are considered within the operational assessment.

12.1.5 The assessment of transport presented in this section has considered the requirements of the National Policy Statement for Waste Water (Defra, 2012)[1] section 4.13. Further details of these requirements can be found in Vol 2 Section 12.3.

12.1.6 Additionally, a separate *Transport Assessment* has been produced which provides an assessment of the effects on the transport network as a result of the construction and operational phases at the Carnwath Road Riverside site. The *Transport Assessment* accompanies the application for development consent (the application).

12.1.7 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Volume 10 Carnwath Road Riverside Figures).

12.1.8 The separate but related assessments of effects of transport on air quality and noise and vibration are contained in Sections 4 and 9 respectively.

12.2 Proposed development relevant to transport

12.2.1 The proposed development is described in Section 3 of this volume. The elements of the proposed development relevant to transport are set out below.

Construction

12.2.2 The construction site would be located on land to the south of Carnwath Road and part of the foreshore of the River Thames. Vehicle access to and from the site would take place from Carnwath Road via Wandsworth Bridge Road (A217).

12.2.3 During construction it is anticipated that the elements listed under para. 12.1.2 may be affected as a result of the additional construction traffic associated with Carnwath Road Riverside and other Thames Tideway Tunnel project construction sites with construction routes along Wandsworth Bridge Road (A217), pedestrian and cycle diversions along the Thames Path and changes to on-street parking.

12.2.4 Details of the peak year of construction, anticipated lorry and barge movements and the activities which would generate these movements are provided in Vol 10 Table 12.2.1.

Vol 10 Table 12.2.1 Transport - construction details

Description	Assumption
Assumed peak period of construction lorry movements	Site Year 2 of construction
Assumed average peak daily construction lorry vehicle movements (in peak month of Site Year 2 of construction)	90 movements per day (45 vehicle trips)
Assumed peak period of construction barge movements	Site Year 2 of construction
Assumed average peak daily construction barge movements (in peak month of Site Year 2 of construction)	4 movements per day (2 barge trips)
Typical types of lorry requiring access (comprising rigid-bodied, flatbed and articulated vehicles)	Excavation lorries Tunnel precast concrete linings lorries Imported fill lorries Aggregate lorries Cement tankers lorries Ready mix mixer lorries

Description	Assumption
	Steel reinforcement lorries Office delivery lorries Plant and equipment lorries Temporary construction material lorries including Pipe/track/oils/greases lorries

Note: a movement is a construction vehicle/barge moving either to or from a site. A Site Year is a 12 month period, one in a series of Site Years; Site Year 1 commences at the start of construction.

12.2.5 During construction excavated material from the main tunnel and shaft would be transported out and main tunnel secondary lining aggregates would be transported in by barge. For the transport assessment it has been assumed that 90% of these materials are taken by river. This allows for periods that the river is unavailable and material unsuitable for river transport. All other material would be transported by road.

12.2.6 Although this site would have 24-hour working, lorry and barge movements would only take place during the standard day shift of ten hours on weekdays (08:00 to 18:00) and five hours on Saturdays (08:00 to 13:00). It would only be in exceptional circumstances that HGV and abnormal load movements could occur up to 22:00 on weekdays for large concrete pours and later at night on agreement with the LB of Hammersmith and Fulham.

Construction traffic routing

12.2.7 The access plan and highway layout during construction – area 1 and area 2 plans (see separate volume of figures – Section 1) show the highway layout at the Carnwath Road Riverside site during construction.

12.2.8 In Phases 1 and 2, two site vehicle accesses would be in operation on Carnwath Road. The western access onto Whiffin Wharf would only be used as an entry for emergency access or specific deliveries and not for routine use and would be left-turn in only. The eastern access to the main site onto Hurlingham Wharf would be used for the majority of construction vehicle movements and would operate as left-turn in and right-turn out only. In Phases 3 and 4, the western access would be closed to allow for crane activities and all construction vehicles would enter and leave the site through the eastern access.

12.2.9 All vehicles entering the site would arrive and leave via Carnwath Road and the junction of Carnwath Road with Wandsworth Bridge Road (A217).

12.2.10 To access the Carnwath Road Riverside site from the wider area, some construction vehicles are likely to be routed from the north using Wandsworth Bridge Road (A217). Some construction vehicles would also travel to and from Carnwath Road Riverside site to/from the south using the Wandsworth Bridge Road (A217). Wandsworth Bridge Road (A217) is part of the Strategic Road Network (SRN) and also connects into Transport for London’s Road Network (TLRN) at the Wandsworth Bridge roundabout. The direction that construction vehicles would come from would depend on the origins and destinations of the materials.

12.2.11 Vol 10 Figure 12.2.1 (see separate volume of figures) shows the construction traffic routes for access to/from Carnwath Road Riverside. Construction routes have been discussed with Transport for London (TfL) for the purposes of the assessment. The Local Highway Authority (LHA), LB of Hammersmith and Fulham, has yet to formally agree this routing although it is in alignment with comments received from Borough Officers.

Construction workers

12.2.12 The construction site is expected to require a maximum workforce of 165 workers on site at any one time. The number and type of workers is shown in Vol 10 Table 12.2.2. It is noted that the table shows the maximum number of workers required (289), however, as a result of shift patterns the maximum workforce on site would be 165 occurring during the dayshift (08:00-18:00).

Vol 10 Table 12.2.2 Transport - construction worker numbers

Contractor					Client	
Staff*		Labour**			Staff***	
08:00-18:00	18:00-08:00	08:00-15:00	15:00-23:00	23:00-08:00	08:00-18:00	18:00-08:00
60	15	60	60	45	45	4

** Staff Contractor – engineering and support staff to direct and project manage the engineering work and site.*
*** Labour – those working on site doing engineering, construction and manual work.*
**** Staff Client – engineering and support staff managing the project and supervising the Contractor.*

12.2.13 It is difficult to predict with certainty the directions to and from which workers at the site would travel. Staff could potentially be based in the local area or in the wider Greater London area and those travelling by car are unlikely to have the same trip attraction to primary A roads as construction lorries.

12.2.14 On this basis it has been assumed that the origins of worker vehicle trips would be similar to the origins of trips to the zone in the TfL Highway Assignment Model (HAM) in which Carnwath Road Riverside is located.

12.2.15 The methodology for assigning worker trips to the transport networks is described in Volume 2 Environmental assessment methodology.

12.2.16 At the Carnwath Road Riverside site it is assumed that while there would be no parking provided within the site boundary for construction workers and measures would be incorporated into site-specific Travel Plan requirements in order to minimise the number of workers travelling to and from the site by car (in accordance with the overall aims and objectives of the *Draft Project Framework Travel Plan*), some construction workers are expected to drive to the site. This is therefore considered as part of the assessment, further details of which are provided in paras. 12.5.2-12.5.5.

Code of Construction Practice

12.2.17 Measures incorporated into the *Code of Construction Practice (CoCP)*[i] *Part A* (Section 5) to reduce transport effects include:

a. site specific *Traffic Management Plans (TMP)*: to set out how vehicular access to the site would be managed so as to minimise impact on the local area and communicate this with the local borough and other stakeholders. This includes any works on the highway, diversion or temporary closure of the highway or public right of way

b. HGV management and control: to ensure construction vehicles use appropriate routes to the sites and the vehicle fleet and/or drivers meet current safety and environmental standards

c. site specific *River Transport Management Plans (RTMP)* are to be produced for each relevant worksite. As with the *TMP*'s this would set out how river access to site would be managed so as to minimise impact on the river and communicate this with the PLA, local borough and other stakeholders.

12.2.18 In addition to the general transport measures within the *CoCP Part A,* the *CoCP Part B* (Section 5) relating to the Carnwath Road Riverside site includes the following measures:

a. the security barrier would be positioned to allow a standard vehicle to be wholly off the road whilst awaiting barrier operation

b. the western access would be only used for emergency access or specific deliveries and not routinely used due to proximity of adjacent properties

c. all vehicles would access/egress the site from the Wandsworth Bridge Road (A217) and Carnwath Road. The junction between Carnwath Road and Wandsworth Bridge Road would be altered at the start of the construction period to enable HGVs to perform a left turn off of Wandsworth Bridge Road onto Carnwath Road

d. the eastern access would be left turn in right turn out.

e. the western access would be left turn in only

f. the diversion of the Thames Path is to be adequately signed

g. the new route on the eastern boundary is to have high quality directional lighting for security

h. three sections of parking to be suspended comprising a potential total of 12 parking spaces on Carnwath Road. Single yellow line parking restrictions would be added where these sections of parking are suspended, with these restrictions operating from 07:00 to 19:00, Monday to Friday.

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[i] The *Code of Construction Practice (CoCP)* is provided in Vol 1 Appendix A. It contains general requirements (Part A), and site specific requirements for this site (Part B).

i. an extension to the hours of operation of the existing single yellow line parking restrictions and loading restrictions on Carnwath Road. This would be extended to no parking or loading 08:00 to 18:00, Monday to Friday and 08:00 to 13:00 on Saturday.

12.2.19 The effective implementation of the *CoCP Part A* and *Part B* measures is assumed within the assessment.

12.2.20 Based on current travel planning guidance including TfL's 'Travel Planning for new development in London', this development falls within the threshold for producing a Strategic Framework Travel Plan. A *Draft Project Framework Travel Plan* has been prepared based on the TfL ATTrBuTE guidance[2]; this accompanies the application. The *Draft Project Framework Travel Plan* addresses project-wide travel planning measures, including the need for a project-wide Travel Plan Manager, initial travel surveys during construction and a monitoring framework. It also contains requirements and guidelines for the site-specific travel plans to be prepared by the site contractors. The site-specific travel planning requirements of relevance to the *Draft Project Framework Travel Plan* are as follows:

a. information on existing transport networks and travel initiatives for the Carnwath Road Riverside site

b. a mode split established for the Carnwath Road Riverside site construction workers to establish and monitor travel patterns

c. site-specific targets and interim targets based on the mode share which would link to objectives based on local, regional and national policy

d. a nominated person with assigned responsibility for managing the Travel Plan monitoring and action plans specifically for this site.

Other measures during construction

12.2.21 Embedded design measures which are not outlined in the *CoCP* but are of relevance to the transport assessment at the Carnwath Road Riverside site comprise:

a. the proposed junction improvement at the Wandsworth Bridge Road (A217) / Carnwath Road / Townmead Road junction.

b. provision of a new crossover at the western site access on Carnwath Road

c. widening of the existing crossover on Carnwath Road at the eastern site access

Operation

12.2.22 During operation, maintenance vehicles would enter the site from Carnwath Road, as set out in the Carnwath Road Riverside design principles (see *Design Principles* report Section 4.7 in Vol 1 Appendix B). Access would be required for a light commercial vehicle on a three to six monthly maintenance schedule. Additionally there would be more substantive maintenance visits at approximately ten year intervals which would require access to enable two mobile cranes and associated support vehicles to be brought to the site, which may require temporary suspension of some on-street parking in the vicinity of the site.

12.3 Assessment methodology

Engagement

12.3.1 Vol 2 documents the overall engagement which has been undertaken in preparing the *Environmental Statement*. Specific comments relevant to this site for the assessment of traffic and transport are presented in Vol 10 Table 12.3.1.

12.3.2 It is noted that it was reported in the *Scoping Report* that operational traffic effects for the project as a whole were scoped out of the environmental impact assessment (EIA). However, while the environmental effects associated with transport for the operational phase are not expected to be significant or adverse, the assessment of transport effects in the *Environmental Statement* examines relevant aspects of the operational phase in order to satisfy the relevant stakeholders that technical issues have been addressed.

Vol 10 Table 12.3.1 Transport - stakeholder engagement

Organisation	Comment	Response
LB of Hammersmith and Fulham Phase two consultation, February 2012 Consultation workshop, April 2011	LB of Hammersmith and Fulham are concerned about the current level of traffic movements at Wandsworth Bridge Road (A217) / Carnwath Road junction and the impact of the additional construction vehicle trips.	Local modelling has been undertaken to demonstrate how the proposed flows would affect operation of this junction. This is reported in Section 12.5.
LB of Hammersmith and Fulham Phase two consultation, February 2012 Consultation workshop, April 2011	Concern raised in regard to the left turn from Wandsworth Bridge Road (A217) into Carnwath Road with large HGV vehicles making the turn from the middle lane, not the near side lane.	This manoeuvre is the arrangement for HGVs currently servicing the many industrial units in Carnwath Road. However, it is proposed to widen the junction to allow this manoeuvre to be made from the near side lane, improving the junction for all users.
LB of Hammersmith and Fulham, phase two consultation, February 2012	Concern raised for the health and safety of 94 residential properties fronting the site as well as school and nursery children. This would also be applicable to diverted	The effects on receptors in the surrounding area including residents and school children have been considered in the assessment (see Section 12.5) and measures are

Organisation	Comment	Response
	Thames Path users.	incorporated within the design to reduce these effects where possible.
LB of Hammersmith and Fulham, phase two consultation, February 2012	The borough believes that up to 29,000 lorries could be servicing the site.	The *Transport Strategy* sets out that approximately 25,847 construction lorries would visit the site over the whole of the construction period
LB of Hammersmith and Fulham, phase two consultation, February 2012	Consultation supports improved access and urban design of the Thames Path	The permanent design of the site reinstates the Thames Path along Carnwath Road and a passive provision would be provided for a possible future extension along Whiffin Wharf.
LB of Hammersmith and Fulham, phase two consultation, February 2012	The borough does not support the recommission of Hurlingham Wharf pier and would prefer consolidation of pier facilities	Hurlingham Wharf, which would form part of Carnwath Road Riverside site (Hammersmith & Fulham Council, 2012)[3], is a safeguarded wharf, although it is not active at present. The Wharf has been the subject of calls by LB Hammersmith and Fulham to remove the safeguarded status to enable regeneration of the site. This is stated in their *Core Strategy* (Hammersmith & Fulham Council, 2011)[4]. Currently the GLA is conducting a London wide review of safeguarded wharves. The recommendation in the published consultation report[5] is to retain the safeguarding at Hurlingham Wharf. The use of the Wharf by the project does not necessarily mean it would guarantee its future use as a viable wharf on completion of the works, since the project is temporary and specialist, and not aimed at influencing its continued safeguarding.

Organisation	Comment	Response
LB of Hammersmith and Fulham, phase two consultation, February 2012	Concern raised regarding wider transport congestion as well as cumulative impacts with other developments. Improved Phase 2 Consultation material is required	Both of these issues have been fully addressed within the assessment (see Section 12.5). No significant impact or delay has been identified.
LB of Hammersmith and Fulham, phase two consultation, February 2012	A question as to whether a commitment to use barges at Carnwath Road Riverside has been raised. In addition, will all excavated material be moved via barge?	The *Transport Strategy* sets out the proposals to transport main tunnel and shaft excavated material from the site and the main tunnel secondary lining aggregates to the site by barge. For assessment purposes, it has been assumed that 90% of these materials are taken by river.
LB of Hammersmith and Fulham, phase two consultation, February 2012	It is understood that the peak number of daily lorry movements will be significantly higher than the average number.	This is correct but peak activity would occur only for very short periods. The transport assessment considers the levels of activity in the peak month of construction at this site.
Transport for London, phase two consultation, February 2012	Ensure that construction activity does not impede the operation of the SRN/TLRN.	Strategic and local modelling effects on the TLRN have been considered in the assessment (see Section 12.5).
Transport for London, phase two consultation, February 2012	The impact on the hail-and-ride bus service on Carnwath Road must be considered.	The impact on this bus service has been assessed.
Transport for London, phase two consultation, February 2012	The impact of any loss of parking on Carnwath Road during construction should be determined and mitigated if necessary.	A parking impact assessment has been undertaken as part of the assessment (see Section 12.5) and there is sufficient spare capacity to accommodate the level of parking suspension proposed during construction.
LB of Hammersmith and Fulham, consultation workshop, April	LB of Hammersmith and Fulham would prefer construction vehicles to travel south over Wandsworth Bridge rather	Alternative routes were investigated, however, vehicles would need to travel both north and south along Wandsworth Bridge Road (A217) onto

Organisation	Comment	Response
2011	than travelling north on Wandsworth Bridge Road (A217) from Carnwath Road.	Carnwath Road due to the origin and destination of materials.
LB of Hammersmith and Fulham, consultation workshop, April 2011	Details of the management of the required diversion of the Thames Path at Carnwath Road should be provided.	Appropriate signage for the diversion route would be put in place. This is specified in the *CoCP Part B* (Section 5) for the Carnwath Road Riverside site.
LB of Hammersmith and Fulham, consultation workshop, April 2011	The Munster Road / New King's Road junction may have capacity issues and needs to be surveyed.	The Munster Road / New King's Road junction is not on the proposed route for the construction vehicles.
LB of Hammersmith and Fulham, consultation workshop, April 2011	Any proposals for the Wandsworth Bridge Road (A217) / Carnwath Road / Townmead Road junction should consider the borough proposals for this junction.	The borough proposals for capacity, operational and safety improvements at this junction have been taken into account in the assessment.

Baseline

12.3.3 The baseline methodology follows the methodology described in Vol 2. There are no site specific variations for identifying the baseline conditions for this site.

Construction

12.3.4 The assessment methodology for the construction phase follows that described in Vol 2. There are no site-specific variations for undertaking the construction assessment of this site.

12.3.5 The effect of all other Thames Tideway Tunnel project sites on the area surrounding Carnwath Road Riverside has been taken into account within the assessment of the peak year of construction at this site.

12.3.6 As indicated in the site development schedule (see Vol 10 Appendix N), ten other developments identified within 1km of the Carnwath Road Riverside site would be complete and operational by Site Year 2 of construction and one (Wandsworth Riverside Quarter) would be partially complete and occupied. Of these, two developments, comprising the redevelopment and reprovision of a concrete plant on Townmead Road and development at Imperial Wharf, lie on the north side of the River Thames (the same side as the Carnwath Road Riverside site).

12.3.7 As the Wandsworth Riverside Quarter development would be under construction in Site Year 2 of construction at Carnwath Road Riverside, this suggests that the transport assessment should consider cumulative effects. However, as the TfL Highway Assignment Models (HAM) which have been used in the transport assessment have been developed using GLA employment and population forecasts and are based on the employment and housing projections set out in the *London Plan 2011* (GLA, 2011)[6], the assessment inherently takes into account a level of future growth and development across London.

12.3.8 This means that the construction and operational trips associated with the other developments outlined within the site development schedule (see Vol 10 Appendix N) within 1km of the Carnwath Road Riverside site are already taken into consideration within the traffic modelling.

Construction assessment area

12.3.9 The assessment area for the Carnwath Road Riverside site includes the site accesses on Carnwath Road, Carnwath Road itself and the junction of Wandsworth Bridge Road (A217) with Carnwath Road and Townmead Road.

12.3.10 These roads and junctions have been assessed for highway, cycle and pedestrian impacts. The Thames Path has been included within the assessment due to its proximity to the development site. Effects on local bus services within 640m of the site and rail services within 960m of the site have also been assessed[ii].

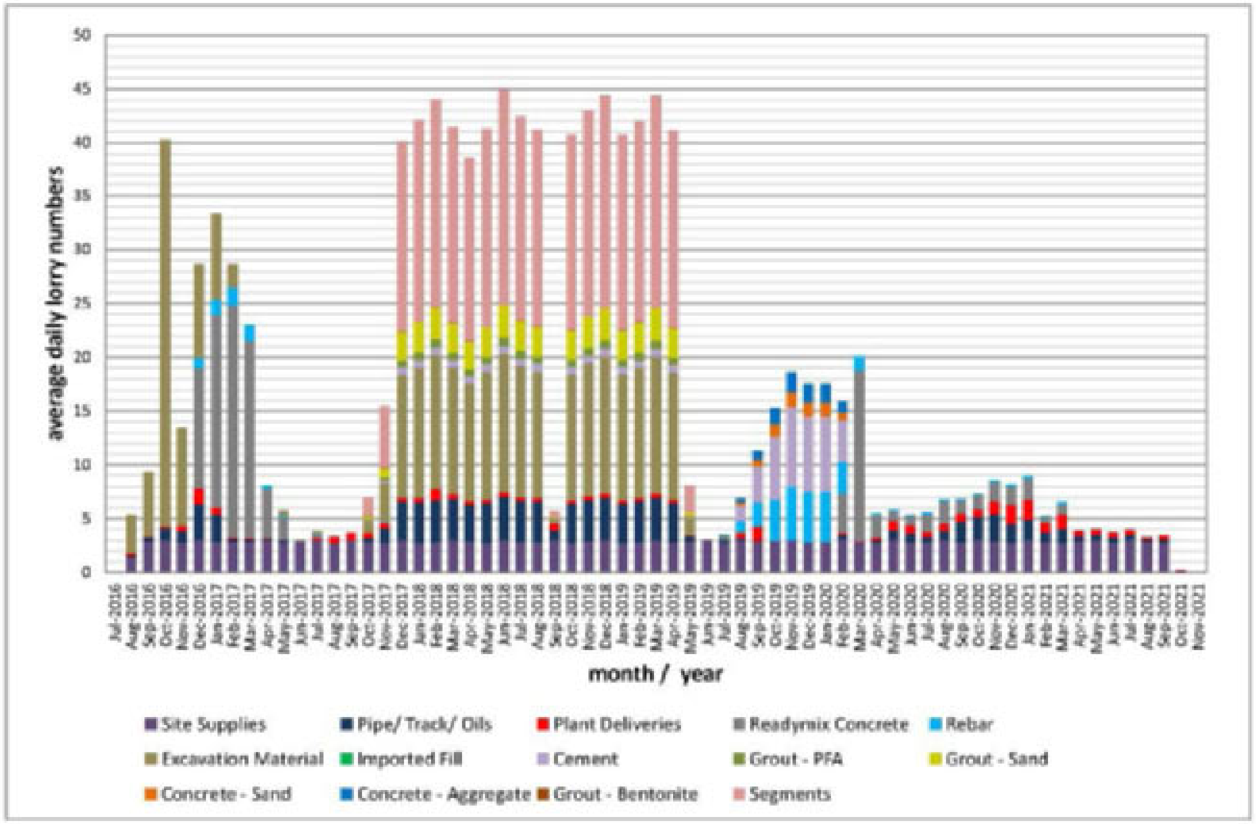
Construction assessment years

12.3.11 A site-specific peak construction assessment year has been identified for this site. The histograms in Vol 10 Plate 12.3.1 and Vol 10 Plate 12.3.2 show that the peak site-specific activity at the Carnwath Road Riverside site would occur in Site Year 2 of construction for both lorry and barge movements. This is therefore the construction year assessed for this site.

12.3.12 The assessment of construction effects also considers the extent to which the assessment findings would be likely to be materially different should the programme for the Thames Tideway Tunnel project be delayed by approximately one year.

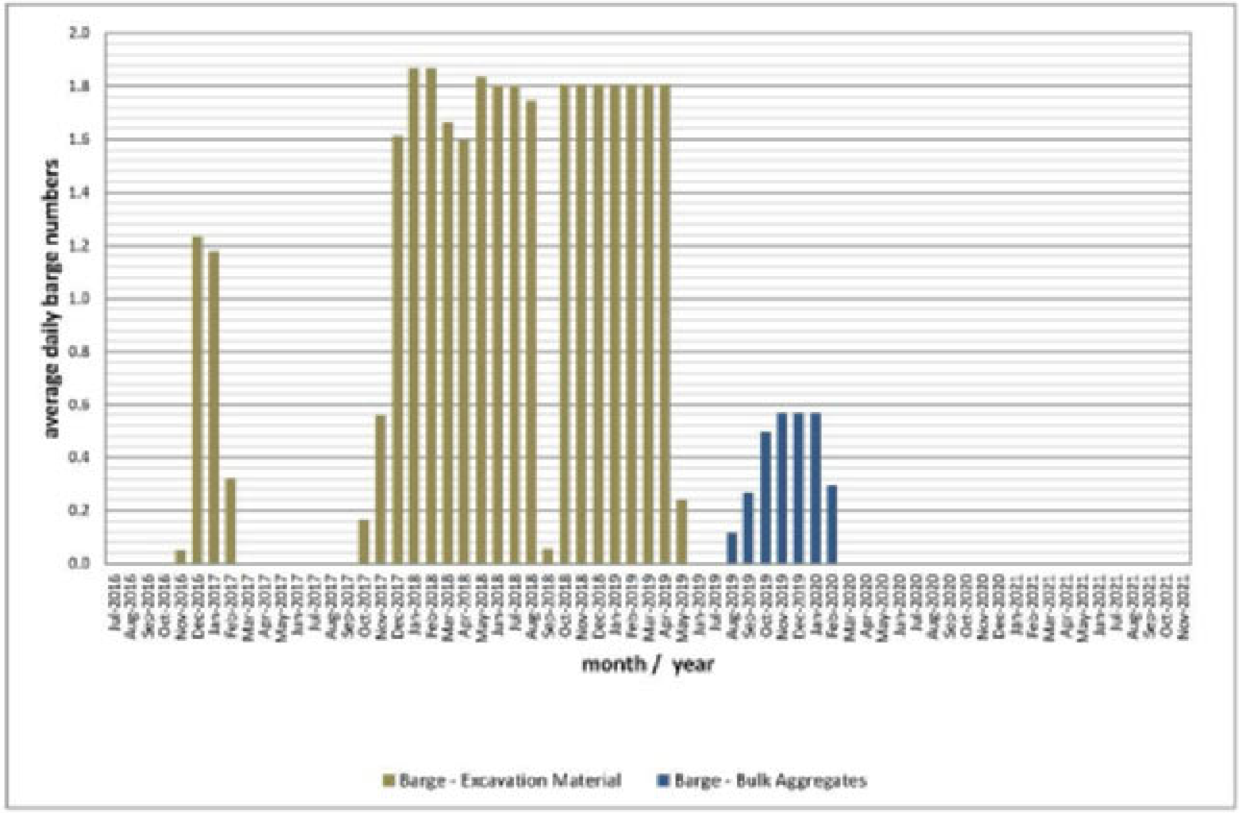
[ii] Distances derived from the Public Transport Accessibility Level (PTAL) methodology described in Volume 2.

Vol 10 Plate 12.3.1 Transport - estimated construction lorry profile



Note: Plate shows approximate volumes and number of lorry trips based upon assumed timings for the works. It is not a programme and remains subject to change.

Vol 10 Plate 12.3.2 Transport - estimated construction barge profile



Note: Plate shows approximate volumes and number of barge trips based upon assumed timings for the works. It is not a programme and remains subject to change.

Operation

12.3.13 The assessment methodology for the operational phase follows that described in Vol 2. There are no site specific variations for undertaking the operational assessment of this site.

12.3.14 Once the Thames Tideway Tunnel project is operational it is not expected that there would be no significant effects on the transport infrastructure and operation within the local area because maintenance trips to the site would be infrequent and short-term. On this basis the only elements considered are:

a. car parking

b. highway layout and operation.

12.3.15 These elements are considered qualitatively (as described in Vol 2) because the minimal effect on the highway network means that a quantitative assessment is not required. The scope of this analysis has been agreed with the LB of Hammersmith and Fulham and TfL.

12.3.16 Also, given the local impact of the transport activity associated with the Thames Tideway Tunnel project during the operational phase, only the localised transport effects around the Carnwath Road Riverside site are assessed. Other Thames Tideway Tunnel project sites would not affect the area around the site in the operational phase and therefore they are not considered in the assessment.

12.3.17 With regard to other developments in the vicinity of the site (as detailed in Vol 10 Appendix N), all the developments would be complete and operational by Year 1 of operation. As a result, they have been included within the operational base case which takes into consideration the effects on highway layout, operation and parking. There are no operational cumulative effects requiring assessment.

Operational assessment area

12.3.18 The assessment area for the operational assessment remains the same as for the construction assessment as set out in paras. 12.3.9 and 12.3.10.

Operational assessment year

12.3.19 As outlined in Vol 2 the operational assessment year has been taken as Year 1 of operation. As the number of vehicle movements associated with the operational phase is low there is no requirement to assess any other year beyond that date.

12.3.20 As with construction, the assessment of operational effects also considers the extent to which the assessment finding would be likely to be materially different should the programme for the Thames Tideway Tunnel project (and hence opening year) be delayed by approximately one year.

Assumptions and limitations

12.3.21 The general assumptions and limitations associated with this assessment are presented in Vol 2.

Assumptions

12.3.22 Local junction modelling for the construction base and development cases at this site has incorporated traffic signal optimisation on the basis that this would be implemented as necessary by TfL (as part of routine management) to ensure the effective operation of the highway network and respond to changes in traffic conditions.

12.3.23 There would be deliveries of fuel for construction plant at this site and a number of construction products may be classified as hazardous. For the Carnwath Road Riverside site, it is assumed that there would be one hazardous load per week generated by the site.

12.3.24 With regard to construction workers travelling to the site, it is assumed that some construction workers may drive to the site, as set out in paras. 12.5.3-12.5.5.

Limitations

12.3.25 There are no site-specific limitations of the transport assessment undertaken for this site.

12.4 Baseline conditions

12.4.1 The following section sets out the baseline conditions for transport within and around the site. Future baseline conditions (base case) are also described.

Current baseline

12.4.2 The site is located adjacent to the north bank of the River Thames and west of Wandsworth Bridge in the LB of Hammersmith and Fulham as shown in Vol 10 Figure 12.4.1 (see separate volume of figures).

12.4.3 There is road access to the site directly from Carnwath Road, which forms a junction with Wandsworth Bridge Road (A217) and Townmead Road to the east of the site.

Pedestrian routes

12.4.4 The existing pedestrian network and facilities in the vicinity of the site are shown in Vol 10 Figure 12.4.2 (see separate volume of figures). Carnwath Road provides an east-west link near to the bank of the River Thames between Wandsworth Bridge and Hurlingham Park.

12.4.5 The footways along either side of Carnwath Road are between 2.3m and 2.5m wide. There are also footways on both sides of Wandsworth Bridge Road (A217) to the east and Broomhouse Lane to the west of the Carnwath Road Riverside site.

12.4.6 Dropped kerbs with tactile paving and central refuges are provided on all arms of the junction of Carnwath Road, Wandsworth Bridge Road (A217) and Townmead Road. However, the pedestrian crossings at the junction are not signal controlled as the phasing of the junction signals does not include a pedestrian phase.

12.4.7 The Thames Path routes along the bank of the River Thames adjacent to the site. The Thames Path passes to the north of Whiffin Wharf and Hurlingham Wharf along Carnwath Road for approximately 240m, before returning back to, and continuing along, the river bank. The route has signs to direct pedestrians and cyclists.

Cycle facilities and routes

12.4.8 The existing cycle network and facilities in the vicinity of the site are shown in Vol 10 Figure 12.4.2 (see separate volume of figures).

12.4.9 There are on-road painted cycle symbols along the kerbside on Carnwath Road where it passes the site.

12.4.10 The main cycle route within the area is National Cycle Network (NCN) Route 4 which follows the line of the River Thames through London. Near to the site it routes across Putney Bridge, around the northern side of Hurlingham Park and along Broomhouse Lane, Sulivan Road, Hugon Road and Stephendale Road. The route is predominantly on-road near to the site; however the contraflow section of cycleway along Hugon Road between Peterborough Road and Dymock Road is segregated from vehicular traffic by a kerb.

12.4.11 An off-carriageway cycle lane is provided in both directions across Wandsworth Bridge. North of Wandsworth Bridge on-road cycle markings are provided both northbound and southbound along Wandsworth Bridge Road (A217). In the northbound direction, an advisory cycle lane[iii] is provided between Wandsworth Bridge and Hugon Road. In the southbound direction, there is a bus lane between Stephendale Road and Townmead Road. Cyclists are able to use the bus lane.

12.4.12 As described in para. 12.4.7, the Thames Path routes along the bank of the River Thames adjacent to the site which has signs to direct pedestrians and cyclists.

12.4.13 Advanced cycle stop lines are provided for cyclists on all arms of the Carnwath Road / Wandsworth Bridge Road (A217) / Townmead Road junction.

12.4.14 One cycle stand capable of accommodating up to two cycles is provided at the Carnwath Road / Wandsworth Bridge Road (A217) / Townmead Road junction. Five cycle stands are located on Wandsworth Bridge Road (A217) to the north of Carnwath Road. These are capable of accommodating up to ten cycles.

12.4.15 The closest Cycle Superhighway to the site is CS8 which routes between Westminster and Wandsworth. At its closest, CS8 is south of Wandsworth Bridge approximately 600m to the south of the Carnwath Road Riverside site.

12.4.16 There are no cycle hire docking stations in the vicinity of the site.

[iii] A painted broken white line with cycle symbols on the road surface which motorists should not enter unless it is clear of cyclists.

Public Transport Accessibility Level

12.4.17 The Public Transport Accessibility Level (PTAL) of the site has been calculated using TfL's approved PTAL methodology (TfL, 2010)[7] and assumes a walking speed of 4.8km/h and considers rail stations within a 12 minute walk (960m) of the site and bus stops within an eight minute walk (640m).

12.4.18 Using this methodology the site has a PTAL rating of 2, rated as 'poor' (with 1a being the lowest accessibility and 6b being the highest accessibility).

12.4.19 Vol 10 Figure 12.4.3 (see separate volume of figures) shows the public transport network around the Carnwath Road Riverside site.

Bus routes

12.4.20 As shown in Vol 10 Figure 12.4.3 (see separate volume of figures), a total of five daytime bus routes and two night bus routes operate within a 640m walking distance of the site. Route 424 operates as a hail-and-ride service along Carnwath Road.

12.4.21 The bus routes operate from the following bus stops:

a. Townmead Road bus stop on Wandsworth Bridge Road (A217) – northbound and southbound, 350m walking distance northeast

b. Wandsworth Bridge bus stop on Townmead Road – eastbound and westbound, 250m walking distance east

c. William Morris Way / Sainsbury's bus stop on Townmead Road – eastbound and westbound, 550m walking distance east

d. Carnwath Road hail-and-ride service – eastbound and westbound

12.4.22 These routes would also serve other stops further from the site as shown on Vol 10 Figure 12.4.3 (see separate volume of figures).

12.4.23 On average there are 60 daytime bus services in total per hour in the AM peak and 55 bus services in total per hour in the PM peak accessible within a 640m walking distance of the site.

12.4.24 There are approximately seven night-time bus services Monday to Friday between 00:00-06:00 and a total of eight night-time bus services on Saturdays between 00:00-06:00 accessible within a 640m walking distance of the site.

London Underground and London Overground

12.4.25 As shown on Vol 10 Figure 12.4.3 (see separate volume of figures), the closest London Underground station is Putney Bridge station which is located approximately 1.1km or 14 minutes walk to the west of the site and is served by the District Line. Trains from this station travel east to Tower Hill and Upminster or north to Edgware Road via Earls Court and south to Wimbledon.

12.4.26 In the AM and PM peak hours the frequency of northbound and southbound trains at Putney Bridge is approximately one every four minutes, providing an average of 15 services in each direction per hour.

12.4.27 Imperial Wharf station is located approximately 1.3km or 17 minutes walk to the east and is served by London Overground. Imperial Wharf station has a frequency of four trains per hour towards Clapham Junction and four trains per hour towards Stratford in the peak hours.

12.4.28 Both stations are outside the 960m walking threshold which is treated as the maximum walkable distance in the PTAL calculations.

National Rail

12.4.29 There are no National Rail stations within 960m of the site. The closest station to the site is Wandsworth Town, which is approximately 1.1km to the south of the site and services Waterloo station to the northeast and Staines to the west.

12.4.30 In each of the AM and PM peak hours, nine trains service Waterloo from Wandsworth Town rail station. Five trains and six trains service westbound routes towards Staines in the AM and PM peak hours respectively.

12.4.31 Imperial Wharf station is located approximately 1.3km or 17 minutes walk to the east and is served by Southern Rail. Imperial Wharf station has a frequency of one train per hour towards Milton Keynes central and one train per hour towards South Croydon in the peak hours.

River passenger services

12.4.32 The Carnwath Road Riverside site has no river passenger piers in the immediate vicinity, with the nearest pier being Wandsworth Riverside Quarter Pier located 2km walking distance from the site, upstream on the opposite side of the river.

River navigation

12.4.33 The Carnwath Road Riverside site lies opposite the Western Riverside Waste Transfer Station on the south bank of the river. Barges are used to transport excavated material away from the facility. Barges arrive and depart on most tides. The time at which such activity takes place is typically around the high tide period.

12.4.34 An analysis has been made of the typical volume of river vessel traffic passing the Carnwath Road Riverside site, based on published river passenger service timetables and estimates of freight traffic based on discussions with operators. It is estimated that the peak hour for river vessel traffic passing the site is between 17:00 and 18:00, Monday to Friday. During this hour around ten vessels are estimated to pass the site. This figure is not constant however as freight vessel transit patterns, which are included in the traffic, are influenced by the rising and falling tide. Therefore, such a peak will only occur every 10 to 12 days when the tide is at its highest. These figures include vessels arriving and departing the excavated material transfer station[8].

Parking

12.4.35 Vol 10 Figure 12.4.4 (see separate volume of figures) shows the locations of the existing car parks and car club spaces within the vicinity of the site.

Existing on-street car parking

12.4.36 There is no on-street parking along Wandsworth Bridge Road (A217) as it forms part of the SRN.

12.4.37 On-street parking is permitted along Carnwath Road. Carnwath Road is within the Controlled Parking Zone (CPZ) ‘Q’. A total of 46 dedicated shared use parking bays are located along either side of Carnwath Road in a staggered arrangement.

12.4.38 There are no blue badge or motorcycle parking spaces located along Carnwath Road.

12.4.39 It is estimated that approximately 400 cars can be accommodated within the on-street parking bays in the vicinity of the site.

Existing off-street / private car parking

12.4.40 A PC World car park is located on Wandsworth Bridge Road (A217) approximately 250m walking distance east of the site which is intended for the use of PC World customers only.

12.4.41 There is a Sainsbury’s car park at 51 Townmead Road, approximately 400m walking distance east of the site, which is intended for customers’ use only.

12.4.42 Riverside West car park is located in Smugglers Way, approximately 1km to the south (across Wandsworth Bridge) of the site. The car park is open 24 hours Monday to Sunday.

12.4.43 A B&Q car park is also located in Smugglers Way which is intended for customers’ use only.

Car clubs

12.4.44 The closest car club parking space to the site is operated by ZipCar and is approximately 400m walking distance to the west of the site on Carnwath Road where one space is provided.

12.4.45 The second closest bay is also operated by ZipCar and is located approximately 540m walking distance east of the site in Townmead Road.

Servicing and deliveries

12.4.46 There are two loading bays located along Carnwath Road. Both of these bays are located on the northern side of the road, outside units 74-84 and 92-100 Carnwath Road, approximately 18m and 70m respectively to the west of the site. The loading bays are restricted to stays of up to 20 minutes only, with no return within one hour.

12.4.47 Observations of vehicle activity along Carnwath Road have concluded that loading and unloading activity also occurs at other locations on Carnwath Road.

Highway network and operation

12.4.48 Carnwath Road is a 30mph single carriageway road and has traffic calming speed cushions along its length.

12.4.49 Carnwath Road intersects with Wandsworth Bridge Road (A217) and

Townmead Road, via a signalised junction, to the east and Broomhouse Lane in the west. Wandsworth Bridge Road (A217) forms part of the SRN and provides a north-south link between Wandsworth Common in the south and Fulham and Chelsea in the north.

12.4.50 Wandsworth Bridge Road (A217) connects with the Wandsworth Gyratory in the south, which forms part of the TLRN.

Data from third party sources

Description of data

12.4.51 Data in relation to traffic flows and accidents have been sourced from TfL.

Accident analysis

12.4.52 A total of 62 accidents were recorded in the assessment area over the five years of accident data analysed. In relation to the severity of these accidents, ten were serious and 51 were slight, predominantly resulting from failure to look properly, poor manoeuvres by drivers and failure to judge another person's path or speed.

12.4.53 One fatal accident was recorded at the Broomhouse Lane / Daisy Lane junction to the northwest of the Carnwath Road Riverside site.

12.4.54 The largest number of accidents and the only significant cluster of accidents in the vicinity of the Carnwath Road Riverside site were recorded at the Wandsworth Bridge Road (A217) junction with Townmead Road and Carnwath Road. There were ten slight and three serious accidents recorded in this location over the five year period.

12.4.55 Of the accidents, two involved medium goods vehicles (MGVs) and an HGV. In regard to the MGVs their severity was a slight and serious, whilst for the HGV the severity was serious.

12.4.56 There is no evidence of accidents occurring due to highway geometry or poor infrastructure.

Survey data

Description of surveys

12.4.57 Baseline survey data were collected in May, July, and August 2011 to establish the existing transport movements and usage of parking in the area. Vol 10 Figure 12.4.5 (see separate volume of figures) shows the survey locations in the vicinity of the site.

12.4.58 As part of surveys in May and July 2011, manual and automated traffic surveys were undertaken to establish specific traffic, pedestrian and cycle movements including turning volumes, queue lengths and traffic signal timings. Parking surveys were undertaken to establish the usage of on-street parking in Carnwath Road. Further surveys were conducted in August 2011 to establish the summer usage of the Thames Path.

Results of the surveys

12.4.59 The surveys inform the analysis of the baseline situation in the area surrounding the site.

Pedestrians and cyclists

12.4.60 Pedestrian surveys were undertaken at three locations around the site during the AM and PM peak hours. Pedestrian flows on the Thames Path west of Wandsworth Bridge were very low with approximately seven two way movements in the AM peak hour, 15 in the PM peak hour and 18 in the Saturday peak hour.

12.4.61 There were significantly higher pedestrian flows on Carnwath Road and Hugon Road with the survey data suggesting a higher flow westbound in the AM peak hour and higher flow eastbound in the PM peak hour. The pedestrian survey on Carnwath Road by Dymock Street recorded 133 pedestrians travelling in the westbound direction and 27 eastbound in the AM peak hour. In the PM peak hour there were 27 pedestrians travelling westbound and 115 eastbound.

12.4.62 The pedestrian survey on Hugon Road by Dymock Street recorded 222 pedestrians travelling in the westbound direction and 28 eastbound in the AM peak hour. In the PM peak hour there were 44 travelling westbound and 70 eastbound.

12.4.63 The cycle surveys indicate that demands are not high in the area. There was a maximum of six cyclists recorded on the Thames Path travelling eastbound in the PM peak hour, with four travelling westbound.

12.4.64 The junction counts suggest greater cycle usage along Carnwath Road than on the Thames Path with 58 cyclists travelling in the westbound direction and 26 eastbound in the AM peak hour. While in the PM peak hour there were 18 travelling westbound and 19 eastbound.

12.4.65 In addition, there is significant cycle movement along Wandsworth Bridge Road (A217) and through the Wandsworth Bridge Road (A217)/Carnwath Road/Townmead Road junction, with 217 cyclists travelling (to the south side of the junction) in the northbound direction and 48 southbound in the AM peak hour. In the PM peak hour there were 32 travelling northbound and 171 southbound. Concurrently the numbers to the north of the junction were 113 cyclists travelling in the northbound direction and 25 southbound in the AM peak hour, while in the PM peak hour there were 29 travelling northbound and 107 southbound.

Traffic flows

12.4.66 The ATC data has been analysed to identify the existing traffic flows along Wandsworth Bridge Road (A217). Weekday flows are used as this is when the greatest impacts from the project are likely to be experienced.

12.4.67 The AM peak period for the north side of Wandsworth Bridge is the busiest hour with a maximum of approximately 480 vehicles travelling northbound every 15 minutes, and approximately 250 vehicles travelling southbound during the same period. The PM peak hour shows a reverse of this pattern with approximately 400 vehicles travelling southbound and 300 travelling northbound every 15 minutes.

12.4.68 There is a more even profile for Wandsworth Bridge Road (A217) 20m north of Beltran Road and south of by Clancarty Road. The peak for this location occurred in the hour before the AM peak hour of assessment with a maximum of approximately 160 vehicles travelling northbound and approximately 140 travelling southbound every 15 minutes. This reversed in the evening peak with approximately 150 vehicles travelling southbound and 140 travelling northbound respectively every 15 minutes.

12.4.69 The traffic flows for the busiest period (weekday AM peak hour, 08:00-09:00) within the area are shown in Vol 10 Figure 12.4.6 and Vol 10 Figure 12.4.7 (see separate volume of figures).

Parking

12.4.70 It was estimated that approximately 400 cars can be accommodated within the on-street parking bays in the vicinity of the site.

12.4.71 The parking surveys indicate that usage of the on-street parking is moderate. The survey suggested that about 50% of all available spaces were used throughout the day. The utilisation is slightly higher on the Saturday and weekday interpeak when compared to the AM and PM weekday peak periods.

Local highway modelling

12.4.72 For the assessment of the local highway network, a scope was agreed with TfL and LB of Hammersmith and Fulham to assess the Carnwath Road site accesses using the PICADY model and the junction of Wandsworth Bridge Road (A217) / Carnwath Road / Townmead Road using the LinSig model.

12.4.73 A baseline model for the new site accesses was not created as these locations are not currently in use as accesses. For the baseline modelling, only the LinSig model was used to assess the junction of Wandsworth Bridge Road (A217) / Carnwath Road / Townmead Road. The baseline modelling follows the methodology set out in Vol 2.

12.4.74 The weekday AM and PM baseline model queues for the junction of Carnwath Road, Townmead Road and Wandsworth Bridge Road (A217) were compared against observed queue lengths for the peak periods to validate the LinSig model and ensure reasonable representation of existing conditions.

12.4.75 Vol 10 Table 12.4.1 below summarises the baseline performance of the Wandsworth Bridge Road (A217) / Carnwath Road / Townmead Road junction. This includes worker, delivery and customer vehicles associated with the Carnwath Business Centre. The overall junction performance shows that the junction is currently operating at capacity in the weekday AM peak hour and within capacity in the PM peak hour. The validated model indicates that the overall junction delay is 28 seconds per vehicle in the AM peak hour and 23 in the PM peak hour. However, the maximum delay per vehicle is 89 seconds in the AM peak hour and 57 seconds in the PM peak hour. The delay to vehicles is most significant for vehicles turning right from Carnwath Road eastbound into Wandsworth Bridge Road (A217) southbound.

Vol 10 Table 12.4.1 Transport - baseline LinSig model outputs

Approach	Movement	Weekday							
		AM peak hour (08:00-09:00)				PM peak hour (17:00-18:00)			
		Flow (PCUs)	DoS	MMQ (PCUs)	Delay (seconds per PCU)	Flow (PCUs)	DoS	MMQ (PCUs)	Delay (seconds per PCU)
Wandsworth Bridge Road (A217)	Left / ahead	151	26%	3	29	305	36%	6	20
	Ahead / right	365	62%	9	37	688	80%	17	32
Townmead Road	Left	304	34%	5	14	522	78%	14	36
	Right / ahead	104	29%	3	40	56	17%	1	40
Wandsworth Bridge	Left / ahead	1340	89%	21	19	988	60%	7	9
	Right	673	81%	17	34	315	59%	8	38
Carnwath Road	Left / ahead	119	34%	3	41	76	23%	2	40
	Right	233	88%	9	89	199	67%	6	57
		PRC		**Total delay (PCU hours)**		**PRC**		**Total delay (PCU hours)**	
Overall junction performance		0.9%		28		12.9%		23	

Note: DoS represents Degree of Saturation; the ratio of flow to capacity. MMQ represents Mean Maximum Queue for the busiest-case 15 minute modelled period (in vehicle lengths). PRC represents Practical Reserve Capacity; measure of how much additional traffic could pass through a junction whilst maintaining a maximum DoS of 90% on all lanes. Delay represents the mean delay per PCU. PCU value for a car is one PCU. Vans and three-axle vehicles are 1.5 PCUs, vehicles with four or more axles are 2.3 PCUs. Buses and coaches are two PCUs. Motorcycles are 0.4 PCUs and pedal cycles are 0.2 PCUs

Transport receptors and sensitivity

12.4.76 The receptors and their sensitivities in the vicinity of the Carnwath Road Riverside site are summarised in Vol 10 Table 12.4.2. The transport receptor sensitivity is defined as high, medium or low using the criteria detailed in Vol 2.

12.4.77 The transport effects identified in this assessment are directly related to changes to the operation of transport networks which may occur as a result of physical changes to transport networks or of additional vessel or vehicle movements or additional public transport patronage. These changes in operation could lead to effects which would be experienced by people using those transport networks, whether as pedestrians, cyclists, public transport or private vehicle users. The assessment identifies several 'generic' groups of transport users in the list of transport receptors.

12.4.78 Receptors who are occupiers and users of or visitors to existing or committed developments in the vicinity of each of the project sites may experience transport effects on their journeys to and from those developments. In many cases those effects would be similar (or identical) to the effects identified for the 'generic' groups of transport users. However, the assessment specifically includes these receptors to ensure that any particular effects that they would be likely to experience (for instance because they make use of particular routes or transport facilities) have been identified.

Vol 10 Table 12.4.2 Transport – receptors and sensitivity

Receptors (relating to all identified transport effects)	Phase at which receptor is sensitive to identified impacts	Value/sensitivity and justification
Pedestrians and cyclists (including sensitive pedestrians[iv]) using the Thames Path and Carnwath Road footways	Construction	High sensitivity to diversions and footway closures, resulting in increases to journey times.
Private vehicle users in the area using the local highways or on-street parking.	Construction Operation	Medium sensitivity to increases in HGV traffic and changes in journey time.
Emergency vehicles travelling on Wandsworth Bridge Road (A217) and	Construction Operation	High sensitivity to journey time delays due to time constraints on

[iv] Sensitive pedestrians include those with mobility impairments, including wheelchair users.

Receptors (relating to all identified transport effects)	Phase at which receptor is sensitive to identified impacts	Value/sensitivity and justification
Carnwath Road		journey purposes.
Marine emergency services	Construction	High sensitivity to changes in vessel movements / moorings
Service vehicles using loading bays on Carnwath Road	Construction Operation	Medium sensitivity to increases in HGV traffic and changes in journey time.
Bus users (passengers) travelling on routes along Carnwath Road, Townmead Road and Wandsworth Bridge Road (A217)	Construction	Medium sensitivity to journey time delays as a result of increases to traffic flows.
River vessel operators including those at Western Riverside Waste Transfer Station	Construction	Medium sensitivity to increases in barge movements.
Leisure users of the River Thames	Construction	High sensitivity to passage of construction barges
Public transport users using rail or river services within the area	Construction	Low sensitivity given distance from site
Residents of 5 Carnwath Road, adjacent to site	Construction Operation	High sensitivity to increases in HGV traffic and changes to pedestrian environment resulting in journey time delays.
Residents of 89-101 Carnwath Road, 2.5m	Construction	High sensitivity to increases in HGV and

Receptors (relating to all identified transport effects)	Phase at which receptor is sensitive to identified impacts	Value/sensitivity and justification
west of site	Operation	barge traffic and changes to pedestrian environment resulting in journey time delays.
Pupils, parents and staff at Thomas' London Day School, 105m north of site	Construction	High sensitivity to increases in HGV traffic and changes to pedestrian environment resulting in journey time delays.
Users of B1 Offices/studios (50 Carnwath Road), 10m north of site	Construction Operation	High sensitivity to increases in HGV traffic and changes to pedestrian environment resulting in journey time delays.
Users of Energie Fitness gym within Piper Centre, 10m north of site	Construction Operation	High sensitivity to increases in HGV traffic and changes to pedestrian environment resulting in journey time delays.
Users of Townmead Road concrete plant, 230m east of site	Construction	Low sensitivity to increases in HGV movements and changes in journey times.

Construction base case

12.4.79 As described in Section 12.3, the construction assessment year for transport effects in relation to this site is Site Year 2 of construction.

12.4.80 There are no known proposals to change the cycle or pedestrian network by Site Year 2 of construction and it is assumed that the network will operate as indicated in the baseline situation.

12.4.81 In terms of the public transport network, it is expected that as a result of the TfL *London Underground Upgrade Plan* (TfL, 2011)[9] capacity will increase on the District Line by approximately 24% compared to the current baseline capacity. It is envisaged that London Underground and

London Overground patronage will also increase by Site Year 2 of construction.

12.4.82 In order to ensure that the busiest base case scenario is used in the assessment, the capacity for London Overground and London Underground services in the base case has been assumed to remain the same as capacity in the baseline situation. This ensures a robust assessment as outlined in Vol 2.

12.4.83 There are no known current proposals to alter any river navigation patterns from the current baseline conditions and therefore the construction base case remains the same as the baseline position.

12.4.84 Baseline traffic flows (from the junction surveys) have been used and forecasting carried out to understand the capacity on the highway network in the vicinity of the Carnwath Road Riverside site in Site Year 2 of construction without the Thames Tideway Tunnel project. Traffic flows for the base case (derived from the survey data) providing input to the LinSig model are shown on Vol 10 Figure 12.4.6 and Vol 10 Figure 12.4.7 (see separate volume of figures).

12.4.85 The key findings from the construction base case LinSig model for the Carnwath Road Riverside site indicate that there will be an increase in queue lengths and changes to average delays at the junction of six seconds in the AM peak hour and four seconds in the PM peak hour in the construction base case, compared to baseline conditions.

12.4.86 Results also indicate that the local highway network would operate above theoretical capacity in the AM peak hour and within capacity in the PM peak hour when taking into account the construction base case traffic flows.

12.4.87 With regard to the identification of additional receptors associated with the other developments included in the base case, there are four within 250m of the site, although only one represents an additional relevant receptor for the transport assessment (Wandsworth Riverside Quarter). This is therefore included as an additional receptor as detailed in Vol 10 Table 12.4.3 below on the basis that impacts could be experienced by residents, employees and visitors using the footways and local highway network in the vicinity of the site.

Vol 10 Table 12.4.3 Transport – construction base case additional receptors

Receptors (relating to all identified transport effects)	Phase at which receptor is sensitive to identified impacts	Value/sensitivity and justification
Residents of Wandsworth	Construction	Low sensitivity to pedestrian and cycle

Receptors (relating to all identified transport effects)	Phase at which receptor is sensitive to identified impacts	Value/sensitivity and justification
Riverside Quarter, 200m southwest of site (opposite bank of River Thames)		diversions, highway and parking changes, due to distance from the site

Operational base case

12.4.88 The operational assessment year for transport is Year 1 of operation.

12.4.89 As explained in para. 12.3.14, the elements of the transport network considered in the operational assessment are highway layout and operation and parking. For the purposes of the operational base case it is anticipated that the highway layout and parking will be as described in the construction base case.

12.4.90 The operational base case takes into account the developments described in Vol 10 Appendix N (site development schedule). All three of the developments within 250m of the site (Wandsworth Riverside Quarter, Townmead Road concrete plant and Western Riverside Transfer Station) would be complete by Year 1 of operation. However, given the limited effects which are anticipated in the operational phase, these developments do not present any additional transport receptors that require consideration in the operational effects assessment.

12.5 Construction effects assessment

12.5.1 This section summarises the findings of the assessment undertaken for the peak year of construction at the Carnwath Road Riverside site (Site Year 2 of construction).

12.5.2 The anticipated mode split of worker trips (covering all types of construction worker as set out in Vol 10 Table 12.2.2) for the Carnwath Road Riverside site is detailed in Vol 10 Table 12.5.1 and has been generated based on 2001 Census data for journeys to workplaces within the vicinity of Carnwath Road Riverside[v]. This shows that the predominant mode of travel for journeys to work in this area is car.

12.5.3 At this site there would be no parking provided within the site boundary for workers and measures would be incorporated into site-specific *Travel Plan* requirements in order to minimise the number of workers travelling to and from the site by car. This accords with the overall aims and objectives of the *Draft Project Framework Travel Plan*.

12.5.4 However, given that not all parking in the surrounding streets is subject to restrictions at all times and that spare capacity has been observed within the available on-street parking provision, the transport assessment has

[v] Based on 2001 Census as this type of data had not yet been released from the 2011 Census at the time of assessment.

considered the effects that could arise if some workers were to travel by car and park in surrounding streets. This is to ensure a robust assessment of the likely effects.

12.5.5 The mode split outlined in Vol 10 Table 12.5.1 has therefore been used to assess the impacts of worker journeys on the highway and public transport networks.

Vol 10 Table 12.5.1 Transport – mode split

Mode	Percentage of trips to site	Equivalent number of worker trips (based on 165 worker trips)	
		AM peak hour (07:00-8:00)	PM peak hour (18:00-19:00)
Bus	12.3%	20	13
National Rail	9.6%	16	10
Underground	15.6%	26	16
Car driver	37.9%	63	40
Car passenger	2.4%	4	2
Cycle	5.5%	9	6
Walk	11.9%	20	12
River	0.8%	1	1
Other (taxi/motorcycle)	4.1%	7	4
Total	**100%**	**165**	**105**

Note: PM peak hour figure is lower than the AM peak hour as shift change is at 15:00 not 18:00. Census mode shares have been used in the assessment to provide a robust analysis; notwithstanding that site-specific Travel Plan measures would be likely to reduce worker car journeys to a minimum.

Pedestrian routes

12.5.6 The Thames Path routes through and around the site and would need to be diverted during construction at Carnwath Road. The diversion would continue the Thames Path along Carnwath Road for an additional 110m before connecting back to the riverside along the back of the Retail Park. The overall length of the Thames Path would however remain unchanged.

12.5.7 The construction phase layout – phase 1-4 plans (see separate volume of figures – Section 1) show the layout of the pedestrian footways during construction.

12.5.8 To assess a busiest case scenario it has been anticipated that all workers would finish their journeys to the site and start their journeys from the site on foot. As a result the 165 worker trips generated in the AM peak hour and 105 worker trips generated in the PM peak hour have been added to the construction base case pedestrian flows to determine the development case pedestrian flows in the AM and PM peak hours.

12.5.9 Taking into consideration the pedestrian diversions and increase in worker trips the greatest effect would be on the southern footway along Carnwath Road to which pedestrians would be diverted from the Thames Path.

12.5.10 In determining the magnitude of impacts on pedestrian routes the relevant impact criteria are pedestrian delay, pedestrian amenity and accidents and safety (as set out in Vol 2).

12.5.11 The proposed Thames Path diversion around the Carnwath Road Riverside site would not create any additional pedestrian delay as the overall journey distance would remain the same.

12.5.12 The introduction of new site accesses along the southern side of Carnwath Road would however result in pedestrians having to cross both site accesses. When construction vehicles are entering or leaving the Carnwath Road Riverside site this could introduce occasional delays to pedestrian journeys which are expected to be a maximum of 30 seconds in each case. The maximum overall delay that might be experienced would therefore be one minute. However, it is unlikely that pedestrians would encounter vehicle movements at both accesses and therefore the average delay to the few pedestrians who would be affected whilst waiting for a vehicle to access Carnwath Road Riverside site is likely to be in the order of 30 seconds. This represents a negligible impact on pedestrian delay.

12.5.13 With regard to pedestrian amenity the diversion of the Thames Path would result in a medium adverse impact on pedestrian amenity. Although the overall walking distance would not change, pedestrians would have to cross the two site access points on the southern side of Carnwath Road.

12.5.14 The impact on pedestrian accidents and safety would be low adverse using the criteria set out in Vol 2. This is on the basis that pedestrian flows would be less than 120 people per hour and there would be between four and 20 two way construction HGV movements an hour with pedestrians having to cross the two site access points.

Cycle facilities and routes

12.5.15 The relevant impact criteria for determining the magnitude of impacts on cycle facilities and routes are cycle delay and accidents and safety (as set out in Vol 2).

12.5.16 Cyclists using the highway may experience some delay to journey time as a result of the additional traffic generated by the construction works at the Carnwath Road Riverside site. The effect on journey times is identified in the highway operation and network assessments (paras. 12.5.60-12.5.61) and would be an increase of a maximum of some 14 seconds over that in the construction base case. Cyclists using the Thames Path would be diverted, as discussed in para 12.5.11 above. However, this would not alter cycle journey times as the distance using the diversion is equivalent to that in the base case. This impact on cycle delay is therefore deemed to be negligible.

12.5.17 With regard to accidents and safety, cyclists would cross the two new site entrances (although they would not be required to make any additional road crossings) and there would be an increase in construction traffic flow of between four and 20 two-way HGV movements per hour. This represents a low adverse impact.

12.5.18 The on-road painted cycle symbols along the kerbside on Carnwath Road would be unaffected by the construction works at the Carnwath Road Riverside site.

Bus routes and patronage

12.5.19 No bus services run immediately past the site entrances. However, the additional construction vehicles travelling along Wandsworth Bridge Road (A217) and Carnwath Road may affect bus journey times. The effect on journey times is identified in the highway operation and network assessment (see paras. 12.5.59-12.5.66) and would be an increase of a maximum of some 14 seconds over the construction base case. This represents a negligible impact.

12.5.20 It is expected that approximately 20 and 13 worker trips (Vol 10 Table 12.5.1) would be made by bus during the AM and PM peak hours respectively. Based on a service of 60 and 55 buses within a 640m walking distance during the AM and PM peak hours respectively this equates to less than one additional passenger per bus.

12.5.21 If the additional 42 workers in the AM peak hour and 26 in the PM peak hour expected to travel by rail and underground were to complete their journeys by bus this would increase the additional demand on bus services to approximately 62 journeys in the AM peak hour and 39 in the PM peak hour. This would equate to approximately one additional journey per bus. Based on the impact criteria outlined in Vol 2, the additional worker trips made by bus in peak hours would have a negligible impact on bus patronage.

London Underground, London Overground and National Rail patronage

12.5.22 No underground or rail stations are directly adjacent to the site and therefore none would be directly affected by the construction works at the site.

12.5.23 The mode split in Vol 10 Table 12.5.1 is based on 2001 Census data and was collected before the introduction of London Overground services. Some of the trips assigned to ‘Underground’ and National Rail modes could therefore be made by Overground services and thus this assessment represents a reasonable worst case assessment for London Underground and National Rail services.

12.5.24 It is anticipated that approximately 68 workers would use London Underground or National Rail services to access the site which would result in 16 additional person trips on National Rail services and 26 additional person trips on London Underground services in the AM peak hours and 10 additional person trips on National Rail services and 16 additional person trips on London Underground services in the PM peak hours.

12.5.25 On National Rail (and London Overground) services this equates to approximately one additional passengers per train, based on a frequency of 18 to 19 services in the AM and PM peak hours respectively. On London Underground services the additional trips would equate to approximately one additional passenger per train based on a frequency of 30 services in the peak hours.

12.5.26 Based on the quantitative assessment of patronage and the impact criteria on rail patronage in Vol 2, this would result in a negligible impact on London Underground and National Rail patronage.

12.5.27 As there are no London Underground/ Overground or National Rail stations within 960m of the Carnwath Road Riverside site, workers using these services as their main mode of transport would either complete their journey by bus or on foot which is taken into account in the above pedestrian and bus assessments.

River passenger services and patronage

12.5.28 There are no river passenger service piers in the immediate vicinity of the Carnwath Road Riverside site and therefore it is not expected that the transport of construction materials by river would directly affect services.

12.5.29 It is anticipated that less than 1% of construction workers would use river services to access the construction site, and such workers would complete their journeys on foot or by bus. There would therefore be a negligible impact on river passenger service patronage.

River navigation and access

12.5.30 This section addresses the effects on river navigation and access in the vicinity of the Carnwath Road Riverside site. The wider effects of transporting construction materials by river from a number of sites within the project are dealt with in Vol 3.

12.5.31 During construction it is assumed that 90% of excavated material from the main tunnel and shaft would be transported out and 90% of main tunnel secondary lining aggregates would be transported in by barge. The peak number of barge movements would occur within Site Year 2 of construction with an average of four barge movements a day. Barges would be hauled by tugs which may haul two barges at a time where possible.

12.5.32 There would be no changes to existing mooring arrangements at other locations in the vicinity of the site, nor to the provision of river access for leisure users of the river.

12.5.33 Due to the low number of barges arriving at the site and based on the impact criteria outlined in Vol 2, it is anticipated that the impact on river navigation in the vicinity of the site as a result of barges arriving at Carnwath Road Riverside would be negligible.

12.5.34 A separate *Navigational Issues and Preliminary Risk Assessment* has been undertaken for the temporary construction works and barges to be used at the Carnwath Road Riverside site. This is reported separately outside of the *Environmental Statement* and *Transport Assessment* and accompanies the application.

Parking

12.5.35 There is on-street shared use parking in place along both sides of Carnwath Road in a staggered arrangement including along the length of the site boundary. There are also single yellow line restrictions in place between the sections of on-street parking.

12.5.36 To accommodate the site access and larger vehicles travelling along Carnwath Road, it would be necessary to suspend sections of the shared use parking.

12.5.37 Three sections of parking would be suspended throughout the construction period comprising a potential total of approximately 12 parking spaces. Three of these parking spaces are on the north side of Carnwath Road located opposite the western site access while the remaining nine parking spaces are on the southern side of Carnwath Road to the west of Peterborough Road. Single yellow line parking restrictions would be added where these sections of parking are suspended and these restrictions would operate from 08:00 to 18:00, Monday to Friday and 08:00 to 13:00 on Saturday.

12.5.38 It would also be necessary to extend the hours of operation of the existing single yellow line parking restrictions and loading restrictions on Carnwath Road from the junction with the Wandsworth Bridge Road (A217) and Townmead Road to the western site boundary. This would be extended to no parking or loading 08:00 to 18:00, Monday to Friday and 08:00 to 13:00 on Saturday.

12.5.39 The highway layout during construction plans (see separate volume of figures – Section 1) show the proposed suspension of parking bays and extended hours of restrictions for single yellow lines associated with the construction works at the Carnwath Road Riverside site.

12.5.40 Parking for fifteen essential construction site operations and contractor activity operation vehicles would be provided on site. With regard to construction worker parking, measures would be taken for this site to discourage workers from travelling by car, including promoting the use of public transport, walking or cycling. These measures are included in the *Draft Project Framework Travel Plan* and *CoCP* and would be reflected in the site-specific *Travel Plan* for this site. However, as explained in paras 12.5.2 to 12.5.4 the 2001 census data has been used to provide a robust assessment of the effects that might arise if workers drive to this site and on that basis 63 workers could be expected to drive to the Carnwath Road Riverside site per day.

12.5.41 There is an eight hour maximum pay-and-display limit for those without a valid permit for CPZ 'Q' on Carnwath Road. As restrictions apply between

09:00 and 17:00 Monday to Saturday those who are working night shifts would not be subject to any parking restrictions or charges.

12.5.42 The parking survey indicates that there would be sufficient capacity to accommodate the additional car parking associated with any worker car use along Carnwath Road and the displacement of parking associated with the suspension of parking bays in the vicinity of the site accesses. It would therefore not be necessary to reprovide the suspended parking spaces.

12.5.43 The two dedicated loading bays to the west of the site on Carnwath Road would be unaffected by construction works at the Carnwath Road Riverside site. However there would be extended loading restrictions as highlighted in para. 12.5.39.

12.5.44 Taking account of the suspension of parking and the availability of spare capacity in the area, the impact on car parking and loading would be classified as low adverse using the criteria set out in Vol 2.

Highway network and operation

12.5.45 The highway layout during construction plans (see separate volume of figures – Section 1) show the highway layout during construction at the Carnwath Road Riverside site. The highway layout during construction vehicle swept path analysis plans (see Carnwath Road Riverside *Transport Assessment* Figures) demonstrates that the construction vehicles would be able to safely enter and leave the site.

12.5.46 At the junction of Carnwath Road / Wandsworth Bridge Road (A217) / Townmead Road, a potential conflict has been identified for 16.5m articulated vehicles and 12.0m rigid vehicles turning left into Carnwath Road from Wandsworth Bridge Road (A217). A junction improvement is therefore proposed as part of the design to realign the existing kerb to allow the construction vehicles to carry out this manoeuvre without overrunning the kerb. This is still under consideration by the LB Hammersmith and Fulham. The highway layout during construction vehicle swept path analysis plans (see Carnwath Road Riverside *Transport Assessment* Figures) show the proposed junction improvements.

12.5.47 In Phases 1 and 2 there would be two site accesses on Carnwath Road. The western access would only be used for emergency access or as entry-only for specific deliveries only. In Phases 3 and 4, the western access would be closed to allow for crane activities and all construction vehicles would enter and leave the site through the eastern access.

12.5.48 Construction lorry movements would be limited to the day shift only (08:00 to 18:00 Monday to Friday and 08:00 to 13:00 Saturday) except for in exceptional circumstances when HGV and abnormal load movements could occur up to 22:00 on weekdays for large concrete pours and later at night. This would be subject to agreement with the LB of Hammersmith and Fulham.

12.5.49 Vol 10 Table 12.5.2 shows the construction lorry movement assumptions for the local peak traffic periods. These are based on the peak months of construction activity at this site.

12.5.50 As noted in paras 12.5.2 to 12.5.4, the assessment has examined the implications of workers driving to the site, based on the 2001 Census mode shares. However, given the commitments made in the *Draft Project Framework Travel Plan* and *CoCP*, it is highly unlikely in practice that workers would drive to the site. The assessment therefore represents a reasonable worst case in relation to highway network operational issues.

12.5.51 On that basis, it was estimated that 63 workers could drive to the site during the AM peak hour based on the 2001 census mode shares set out in Vol 10 Table 12.5.1. Due to the shift changeover in this period there would be 63 cars arriving and 24 cars departing between 07:00 and 09:00. However, in the afternoon because of shift patterns, only seven cars would be arriving and 40 cars departing between 17:00 and 19:00.

12.5.52 The table below (Vol 10 Table 12.5.2) shows the construction worker vehicle movements expected to be generated by the site. The assessment has been based on 10% of the daily number of lorry journeys occurring in the peak hours, which has been agreed with TfL as a reasonable approach. It is recognised that it may be desirable to reduce the number of construction lorry movements in peak hours and the mechanisms for addressing this would form part of the *Traffic Management Plan*s which are required as part of the *CoCP Part A* (Section 5).

Vol 10 Table 12.5.2 Transport – peak construction works vehicle movements

Vehicle type	Vehicle movements per time period				
	Total daily	07:00 to 08:00	08:00 to 09:00	17:00 to 18:00	18:00 to 19:00
Construction lorry vehicle movements 10%*	88	0	9	9	0
Other construction vehicle movements**	134	6	6	6	6
Worker vehicle movements***	219	63	24	7	40
Total	**441**	**69**	**39**	**22**	**46**

** The assessment has been based on 10% of the daily construction lorry movements associated with materials taking place in each of the peak hours.*
*** Other construction vehicle movements includes cars and light goods vehicles associated with site operations and contractor activity.*
**** Worker vehicle numbers based on 37.9% of workers driving, derived by taking the highest number of workers during the peak month and calculating the percentage of trips*

using the 2001 Census Journey to Work data. This represents an unconstrained case to produce a robust assessment, as there would be no parking on site for workers and the Draft Project Framework Travel Plan and site-specific Travel Plan would include measures to discourage workers from driving or parking in surrounding streets

12.5.53 The busiest peak in the AM and PM period for each type of movement (construction lorries, other construction vehicles and worker vehicles) has been combined in the development case and assessed against the peak hour operation of the highway network. In reality, not all peaks for these movements would occur concurrently and the peak for worker trips would be outside of the highway network peak hour, therefore the assessment is considered to be worst-case.

12.5.54 An average peak flow of 441 vehicle movements a day is expected during the months of greatest activity during Site Year 2 of construction at this site. At other times in the construction period, vehicle flows would be lower than this average peak figure.

12.5.55 The relevant impact criteria for determining the magnitude of impacts on the highway network and operation are accidents and safety, road network delay and hazardous loads (as set out in Vol 2).

12.5.56 It is anticipated that along Carnwath Road there would be an additional nine two-way HGV movements per hour as a result of the construction at Carnwath Road Riverside. This together with the fact that the site accesses would not be directly onto a strategic road results in a low adverse impact on accidents and safety.

12.5.57 There would be one additional construction HGV movement per hour associated with other Thames Tideway Tunnel project sites that would use Wandsworth Bridge Road (A217). This would produce a combined total of ten movements per hour when added to movements generated by the Carnwath Road Riverside site which would remain as a low adverse impact.

12.5.58 It is assessed that potentially, one hazardous load per week would be generated by this site and this equates to a medium adverse impact in accordance with the criteria set out in Vol 2.

12.5.59 The local PICADY and LinSig models have been used to apply the construction traffic demands and local geometrical changes to the construction base case to determine the changes in the highway network operation due to the project (ie, comparison of base and development cases). The development case traffic flows (providing input to the LinSig and PICADY models) are shown on Vol 10 Figure 12.4.6 and Vol 10 Figure 12.4.7 (see separate volume of figures).

12.5.60 A summary of the construction assessment results for the Carnwath Road / Wandsworth Bridge Road (A217) / Townmead Road junction in the weekday AM and PM peak hours is presented in Vol 10 Table 12.5.3 and Vol 10 Table 12.5.4. The construction base case model indicates that the local highway will be operating over theoretical capacity in the AM peak hour and within capacity in the PM peak hour without the Thames Tideway Tunnel project proposals.

12.5.61 With the inclusion of the construction traffic generated the construction development case indicates that the local highway would remain over theoretical capacity in the AM peak hour and within capacity in the PM peak hour.

12.5.62 There would be a slight increase in demand resulting from the construction traffic. This would increase the degree of saturation by 5% on Carnwath Road in the AM peak hour, with an additional delay of 14 seconds per PCU. On Wandworth Bridge northbound approach the degree of saturation would increase by 3%, with an additional queue of 12 PCUs and additional delay of 11 seconds per PCU.

12.5.63 In the PM peak hour, there would be virtually no impact on junction performance.

12.5.64 Overall, the changes in capacity, queue length and delay would result in a negligible impact, based on the impact criteria identified in Vol 2.

12.5.65 The junctions between the two new site accesses and Carnwath Road is represented by a single new site access in the PICADY model. This model also uses the peak traffic flow and hence provides the reasonable worst case impact on any one of the Carnwath Road/new site access junctions.

12.5.66 The results of the PICADY modelling shown in Vol 10 Table 12.5.5 indicate that the accesses would operate well within capacity during construction. No comparison with the base case has been made as these accesses would be introduced specifically for the works at the Carnwath Road Riverside site.

Vol 10 Table 12.5.3 Transport – construction LinSig model outputs (AM peak hour)

Approach	Arm	Flow (PCUs)	Weekday								
			AM peak hour (08:00-09:00)								
			DoS			MMQ (PCUs)			Delay (seconds per PCU)		
			Base case	Devt case	Change	Base case	Devt case	Change	Base case	Devt case	Change
Wandsworth Bridge Road (A217)	Left / ahead	**269**	55%	56%	+1%	7	7	+1	39	39	-
	Ahead / right	**273**	56%	56%	-	7	7	+1	40	41	+1
Townmead Road	Left	**318**	33%	33%	-	4	4	- 1	11	11	-
	Right / ahead	**111**	28%	28%	-	3	3	-	38	38	-
Wandsworth Bridge	Left / ahead	**1409**	93%	96%	+3%	25	35	+12	24	35	+11
	Right	**705**	81%	81%	-	18	18	-	33	33	-
Carnwath Road	Left / ahead	**128**	32%	33%	+ 1%	3	3	-	38	39	+1
	Right	**257**	86%	91%	+5%	9	11	-	82	96	+14
			PRC						**Total delay (PCU hours)**		
Overall junction performance			-5.6%	-7.0%	-1.4%				34	36	2

Notes: 1. DoS represents Degree of Saturation; the ratio of flow to capacity. MMQ represents Mean Maximum Queue for the busiest-case 15 minute modelled period (in vehicle lengths). PRC represents Practical Reserve Capacity; measure of how much additional traffic could pass through a junction whilst maintaining a maximum DoS of 90% on all lanes. Delay represents the mean delay per PCU. PCU value for a car is one PCU. Vans and three-axle vehicles are 1.5 PCUs, vehicles with four or more axles are 2.3 PCUs. Buses and coaches are two PCUs. Motorcycles are 0.4 PCUs and pedal cycles are 0.2 PCUs. Thames Tideway Tunnel project construction vehicles would be a mixture of three- and four-axle vehicles and have therefore been given a PCU value of two.
2. Assessment has assumed that traffic signal optimisation has been undertaken as detailed in para. 12.3.22.

Vol 10 Table 12.5.4 Transport – construction LinSig model outputs (PM peak hour)

Approach	Arm	Flow (PCUs)	Weekday								
			PM peak hour (17:00-18:00)								
			DoS			MMQ (PCUs)			Delay (seconds per PCU)		
			Base case	Devt case	Change	Base case	Devt case	Change	Base case	Devt case	Change
Wandsworth Bridge Road (A217)	Left / ahead	**307**	35%	35%	-	6	6	-	19	19	-
	Ahead / right	**739**	83%	84%	+ 1%	19	20	+1	34	35	+1
Townmead Road	Left	**548**	84%	84%	-	16	16	-	42	42	-
	Right / ahead	**60**	18%	18%	-	1	1	-	40	40	-
Wandsworth Bridge	Left / ahead	**1042**	63%	64%	+ 1%	7	7	-	9	10	+1
	Right	**331**	66%	69%	+ 3%	9	9	-	43	45	+2
Carnwath Road	Left / ahead	**83**	24%	24%	-	2	2	-	40	39	- 1
	Right	**225**	71%	73%	+ 2%	6	7	+1	60	60	-
			PRC						**Total delay (PCU hours)**		
Overall junction performance			7.0%	7.0%	-				27	27	-

Notes: 1. DoS represents Degree of Saturation; the ratio of flow to capacity. MMQ represents Mean Maximum Queue for the busiest-case 15 minute modelled period (in vehicle lengths). PRC represents Practical Reserve Capacity; measure of how much additional traffic could pass through a junction whilst maintaining a maximum DoS of 90% on all lanes. Delay represents the mean delay per PCU. PCU value for a car is one PCU. Vans and three-axle vehicles are 1.5 PCUs, vehicles with four or more axles are 2.3 PCUs. Buses and coaches are two PCUs. Motorcycles are 0.4 PCUs and pedal cycles are 0.2 PCUs. Thames Tideway Tunnel project construction vehicles would be a mixture of three- and four-axle vehicles and have therefore been given a PCU value of two.
2. Assessment has assumed that traffic signal optimisation has been undertaken as detailed in para. 12.3.22.

Vol 10 Table 12.5.5 Transport – construction PICADY model outputs (AM peak hour and PM peak hour)

Approach	Movement	Weekday							
		AM peak hour (08:00-09:00)				PM peak hour (17:00-18:00)			
		Flow (vehicles)	RFC	MMQ (vehicles)	Delay (seconds per vehicle)	Flow (vehicles)	RFC	MMQ (vehicles)	Delay (seconds per vehicle)
Site Access	Right	8	5%	0	24	8	3%	0	15
Carnwath Rd (westbound)	Right	9	1%	0	5	5	1%	0	5

Notes: 1. RFC represents Ratio of Flow to Capacity. MMQ represents Mean Maximum Queue for the busiest-case 15 minute modelled period (in vehicle lengths). Delay represents the mean delay per vehicle.
2. The PICADY model reports right turns from major roads as other movements have the right of way.

Significance of effects

12.5.67 The significance of the effects has been determined by considering the transport impacts described above in the context of the sensitivity of the receptors identified in Vol 10 Table 12.4.2.

12.5.68 Vol 10 Table 12.5.6 sets out the effects on each receptor in the vicinity of the site.

Vol 10 Table 12.5.6 Transport – significance of effects during construction

Receptors (relating to all identified transport effects)	Significance of effect	Justification (receptor sensitivity and impacts)
Pedestrians and cyclists (including sensitive pedestrians) using the Thames Path and Carnwath Road footways	Minor adverse effect on pedestrians Minor adverse effect on cyclists	**Pedestrians:** • High sensitivity • Negligible impact on pedestrian delay • Medium adverse impact on pedestrian amenity • Low adverse impact on accidents and safety • Due to negligible, low and medium impacts, equates to minor adverse effect. **Cyclists:** • High sensitivity • Negligible impact on cycle delay. • Low adverse impact on accidents and safety. • Due to negligible and low impacts, equates to minor adverse effect
Private vehicle users in the area using the local highways or on-street parking	Minor adverse effect on highway users Minor adverse effect on parking users	**Highway users:** • Medium sensitivity • Low adverse impact on accidents and safety • Medium adverse impact from hazardous loads • Negligible effect on road network delay • Overall equates to minor adverse effect **Parking users:** • Medium sensitivity

Receptors (relating to all identified transport effects)	Significance of effect	Justification (receptor sensitivity and impacts)
		• Low adverse impact on parking • Equates to minor adverse effect
Emergency vehicles travelling on Wandsworth Bridge Road (A217) and Carnwath Road	Minor adverse effect	• High sensitivity • Low adverse impact on accidents and safety • Medium adverse impact from hazardous loads • Negligible effect on road network delay • Overall equates to minor adverse effect
Marine emergency services	Negligible effect	• High sensitivity • Negligible effect on river navigation / moorings • Equates to negligible effect
Service vehicles using loading bays on Carnwath Road	Minor adverse effect	• Medium sensitivity • Low adverse impact on loading bays • Equates to minor adverse effect
Bus users (passengers) travelling along Carnwath Road, Townmead Road and Wandsworth Bridge Road (A217)	Negligible effect	• Medium sensitivity • Negligible impact on road network delay and patronage • Due to negligible impacts, equates to negligible effect.
River vessel operators including those at Western Riverside Waster Transfer Station	Negligible effect	• Medium sensitivity • Negligible effect on river navigation / moorings • Equates to negligible effect
Leisure users of the River Thames	Negligible effect	• High sensitivity • Negligible effect on river navigation / moorings • Equates to negligible effect
Public transport users	Negligible effect	• Low sensitivity

Receptors (relating to all identified transport effects)	Significance of effect	Justification (receptor sensitivity and impacts)
using rail or river services within the area		• Negligible impact on rail and river service patronage • Equates to negligible effect
Residents of 5 Carnwath Road Residents of 89-101 Carnwath Road Pupils, parents and staff at Thomas' London Day School Users of B1 Offices/studios (50 Carnwath Road) Users of Energie Fitness Centre	Minor adverse effect on pedestrians Minor adverse effect on cyclists Minor adverse effect on highway users. Minor adverse effect on parking users.	**Pedestrians:** • High sensitivity • Negligible impact on pedestrian delay • Medium adverse impact on pedestrian amenity • Low adverse impact on accidents and safety • Due to negligible, low and medium impacts, equates to minor adverse effect. **Cyclists:** • High sensitivity • Negligible impact on cycle delay. • Low adverse impact on accidents and safety. • Due to negligible and low adverse impacts, equates to minor adverse effect. **Highway users:** • High sensitivity • Low adverse impact on accidents and safety • Medium adverse impact in relation to hazardous loads • Negligible effect on road network delay • Overall equates to minor adverse effect **Parking users:** • High sensitivity • Low adverse impact on parking • Equates to minor adverse effect
Users of Townmead	Minor adverse	• Low sensitivity

Receptors (relating to all identified transport effects)	Significance of effect	Justification (receptor sensitivity and impacts)
Road concrete plant	effect	• Low adverse impact on accidents and safety • Medium adverse impact in relation to hazardous loads • Negligible effect on road network delay • Overall equates to minor adverse effect
Residents of Wandsworth Riverside Quarter	Negligible effect on pedestrians Negligible effect on cyclists Negligible effect on highway users Negligible effect on parking users	**Pedestrians:** • Low sensitivity • Negligible impact on pedestrian delay • Medium adverse impact on pedestrian amenity • Low adverse impact on accidents and safety • Overall taking account of distance from site and sensitivity, equates to negligible effect. **Cyclists:** • Negligible impact on cycle delay. • Low adverse impact on accidents and safety. • Overall taking account of distance from site and sensitivity, equates to negligible effect. **Highway users:** • Low sensitivity • Low adverse impact on accidents and safety • Medium adverse impact in relation to hazardous loads • Negligible effect on road network delay • Overall taking account of distance from site and sensitivity, equates to negligible effect. **Parking users:** • Low sensitivity • Low adverse impact on parking

Receptors (relating to all identified transport effects)	Significance of effect	Justification (receptor sensitivity and impacts)
		• Overall taking account of distance from site and sensitivity, equates to negligible effect.

Sensitivity test for programme delay

12.5.69 The assessment has been based on an estimated programme for the construction of the Thames Tideway Tunnel project. That programme has been used to derive construction vehicle numbers and to understand the relationships between the project and other developments in the vicinity of project sites, in order to allow appropriate receptors to be identified.

12.5.70 If the overall programme were to be delayed by approximately a year, the implications in relation to the transport effects would be as follows:

a. It is unlikely that the effects on pedestrians and cyclists would change. Over the course of one year, it is unlikely that pedestrian or cycle traffic in the vicinity of the project site would increase by a sufficient amount to change the magnitude of impacts or the significance of effects reported, nor that the arrangements for pedestrian diversions, would be any different to those currently proposed

b. Effects on public transport are unlikely to change as the rate of public transport patronage growth is relatively low and over the course of one year, any reduction in spare capacity on existing public transport networks would be small. Additionally, there is a general trend towards the enhancement of the public transport network through the provision of additional bus, rail and river services in order to meet future demand and accommodate future patronage growth. The transport assessment typically indicates that the additional public transport patronage arising from Thames Tideway Tunnel project sites would be small and not significant in the context of the capacity available on the wider networks

c. Effects on river navigation and access would not be significantly different as the rate of change in patterns of river usage is comparatively small

d. Effects on the operation of the highway network are derived from the use of the TfL Highway Assignment Models (HAMs), which have a forecast model year of 2021. To provide consistency within the assessment, it has been agreed with TfL that this is an appropriate approach. Since the local highway capacity models for the base case also use traffic flow information from the HAMs, it follows that both the strategic and local capacity assessments are effectively based on a year of 2021. As the peak months of activity at the Carnwath Road Riverside site fall before 2021 based on the programme that has been assessed, it follows that a delay of up to one year would not alter the outcomes of the highway network modelling and therefore would not alter the effects reported

e. Based on the site development schedule (see Vol 10 Appendix N), it is possible that as a result of a one year delay, the Wandsworth Riverside Quarter development which has been assumed to be partially under construction in this assessment would be more complete with more buildings occupied. However, it is not expected that new receptors would experience any different effects to those receptors which have been assessed above; rather it would be a case of the potential for some additional receptors to experience the same effects that have already been identified.

12.6 Operational effects assessment

12.6.1 This section summarises the findings of the assessment undertaken for Year 1 of operation at the Carnwath Road Riverside site.

12.6.2 The transport demands created by the development in the operational phase would be extremely low and limited to occasional maintenance visits every three to six months and larger cranes and other associated support vehicles required for access to the shaft and tunnel every ten years.

12.6.3 The assessment of the operational phase is therefore limited to the physical issues associated with accessing the site from the highway network as outlined in para. 12.3.14. This has been agreed with the LB of Hammersmith and Fulham and TfL.

12.6.4 The operational assessment has taken into consideration those elements that would be affected, which comprise the short-term impacts on parking, highway layout and operation when maintenance visits are made to the site.

Parking

12.6.5 When large vehicles are required to service the site the suspension of a small number of parking bays may be required depending on the size of vehicle. This temporary suspension would be on an infrequent basis and would occur approximately once every six months at most.

12.6.6 Based on the impact magnitude criteria outlined in Vol 2, the temporary suspension of parking bays would result in a low adverse impact on parking within the local area.

12.6.7 Taking into consideration the infrequent and temporary nature of the arrival of vehicles at Carnwath Road Riverside which would require parking suspension and the sensitivity of the receptor (parking users along Carnwath Road) it is anticipated that there would be a **negligible** effect on parking.

Highway layout and operation

12.6.8 During the operational phase, the site would be accessed via Carnwath Road from the westbound lane. The permanent highway layout plans (see separate volume of figures – Section 1) show the access arrangements for the operational phase.

12.6.9 For routine three- or six-monthly inspections vehicular access would be required for light commercial vehicles, typically a van. On occasion there may also be a need for small flatbed vehicles to access the site.

12.6.10 During ten-yearly inspections an area to locate two large cranes within the site area would be required. The cranes would facilitate lowering and recovery of tunnel inspection vehicles and to provide duty/standby access for personnel. To assess the effect of these on the highway layout, swept path analyses have been undertaken for the largest vehicles expected to access the site; an 11.36m mobile crane, a 10m articulated vehicle, a 10.7m articulated vehicle and a 13.6m mobile crane. The permanent highway layout vehicle swept path analysis plans (see Carnwath Road Riverside *Transport Assessment* Figures) demonstrate that operational vehicles would be able to safely enter and leave the site.

12.6.11 When larger vehicles are required to service the site there may also be some temporary, short-term delay to other road users while manoeuvres are made. However it is anticipated that the arrival of large vehicles would normally be scheduled to take place outside of the peak hours to minimise the effect on the local highway network.

12.6.12 In accordance with the criteria outlined in Vol 2, during the routine inspections of the operational site there would therefore be a negligible impact on road network delay.

12.6.13 Taking into consideration the various sensitivities of the receptors affected during the operational phase (private vehicle users, emergency vehicles, service vehicles, residents of 5 Carnwath Road, residents of 89-101 Carnwath Road, B1 office/studios (50 Carnwath Road) and Energie Fitness Gym within the Piper Centre), this would result in a **negligible** effect on highway layout and operation.

Sensitivity test for programme delay

12.6.14 If the opening year of the Thames Tideway Tunnel project were to be delayed by approximately one year, the results of the operational assessment would not be materially different to the assessment findings reported above.

12.7 Cumulative effects assessment

Construction effects

12.7.1 As indicated in the site development schedule (see Vol 10 Appendix N), nearly all the other developments identified within 1km of the Carnwath Road Riverside site would be complete and operational by Site Year 2 of construction. Part of the Wandsworth Riverside Quarter would still be under construction at this point. However, there is no need to assess specific cumulative effects since as para. 12.3.7 explains, the TfL Highway Assignment Models (HAM) used in the assessment have been developed using GLA employment and population forecasts, which are based on the employment and housing projections set out in the *London Plan 2011*. As a result, the assessment inherently takes into account a level of future growth and development across London. The effects on transport would therefore remain as described in Section 12.5. This would also be the case if the programme for the Thames Tideway Tunnel project were delayed by approximately one year.

Operational effects

12.7.2 As indicated in the Development Schedule (see Vol 10 Appendix N), all other developments within 1km of the site would be complete and operational by Year 1 of operation and therefore there is no need for a cumulative assessment on transport and the effects would remain as described in Section 12.6 above. This would also be the case if the programme for the Thames Tideway Tunnel project were delayed by approximately one year.

12.8 Mitigation

12.8.1 The project has been designed to limit the effects on transport networks as far as possible and many measures have been embedded directly in the design of the project, including the *CoCP* and *Draft Project Framework Travel Plan* (see Section 12.2). No additional measures are proposed for transport and therefore there is no mitigation identified for either construction or operation.

12.9 Residual effects assessment

Construction effects

12.9.1 As no mitigation measures are proposed, the residual construction effects remain as described in Section 12.5. All residual effects are presented in Section 12.10.

Operational effects

12.9.2 As no mitigation measures are proposed, the residual operational effects remain as described in Section 12.6. All residual effects are presented in Section 12.10.

12.10 Assessment summary

Vol 10 Table 12.10.1 Transport – summary of construction assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Pedestrians and cyclists (including sensitive pedestrians) using the Thames Path and Carnwath Road footways	• Additional crossing points and vehicle conflicts at site accesses • Diversion of Thames Path • Movement of large construction vehicles	Minor adverse effect on pedestrians. Minor adverse effect on cyclists	None	Minor adverse effect on pedestrians. Minor adverse effect on cyclists
Private vehicle users in the area using the local highway or on-street parking	• Suspension of parking bays and extension of single yellow line restrictions on Carnwath Road • Movement of large construction vehicles • Potential for additional parking demand from construction workers particularly on night shifts	Minor adverse effect on highway users Minor adverse effect on parking users	None	Minor adverse effect on highway users Minor adverse effect on parking users
Emergency vehicles travelling on Wandsworth Bridge Road (A217).	• Movement of large construction vehicles leading to journey time delay	Minor adverse effect	None	Minor adverse effect
Marine emergency services	• Additional barge movements on the River Thames	Negligible effect	None	Negligible effect
Service vehicles using loading bays on Carnwath Road	• Extended loading restrictions	Minor adverse effect	None	Minor adverse effect
Bus users (passengers) travelling along Carnwath Road, Townmead	• Movement of large construction vehicles	Negligible effect	None	Negligible effect.

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Road and Wandsworth Bridge Road (A217)	• Some additional patronage from construction workers			
River vessel operators	• Additional barge movements on the River Thames	Negligible effect	None	Negligible effect
Leisure users of the River Thames	• Additional barge movements on the River Thames	Negligible effect	None	Negligible effect
Residents of 5 Carnwath Road Residents of 89-101 Carnwath Road Pupils, parents and staff at Thomas' London Day School Users of B1 Offices/studios (50 Carnwath Road) Users of Energie Fitness Centre Users of Townmead Road concrete plant	• Movement of large construction vehicles • Additional crossings of site accesses on Carnwath Road for pedestrians and cyclists • Suspension of parking bays and extension of single yellow parking restrictions on Carnwath Road.	Minor adverse effect	None	Minor adverse effect
Residents of Wandsworth Riverside Quarter	• Movement of large construction vehicles • Changes to pedestrian and cycle routes • Suspension of parking bays and extension of single yellow parking restrictions on Carnwath Road	Negligible effect	None	Negligible effect

Vol 10 Table 12.10.2 Transport – summary of operational assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Private vehicle users in the area using the local highways or on-street parking	• Occasional suspension of on-street parking spaces and short-term delay to road users in the immediate vicinity of the site during maintenance.	Negligible effect	None	Negligible effect
Emergency vehicles travelling on Wandsworth Bridge Road (A217)	• Occasional maintenance trips resulting in some temporary, short-term road network delay.	Negligible effect	None	Negligible effect
Service vehicles using loading bays on Carnwath Road	• Occasional suspension of on-street loading bays and short-term delay to road users in the immediate vicinity of the site during maintenance visits	Negligible effect	None	Negligible effect
Residents of 5 Carnwath Road Residents of 89-101 Carnwath Road Users of B1 Offices/studios (50 Carnwath Road) Users of Energie Fitness Centre	• Occasional suspension of on-street parking spaces and short-term delay to road users in the immediate vicinity of the site during maintenance visits.	Negligible effect	None	Negligible effect

References

[1] Defra. *National Policy Statement for Waste Water*, 2012.

[2] Transport for London. *Assessment Tool for Travel Plan Building Testing and Evaluation* (ATTrBuTE) (2011) http://www.attrbute.org.uk/.

[3] Hammersmith & Fulham Council. *South Fulham Riverside Supplementary Planning Document Second draft for public consultation, Chapter 7: Area Planning Framework and Land Use Strategy*, , Page 35, March 2012.

[4] Hammersmith & Fulham Council. *Core Strategy, Local Development Framework*, October 2011.

[5] Safeguarded Wharves Review 2011/2012 – Further Consultation July 2012.

[6] Greater London Authority. *London Plan 2011*, July 2011.

[7] Transport for London. *Transport Assessment Best Practice Guidance*, April 2010.

[8] The estimates are derived from study team calculations that use the arrival and departure times for piers published in TfL River Bus and Tour timetables (http://www.tfl.gov.uk/modalpages/2648.aspx) and information on barge movements obtained from barge operators and commercial users.

[9] Tfl. London Undergr*ound Upgrade Plan,* 2011. Available at: *http://www.tfl.gov.uk/assets/downloads/corporate/our-upgrade-plan-london-underground-february-2011.pdf*

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.10**

Volume 10: Carnwath Road Riverside site assessment

Section 13: Water resources - groundwater

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

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Thames Tideway Tunnel

Environmental Statement

Volume 10: Carnwath Road Riverside site assessment

Section 13: Water resources − groundwater

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13 Water resources – groundwater

13.1 Introduction

13.1.1 This section presents the findings of the assessment of the likely significant effects of the proposed development on groundwater at the Carnwath Road Riverside site (including the Carnwath Road Riverside highway work site).

13.1.2 The proposed development has the potential to affect groundwater due to:

a. dewatering of aquifer units

b. creation of pathways for pollution

c. obstruction to groundwater flows

d. seepages into and out of the main tunnel shaft during operations

13.1.3 The groundwater assessment at this site should be read in conjunction with the supporting Volume 10 Appendix K and the land quality assessment (see Vol 10 Section 8 Land quality).

13.1.4 The assessment of groundwater effects relates to the main Carnwath Road Riverside site. The Carnwath Road Riverside highway work site would involve only shallow workings and therefore has not been assessed.

13.1.5 The site is underlain by a thick layer of relatively impermeable London Clay Formation and construction would extend down into the Lambeth Group. No dewatering of the upper aquifer would be required at the Carnwath Road Riverside site and instead the groundwater in the River Terrace Deposits (upper aquifer) would be cut off using a sheet pile wall[i]. Depressurisation of the top of the Lambeth Group (Upper Shelly Beds) would be required to avoid minor seepages and inflows of groundwater during the construction of the main tunnel shaft and thick base slab. There would be no effects on the lower aquifer because of the separation distance between the base of the shaft and the lower aquifer therefore this has not been assessed.

13.1.6 An assessment of project-wide environmental effects on groundwater is presented in Volume 3 Project-wide assessment.

13.1.7 The assessment of groundwater presented in this section has considered the requirements of the National Policy Statement for Waste Water (Defra, 2012)[1] section 4.2. The physical characteristics of the groundwater environment including groundwater resources and quality are presented and the anticipated effects (including cumulative effects) on these resources addressed in the assessment that follows (further detail can be found in Vol. 2 Methodology, Section 13.3).

[i] Sheet pile wall – a sub-surface structure installed to support excavation and in which amongst other things helps to control inflows of shallow groundwater, typically formed of steel.

13.1.8 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Vol 10 Carnwath Road Riverside Figures).

13.1.9 Two barge berthing options have been considered: Option A would involve barges berthing on a campshed only and Option B would involve barges berthing at a jetty, which would also have a campshed. Both options would not alter the assessment of likely significant effects on ground water as they would not impact on groundwater resources at the Carnwath Road Riverside site. The options are therefore not presented or reported separately for this topic.

13.2 Proposed development relevant to groundwater

13.2.1 The proposed development is described in Section 3 of this volume. The elements of the proposed development relevant to groundwater are set out below.

Construction

13.2.2 The elements of construction at the Carnwath Road Riverside site, relevant to groundwater, would include:

a. A main tunnel shaft approximately 25m internal diameter (ID) and approximately 42m deep (or 63.32mATD[ii] based on an assumed ground level of 105.5mATD) excluding an approximately 8m thick base slab once constructed.

b. The shaft would receive the Frogmore connection tunnel which would intercept current discharges from the Frogmore Storm Relief (SR) - Bell Lane Creek combined sewer overflow (CSO) at Dormay Street and the Frogmore SR - Buckhold Road CSO at King George's Park.

13.2.3 The proposed methods of construction for these elements of the site are described in Section 3 of this volume and summarised in Vol 10 Table 13.2.1. Approximate duration of construction and depths are also contained in Vol 10 Table 13.2.1.

Vol 10 Table 13.2.1 Groundwater – methods of construction

Design elements	Method of construction	Construction periods (years)*	Construction depth**
Main tunnel reception and drive shaft	Sheet piling and Sprayed Concrete Lining (SCL) through superficial deposits and London Clay and	>1	Deep

[ii] In general, the measurements of depth are expressed as metres Above Tunnel Datum (mATD). The standard zero point for mATD scale is -100maOD (metres above Ordnance Datum is based on Newlyn datum point for mean sea level). The use of the mATD scale avoids the need for use of negative values, and is widely used for large scale sub-surface projects.

Design elements	Method of construction	Construction periods (years)*	Construction depth**
	dewatering of the Lambeth Group		

** The site would be used for construction purposes for up to 6 years*
*** In terms of construction depth - Deep (>10m)*

Code of Construction Practice

13.2.4 All works would be undertaken in accordance with the *Code of construction practice (CoCP)*. The *CoCP* is provided in Vol 1 Appendix A. It contains general requirements *(Part A)*, and site specific requirements for this site *(Part B)*. Relevant measures included within the *CoCP (Part A)* to ensure adverse effects on groundwater are minimised are as follows:

a. Measures include providing bunded stores for fuel/oils held on site and the settlement of water from excavations to prevent silty water from entering watercourses, surface water drains and onto roads as per Environment Agency guidelines (EA, 2011)[2]. The contractor would have plans and equipment in place to deal with emergency situations as well as ensuring that staff are appropriately trained.

b. A precautionary approach, involving targeted risk-based audits and checks of water quality monitoring, would be applied to abstraction licences thought to be at risk.

c. Monitoring arrangements for dewatering permits and any permits required on change of licensing regulations would be developed in liaison with the EA (see also the groundwater monitoring strategy in Vol 3 Appendix K.1).

d. At the end of construction where temporary support does not form part of the operational structure it would be removed, piped through or cut down to avoid the build up of groundwater on the upstream side of underground structures.

13.2.5 There are no site specific groundwater measures contained within the *CoCP Part B*.

Other measures during construction

13.2.6 The depth of the main tunnel shaft means that it would extend down through the River Terrace Deposits or upper aquifer and into the lower part of the London Clay Formation, unit A3i[iii] (see Vol 10 Appendix K.1). The base slab, at the bottom of the shaft, would extend into the top of the Lambeth Group, the Upper Mottled Beds (see Vol 10 Appendix K.1). Groundwater in the London Clay Formation and Lambeth Group (Upper Mottled Beds) is likely to consist of localised seepages and/or minor flows.

13.2.7 For the purposes of this assessment, it is not anticipated that dewatering of the River Terrace Deposits (upper aquifer) would be required. Instead a

[iii] Unit A3i – 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.

sheet pile wall[iv] would be constructed into the London Clay Formation around parts of the Carnwath Road Riverside main tunnel shaft to seal out the River Terrace Deposits (upper aquifer). Any water which seeps into the sheet pile walled areas would be pumped back to the tidal Thames, following any necessary treatment and subject to EA approval. Sheet piles may also be required to provide ground support around air ducts on the site.

13.2.8 To prevent possible inundation of the main tunnel shaft by groundwater from the Lambeth Group, dewatering wells would be drilled near to the base of the shaft excavation. Pumps would be placed in the wells and groundwater would be extracted and discharged directly into the tidal Thames, following any necessary treatment and subject to EA approval. The duration of pumping would be determined by ground conditions and groundwater volumes encountered; however this is likely to be in the order of up to one year, the time required to build and excavate the base slab.

13.2.9 For the purposes of this assessment, no ground treatment or grouting[v] is anticipated to be required in the River Terrace Deposits (upper aquifer) or in the Lambeth Group.

Operation

13.2.10 A groundwater monitoring strategy is one of the project's environmental design measures (see Vol 3 Appendix K.1). This covers groundwater levels and groundwater quality and outlines the future monitoring and actions in the event of trigger levels being exceeded.

13.3 Assessment methodology

Engagement

13.3.1 Vol 2 documents the overall engagement which has been undertaken in preparing the *Environmental Statement*. There have been no site-specific comments relevant to the Carnwath Road Riverside site for the assessment of groundwater.

13.3.2 The *Scoping Report* was prepared before Carnwath Road Riverside had been identified as a preferred site. The scope for the assessment of groundwater for this site has therefore drawn on the scoping responses from other London Boroughs in relation to groundwater and is based on professional judgement as well as experience of similar sites.

[iv] Sheet pile wall - a sub-surface barrier installed to support excavation and which amongst other things helps to control inflows of shallow groundwater, typically formed of intersecting concrete or overlapping shafts of concrete.

[v] Grouting - a thin, coarse mortar injected into various voids and cavities, such as rock fissures, to fill them and consolidate the adjoining objects into a solid mass and to eliminate water flow.

Baseline

13.3.3 The baseline methodology follows the methodology described in Vol 2. There are no site-specific variations for identifying the baseline conditions for this site.

13.3.4 The baseline describes receptors within a 1km radius of the site.

13.3.5 The effects on groundwater may however extend beyond a kilometre depending on the hydrogeological setting and the method of construction used. These effects are considered to be of wider regional significance and are assessed in the project-wide assessment (see Vol 3).

Construction

13.3.6 The assessment methodology for the construction phase follows that described in Vol 2. There are no site specific variations for undertaking the construction assessment of this site.

13.3.7 The land quality assessment has highlighted that there may be need to remediate this site prior to Site Year 1, this would be specified following a risk assessment being undertaken (Vol 10 Section 8.2). For the purposes of the groundwater assessment it has been assumed that the Site Year 1 would represent the first year when any impacts on groundwater occur. In this year sheet pilling would be installed and small scale pumping from within the sheet pile would be required. Towards the end of the first year depressurisation of Lambeth Group would be required. The baseline is not anticipated to change substantially between 2011 and Site Year 1 of construction (2016) and so baseline data from 2011 have formed the basis (base case) for the construction assessment. A number of proposed developments which are likely to be complete and operational before commencement of construction have formed part of the construction base case.

13.3.8 The developments considered as part of the base case or included in the cumulative effects assessment are presented in Vol 10 Table 13.3.1. The developments relevant to groundwater are those which would contain basements, Ground Source Heat Pumps (GSHP) or abstractions.

Vol 10 Table 13.3.1 Groundwater – construction base case and cumulative assessment developments (2016)

Development	Component or receptor relevant to groundwater	Construction base case	Cumulative effect assessment	Comments (if required)
Townmead Road London	None	✗	✗	n/a
Wandsworth River Quarter, Point Pleasant/Osiers Road	Basement*	Phase A (buildings 5A, 5B, 5C and 5D) Complete	Phase B (buildings 6A & 6B) under construction	**GSHP not included as within lower aquifer Abstraction

Development	Component or receptor relevant to groundwater	Construction base case	Cumulative effect assessment	Comments (if required)
				**TH/039/0041/001 included within current baseline
Western Riverside Transfer Station	None	✘	✘	n/a
Units 1-20 Enterprise Way	Basement*	✓	✘	n/a
Osiers Road	Basement*	✓	✘	n/a
Battersea Reach	Basement*	✘	✓	n/a
Cockpen House, Buckhold Road	Basement*	✓	✘	n/a
100, 110 and 112 York Road	Basement*	✓	✘	n/a
The Business Village, Broomhill Road	Basement*	✓	✘	n/a
Southside Shopping Centre, Garratt Lane	Basement*	✓	✘	n/a
Imperial Wharf	Basement*	✓	✘	n/a
Jetty adjacent to 51 Townmead Road	None	✘	✘	n/a

** Relevant to the upper aquifer*
*** Relevant to the lower aquifer*
Symbols ✓ applies ✘ does not apply

13.3.9 Section 13.5 details the likely significant effects arising from the construction at the Carnwath Road Riverside site. There are no other Thames Tideway Tunnel project sites which could give rise to additional effects on groundwater resources within the assessment area for this site, therefore no other Thames Tideway Tunnel project sites are considered in this assessment.

Operation

13.3.10 The assessment methodology for the operational phase follows that described in Vol 2. There are no site-specific variations for undertaking the operational assessment of this site.

13.3.11 The assessment year applied to the operational assessment is Year 1 of operation. The baseline is not anticipated to vary significantly before the start of the operational phase in 2023; and therefore baseline data from 2011 has formed the basis for the operational assessment. In addition, information on proposed developments likely to have been completed before commencement of operation of the Thames Tideway Tunnel project has been taken into account in determining the operational base case.

13.3.12 The developments considered as part of the operational base case are included in Vol 10 Table 13.3.2. No developments have been identified which would be considered as part of the cumulative effects assessment. The developments relevant to groundwater are those which would contain basements, a Ground Source Head Pump (GSHP) or an abstraction.

Vol 10 Table 13.3.2 Groundwater – operational base case and cumulative assessment developments (2023)

Development	Component or receptor relevant to groundwater	Operational base case	Cumulative effect assessment	Comments (if required)
Townmead Road London	None	✘	✘	n/a
Wandsworth River Quarter, Point Pleasant/Osiers Road	Basement*	✓	✘	**GSHP not included as within lower aquifer Abstraction **TH/039/0041/001 included within current baseline
Western Riverside Transfer Station	None	✘	✘	n/a
Units 1-20 Enterprise Way	Basement*	✓	✘	n/a
Osiers Road	Basement*	✓	✘	n/a
Battersea Reach	Basement*	✓	✘	n/a
Cockpen House,	Basement*	✓	✘	n/a

Development	Component or receptor relevant to groundwater	Operational base case	Cumulative effect assessment	Comments (if required)
Buckhold Road				
100, 110 and 112 York Road	Basement*	✓	✗	n/a
The Business Village, Broomhill Road	Basement*	✓	✗	n/a
Southside Shopping Centre, Garratt Lane	Basement*	✓	✗	n/a
Imperial Wharf	Basement*	✓	✗	n/a
Jetty adjacent to 51 Townmead Road	None	✗	✗	n/a

** Relevant to the upper aquifer*
*** Relevant to the lower aquifer*
Symbols ✓ applies ✗ does not apply

13.3.13 Section 13.6 details the likely significant effects arising from the operation at the Carnwath Road Riverside site. There are no other Thames Tideway Tunnel project sites which could give rise to additional effects on groundwater resources within the assessment area for this site during the operational phase and so no other Thames Tideway Tunnel project sites are considered in this assessment.

Assumptions and limitations

Assumptions

13.3.14 The construction assumptions relevant to this site are presented in Section 13.2.

13.3.15 The assessment of physical obstruction effects in Sections 13.5 and 13.6 has been based on an estimated hydraulic gradient[vi] of 0.004 in the upper aquifer.

13.3.16 This assessment has assumed that the shaft would have a design criterion to limit the rate of seepage of $1l/m^2/d$ (see Vol 2 Appendix K.3).

13.3.17 In the absence of on-site ground investigation or monitoring boreholes, the hydrogeological conditions encountered at the nearest off-site boreholes are assumed to be representative of site conditions at Carnwath Road Riverside.

[vi] Hydraulic gradient – the slope of the water table which drives groundwater movement

13.3.18 No ground treatment or grouting, which may have the potential to introduce contaminants, such as turbidity into groundwater, is anticipated to be required at the Carnwath Road Riverside site.

13.3.19 The measurements of the depth of shafts are quoted to two decimal places, however these measurements may be altered slightly in the future and are therefore not definitive.

13.3.20 For the purposes of this assessment, deep structures are those extending down more than 10m below ground level.

Limitations

13.3.21 No site-specific pumping tests have yet been undertaken as part of the ground investigation. In the absence of site-specific hydrogeological data, published sources of hydrogeological information have been used in this assessment (see Vol 10 Appendix K.2).

13.3.22 There has been no ground investigation or monitoring boreholes specifically dedicated to the Carnwath Road Riverside site due to its design relocation subsequent to procurement of the borehole investigation. The nearest available ground investigation and monitoring data is from Jews Row on the opposite side of the tidal Thames and situated approximately 200m to the southeast of the Carnwath Road Riverside site.

13.3.23 Groundwater level data available for this assessment is limited, with monitoring data available only from one monitoring borehole within the upper aquifer on the opposite side of the tidal Thames. This monitoring borehole has been included in the assessment as it monitors groundwater levels in the upper aquifer in close proximity to the tidal Thames and is considered to reflect on-site conditions. This has meant that hydraulic gradients have only been estimated across the site and a value of 0.004 has been used. In addition, the range of hydrological conditions experienced during the monitoring period (2010-2012) did not include a prolonged wet winter period when exceptionally high groundwater levels might occur.

13.3.24 Groundwater quality data available to this assessment is also limited. The data used has been from a nearby borehole on the opposite side of the River Thames approximately 200m away. This is the best available data and is considered robust for the purposes of the groundwater assessment.

13.4 Baseline conditions

13.4.1 The following section sets out the baseline conditions for groundwater within and around the site. Future baseline conditions (base case) are also described.

13.4.2 This section of the assessment is supported by Vol 10 Appendix K.

Current baseline

Hydrogeology

13.4.3 The main tunnel shaft would pass through Made Ground, River Terrace Deposits, London Clay Formation and into the top horizons of the Lambeth Group, namely the Upper Shelly Beds and Upper Mottled Beds. The superficial and solid geology in the vicinity of the site, as published by the British Geological Survey (BGS)[3], is shown in Vol 10 Figure 13.4.1 and Vol 10 Figure 13.4.2 respectively (see separate volume of figures).

13.4.4 The River Terrace Deposits form the upper aquifer and are classified by the EA as a secondary A aquifer[vii]. The London Clay Formation is considered an aquiclude[viii] (USGS, 1989)[4], in which any groundwater present is likely to consist of localised seepages and/or minor flows, with the exception of unit A3ii which is regarded as the most porous section of this formation. The Lambeth Group is considered to act as an aquitard[ix] (EA, 2012)[5], in which groundwater is present in several confined[x] groundwater bodies, such as in the upper units, the Upper Shelly Beds and Upper Mottled Beds (potentially small inflows).

13.4.5 The depths and thicknesses of geological layers have been extrapolated from an overwater borehole drilled close by the site; this borehole is SR2082. The anticipated hydrogeological conditions have been determined by reference to information collected from two ground investigation boreholes (SR1102A and SA1105), located at approximately 160m and 460m to the southeast and south respectively on the opposite side of the tidal Thames. The extrapolated depths and thicknesses of the geological layers and the anticipated hydrogeological conditions based on these boreholes are summarised in Vol 10 Table 13.4.1.

Vol 10 Table 13.4.1 Groundwater – anticipated ground conditions and hydrogeology

Formation	Top elevation* (mATD)	Depth (m)	Thickness (m)	Hydrogeology
Alluvium	96.97	0.0	2.0	Confining layer[x] (Schwartz, F.W. & Zhang, H 2003)[6]
River Terrace	94.97	2.0	0.6	Upper aquifer

[vii] Secondary aquifer – either permeable strata capable of supporting local supplies or low permeability strata with localised features such as fissures (was previously referred as a minor aquifer).

[viii] Aquiclude - a hydrogeological unit which, although porous and capable of storing water, does not transmit it at rates sufficient to furnish an appreciable supply for a well or spring (USGS website, 2012)

[ix] 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).

[x] Confined - an aquifer in which water is held under pressure, such that groundwater in a borehole penetrating a confined aquifer would rise to a level above the top of the aquifer

Formation	Top elevation* (mATD)	Depth (m)	Thickness (m)	Hydrogeology
Deposits				
London Clay Unit B Unit A3ii Unit A3i Unit A2	 94.37 82.74 73.79 68.87	 2.60 14.26 26.18 28.1	 11.63 11.95 1.92 10.57	Aquiclude[viii] (USGS, 1989)[7]
Harwich	58.30	38.67	0.48	Aquitard/ aquifer
Lambeth Group USB UMB LtB	 57.82 56.11 53.57	 39.15 40.86 43.4	1.71 2.54 2.25	Aquitard (EA, 2012)[8]

** Based on an assumed ground level of 105.50mATD*
USB – Upper Shelly Beds, UMB – Upper Mottled Beds, LtB – Laminated Beds

13.4.6 The main tunnel shaft would not extend into the lower aquifer (Upnor Formation, Thanet Sands and Chalk) and the separation distance between the base slab and the top of the lower aquifer is approximately 13m based on information from Dormay Street Thames Tideway Tunnel project site, situated approximately 0.5km to the south of the Carnwath Road Riverside site.

Groundwater level monitoring

13.4.7 Groundwater level monitoring has been undertaken at a number of ground investigation boreholes across the assessment area (1km radius of the site). In addition, the EA has a regional network of monitoring boreholes, mainly within the lower aquifer, across London with records available dating back over 50 years.

13.4.8 There is no on-site baseline groundwater quality or land quality data available for the upper aquifer at the Carnwath Road Riverside site. Information on groundwater levels for this assessment was collected from the nearest two monitoring points (SR1102A and SA1105), located on the opposite side of the tidal Thames, approximately 200m downstream of the site. These boreholes have response zones[xi] (EA, 2006)[9] in the River Terrace Deposits and the Upper Shelly Beds (Lambeth Group) respectively and are monitoring groundwater levels in the upper aquifer and aquitard between the upper and lower aquifers respectively. The locations are shown in Vol 10 Figure13.4.3 (see separate volume of figures).

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

13.4.9 The recorded water levels in the River Terrace Deposits at SR1102A range from 99.81 to 102.2mATD. These water levels consistently remain above the top of the formation at 94.97mATD, indicating that the formation is fully saturated and confined by the overlying Alluvium at this location. The water levels show seasonal variation and fluctuate with the tidal cycle. The average, minimum and maximum recorded water levels in the River Terrace Deposits are shown in Vol 10 Table 13.4.2.

Vol 10 Table 13.4.2 Groundwater – water level summary

Monitoring borehole ID	Formation	Average (mATD)	Minimum (mATD)	Maximum (mATD)
SR1102A	River Terrace Deposits	100.86	99.81	102.20
SA1105	Upper Shelly Beds	102.64	102.45	102.80

13.4.10 The recorded water levels in the Upper Shelly Beds at SA1105 range from 102.45 to 102.8mATD. These water levels consistently remain above the top of the formation at 57.82mATD, indicating that the formation is fully saturated and confined by the overlying London Clay Formation at this location. The average, minimum and maximum recorded water levels in the Upper Shelly Beds are shown in Vol 10 Table 13.4.2 above.

13.4.11 A plot of the groundwater levels within the River Terrace Deposits in the vicinity of the site is shown in Vol 10 Figure 13.4.3 (see separate volume of figures). Given that there is one monitoring borehole within the upper aquifer, any determination of the direction of groundwater flow can only be approximate and is based on topography. It is anticipated that groundwater flow would be from north to south, towards the tidal Thames, in these shallow deposits.

Licensed Abstractions

13.4.12 The nearest licensed groundwater abstraction from the River Terrace Deposits or upper aquifer is located at approximately 0.7km to the north-northwest of the site (see Vol 10 Appendix K.4, Vol 10 Table K.6). The licensed abstraction (Licence no 28/39/39/0177) is held by the Trustees of the Hurlingham Club and is used for industrial, commercial or public services.

13.4.13 The licensed groundwater abstractions from the Chalk are unlikely to be impacted as no construction would take place in or around this lower aquifer. There are no known unlicensed groundwater abstractions from either the upper or lower aquifers within 1km of the Carnwath Road Riverside site.

Groundwater source protection zones

13.4.14 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. The nearest SPZ for a Chalk source lies 3.3km to the northeast of the Carnwath Road Riverside site.

Environmental designations

13.4.15 There are no designations relevant to groundwater within 1km of the site.

Groundwater quality and land quality

13.4.16 Historical land use mapping, reviewed as part of the land quality assessment, has indicated possible free phase contamination in shallow aquifer at a site near to the Carnwath Road Riverside site. Further details are provided in see Vol 10 Section 8.

13.4.17 There is no on-site active baseline groundwater quality data available for the upper aquifer at or near the Carnwath Road Riverside site. The nearest ground investigation boreholes are located on the opposite bank of the tidal Thames, approximately 200m away downstream. Given that groundwater flow in the River Terrace Deposits is likely to be towards and into the tidal Thames, the groundwater and land quality at these boreholes are unlikely to be representative of site conditions.

Groundwater flood risk

13.4.18 There are no reported incidences of groundwater flooding in the vicinity of the site, based on information from the LB of Hammersmith and Fulham and the Royal Borough of Kensington and Chelsea Strategic Flood Risk Assessment (SFRA) (JBA Consulting, 2010)[10].

Groundwater receptors

13.4.19 Groundwater receptors which could be affected during construction or operation are summarised in Vol 10 Table 13.4.3 below. The receptors of relevance to the Carnwath Road Riverside site are the upper aquifer and one licensed abstraction from the River Terrace Deposits.

Vol 10 Table 13.4.3 Groundwater – receptors

Receptor	Construction	Operation	Comment
Groundwater body – upper aquifer	✓	✓	Penetrated by main tunnel shaft.
Groundwater body − lower aquifer	✗	✗	Base of main tunnel shaft approximately 13m above the lower aquifer.
Licensed abstractions – upper aquifer	✓	✗	One licensed abstraction (28/39/39/0177) from upper aquifer although this lies 0.7km away and is up hydraulic gradient of site.
Unlicensed abstractions	✗	✗	No known unlicensed abstractions from the upper aquifer.

Symbols ✓ applies ✗ does not apply

Receptor sensitivity

13.4.20 The upper aquifer (River Terrace Deposits) is classified by the EA as a secondary A aquifer and is allocated a medium value in terms of quality and quantity in this assessment.

13.4.21 The abstraction source from the upper aquifer is used for agricultural purposes and is allocated a medium value in the terms of quality and quantity in this assessment.

Construction base case

13.4.22 The construction base case in Site Year 1 is as per the current baseline. It also includes developments that are likely to be complete and partially or fully operational during construction at the Carnwath Road Riverside site. This may have the potential to lead to a change to groundwater in the upper aquifer.

13.4.23 The basements associated with other developments identified in Vol 10 Table 13.3.1 could cause some disruption to groundwater flow in the upper aquifer. However, any impacts are expected to be highly localised. Any substantive changes from the baseline conditions prior to construction would be highlighted by monitoring of groundwater levels in the upper aquifer.

13.4.24 The lower aquifer would not be impacted by the developments identified in Vol 10 Table 13.3.1 and it can be concluded that there would be no change to the base case in Site Year 1 of construction.

Operational base case

13.4.25 The operational base case in Year 1 is as per the current baseline and also includes developments that are likely to be complete and partially or fully operational during operation of the Thames Tideway Tunnel project, and which may have the potential to lead to a change to groundwater in the upper aquifer.

13.4.26 As per the construction base case, the basements associated with other developments are expected to be highly localised effects; and any substantive changes from the baseline conditions prior to operation would be detected by monitoring of groundwater levels in the upper aquifer.

13.4.27 The lower aquifer would not be impacted by the developments identified in Vol 10 Table 13.3.2 and it can be concluded that there would be no change to the base case at the start of operation.

13.5 Construction effects assessment

Construction impacts

Dewatering of aquifers

13.5.1 The upper aquifer (River Terrace Deposits) is separated from the lower aquifer by a thick layer of low permeability material (London Clay Formation). No dewatering of the upper aquifer is anticipated; instead sheet piles would be constructed around the Carnwath Road Riverside main tunnel site and also for air ducts on site, to seal out the River Terrace Deposits (upper aquifer) and any inflows from the London Clay Formation. Using sheet piling techniques is not anticipated to alter the integrity of the upper aquifer. The magnitude of dewatering impacts on the upper aquifer is assessed to be negligible.

13.5.2 A capture zone[xii] for the licensed source no 28/39/39/0177 has been estimated as part of this assessment using licence information and appropriate aquifer properties. The boundaries of this capture zone are at a distance of 0.6km from the Carnwath Road Riverside site (and the source is approximately 0.7km). This licensed abstraction is located hydraulically upgradient of the site but at a distance that is not anticipated to be impacted by construction at the Carnwath Road Riverside site (See Vol 10 Appendix K.4). The magnitude of dewatering impacts on this licensed abstraction is assessed to be negligible.

13.5.3 In order to construct the shaft, depressurisation of the top of the Lambeth Group (Upper Shelly Beds) would be required to avoid minor seepages and inflows of groundwater during construction. The separation distance between the base slab and the lower aquifer (comprising of the Upnor Formation at the base of the Lambeth Group, Thanet Sands and Chalk) is approximately 13m. The hydraulic pressures exerted upwards from the lower aquifer at the base of the excavation are not anticipated to warrant depressurisation of the lower aquifer and therefore no dewatering impact on the lower aquifer would occur.

Groundwater quality

13.5.4 No dewatering of the upper aquifer is required at the Carnwath Road Riverside site and instead sheet piling would be constructed around the main tunnel site, there would be no potential for mobilisation of contamination at this site. The magnitude of impact on groundwater quality within the upper aquifer is assessed to be negligible.

Physical obstruction

13.5.5 The presence of the sheet pile walls and the main tunnel shaft construction activities may disrupt local groundwater flows and alter groundwater levels in the upper aquifer.

13.5.6 The method for assessing the impact of all below ground activities upon the groundwater levels in the upper aquifer is described in Vol 2 Appendix K. It is estimated that the groundwater levels would rise during the construction phase at Carnwath Road Riverside by approximately 0.4m.

13.5.7 Groundwater levels in the upper aquifer can reach 102.2mATD; this is approximately 3.5m below the existing ground surface at Carnwath Road Riverside. The ground investigation borehole SR1102A suggests that the upper aquifer is confined by the overlying Alluvium at this location. On this basis, the predicted rise in water levels (around 0.4m) would result in increased hydraulic pressure within the confined unit rather than an

[xii] Capture zone - the area from which groundwater would be drawn

increase of the water table and so the magnitude of this impact is assessed to be negligible.

Construction effects

13.5.8 By combining the impacts identified above with the receptor value (see paras. 13.4.20 - 13.4.21); the significance of the effects can be derived using the generic significance matrix (Vol 2 Section 2). The results are described in the following sections.

Dewatering of aquifers

13.5.9 A negligible impact on the upper aquifer, a medium value receptor for groundwater quantity, would result in a **negligible** effect.

13.5.10 A negligible impact on the licensed abstraction from the upper aquifer, a medium value receptor for groundwater quantity, would result in a **negligible** effect.

Groundwater quality

13.5.11 A negligible impact on the groundwater quality of the upper aquifer, a medium value receptor for groundwater quality, would result in a **negligible** effect.

Physical obstruction

13.5.12 The predicted rise in groundwater levels of 0.4m would result in increased hydraulic pressures within the confined River Terrace Deposits rather than an increase in the water table. A negligible impact on the upper aquifer, a medium value receptor for groundwater quantity, would result in a **negligible** effect.

13.6 Operational effects assessment

Operational impacts

Physical obstruction

13.6.1 The presence of the main tunnel shaft in the upper aquifer may disrupt groundwater flow and alter groundwater levels.

13.6.2 The method for assessing the impact of the main tunnel, main tunnel shaft, the chamber and the connection culvert upon the groundwater levels in the upper aquifer is described in Vol 2 Appendix K.2. It has been estimated that the groundwater level rise during the operational phase at Carnwath Road Riverside would be less than 0.1m.

13.6.3 The predicted rise in water levels (less than 0.1m) would result in increased hydraulic pressure within the confined River Terrace Deposits rather than an increase of the water table. This predicted rise in water levels is less than the predicted rise during the construction phase as the sheet piles would be removed or pipes cut through to reduce the build up of groundwater. The magnitude of impact on the upper aquifer has been assessed to be negligible.

Seepage into main tunnel shaft

13.6.4 An estimate of the seepage volume into the main tunnel shaft at Carnwath Road Riverside is included in Vol 2 Appendix K.3. The estimated loss of water from the upper aquifer into the shaft is 152m^3/annum (Vol 2 Appendix K, Vol 2 Table K.4). This level of seepage into the main tunnel would be negligible for the upper aquifer.

Seepage from main tunnel shaft

13.6.5 An estimate of the seepage volumes from the main tunnel shaft at Carnwath Road Riverside is included in Vol 2 Appendix K.2. The shaft would be full for only approximately 3% of the year or 11 days per year (see Vol 3 Section 13 Water resources – groundwater). The estimated volume of seepage from the main tunnel shaft into the upper aquifer is 5m^3/annum (Vol 2 Appendix K, Vol 2 Table K.5). The higher heads outside the main tunnel shaft mean that any risk of seepage from the shaft into the upper aquifer would be further reduced. The magnitude of impact has been assessed as negligible for the upper aquifer.

13.6.6 No other operational impacts are envisaged.

Operational effects

13.6.7 Combining the receptor value (paras. 13.4.20 - 13.4.21) with the impacts identified above, the significance of the effects can be derived using the generic significance matrix (Vol 2 Section 2). The results are described in the following sections.

Physical obstruction

13.6.8 The predicted rise in water levels of 0.1m would result in increased hydraulic pressures within the confined River Terrace Deposits rather than an increase in the water table. A negligible impact on the upper aquifer, a medium value receptor for groundwater quantity, would result in a **negligible** effect.

Seepage into main tunnel shaft

13.6.9 The seepage into the main tunnel shaft would be very small. A negligible impact on the upper aquifer, a medium value receptor for groundwater quantity, would result in a **negligible** effect.

Seepage from main tunnel shaft

13.6.10 The main tunnel shaft would be constructed with a secondary lining and would only be full on a few occasions a year. A negligible impact on the upper aquifer, a medium value receptor for groundwater quality, would result in a **negligible** effect.

13.7 Cumulative effects assessment

Construction effects

13.7.1 Two developments have been identified in Vol 10 Table 13.3.1 which could potentially give rise to cumulative effects during construction relevant to groundwater in the upper aquifer through the inclusion of basements. Although there may be a local impact on groundwater levels in the upper aquifer, any impacts are not expected to be significant because the upper aquifer is confined at the site and any substantive changes would be detected by ongoing monitoring of groundwater levels in the upper aquifer.

13.7.2 The lower aquifer would not be impacted by the developments identified in Vol 10 Table 13.3.1. Therefore, no cumulative effects during the construction phase at the Carnwath Road Riverside site have been identified.

Operational effects

13.7.3 No cumulative operational effects assessment has been undertaken as there are no developments likely to be under construction during the operational phase at the Carnwath Road Riverside site. The effects on groundwater during operation would remain as described in Section 13.6 above.

13.8 Mitigation

13.8.1 There are few impacts from the construction phase and those which have been identified would have negligible effects and therefore no mitigation is required.

13.8.2 Similarly, no significant effects are identified in the operational assessment and therefore no mitigation is required.

13.9 Residual effects assessment

Construction effects

13.9.1 As no mitigation measures are required, the residual construction effects remain as described in Section 13.5. All residual effects are presented in Section 13.10.

Operational effects

13.9.2 As no mitigation measures are required, the residual operational effects remain as described in Section 13.6. All residual effects are presented in Section 13.10.

13.10 Assessment summary

Vol 10 Table 13.10.1 Groundwater – construction assessment summary

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Upper aquifer	Lowering of groundwater levels	Negligible	None	Negligible
Upper aquifer (licensed River Terrace Deposits abstractions)	Lowering of groundwater levels in the River Terrace Deposits resulting from dewatering	Negligible	None	Negligible
Upper aquifer	Deterioration in groundwater quality caused by creation of a pathway	Negligible	None	Negligible
Upper aquifer	Change in groundwater storage as a result of physical obstruction	Negligible	None	Negligible

Vol 10 Table 13.10.2 Groundwater – operational assessment summary

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Upper aquifer	Change in groundwater levels as a result of physical obstruction	Negligible	None	Negligible
Upper aquifer	Seepage into main tunnel shaft affecting groundwater resources	Negligible	None	Negligible
Upper aquifer	Deterioration in water quality from seepage out of main tunnel shaft	Negligible	None	Negligible

References

[1] Defra. *National Policy Statement for Waste Water* (2012)

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

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

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[8] See reference 5.

[9] 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

[10] JBA Consulting. *London Borough of Hammersmith and Fulham and Royal Borough of Kensington and Chelsea Strategic Flood Risk Assessment* (June 2010).

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.10**

Volume 10: Carnwath Road Riverside site assessment

Section 14: Water resources - surface water

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

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Thames Tideway Tunnel

Environmental Statement

Volume 10: Carnwath Road Riverside site assessment

Section 14: Water resources – surface water

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14 Water resources – surface water

14.1 Introduction

14.1.1 This section presents the findings of the assessment of the likely significant effects of the proposed development on surface water at the Carnwath Road Riverside site. The assessment of surface water presented in this section has considered the requirements of the *National Policy Statement for Waste Water,* 2012 (NPS)[1]. The physical characteristics of the surface water environment including surface water resources and quality are presented and the anticipated effects (including cumulative effects) on these resources addressed in the assessment that follows. Further details on how the NPS requirements relevant to surface water resources have been met can be found in Vol 2 Section 14.3.

14.1.2 The assessment of surface water effects relates to the main Carnwath Road Riverside site. The Carnwath Road Riverside highway works site would involve only shallow workings and therefore has not been assessed. All references hereafter to the site are to the main site only.

14.1.3 The proposed development has the potential to affect surface water resources (ie, surface waterbodies including the tidal reaches of the River Thames [tidal Thames]) due to construction activities. Operational effects on surface water at this site have not been assessed. This is on the basis that there would be no combined sewer overflow (CSO) interception at the Carnwath Road Riverside site and no significant operational surface water effects are considered likely. For this reason, only information relating to construction is presented in the assessment of effects on surface water.

14.1.4 The assessment of construction effects on surface water includes the following:

a. identification of existing surface water resources baseline conditions

b. determining base case conditions against which the proposed development has been assessed

c. assessment of significant effects from the proposed development during construction

d. mitigation measures and the residual effects during construction.

14.1.5 The assessment of surface water effects partially overlaps with that for groundwater, land quality, aquatic ecology and flood risk. Effects on groundwater resources are assessed separately in Section 13 of this volume. Land quality is addressed in Section 8 of this volume. Effects on aquatic ecology are assessed in Section 5 of this volume. A Flood Risk Assessment (FRA), which assesses the effects of the proposed development on surface water run-off and considers the use of Sustainable Drainage Systems (SuDS), has been carried out separately and is included in Section 15 of this volume.

14.1.6 This assessment covers the effects of the proposed development at the Carnwath Road Riverside site. The catchment-wide effects on the tidal Thames, particularly in relation to the water quality improvements anticipated from the Thames Tideway Tunnel project are assessed separately and presented in Volume 3 Project-wide effects assessment Section 14.

14.1.7 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Volume 10 Carnwath Road Riverside Figures).

14.2 Proposed development relevant to surface water

14.2.1 The proposed development is described in Section 3 of this volume. The elements of the proposed development relevant to surface water are set out below.

Construction

14.2.2 The Carnwath Road Riverside main site is partly located within the River Thames channel, which means that some of the proposed working area would be within the river bed. This includes the construction of a temporary campshed, or jetty (with an associated campshed) and rebuilding of a stretch of the river wall (as shown on the demolition and site clearance plan, see separate volume of figures) .

14.2.3 Barges would be used to export the majority of material from the excavations of the main tunnel shaft and tunnelling. Barges would also be used to import the majority of aggregates for the main tunnel secondary lining; although it is assumed that other imported materials would be brought in by road. The river channel would be dredged to provide sufficient depth of water to allow the barges to moor up adjacent to the main site while loading and unloading occurs.

14.2.4 The main tunnel shaft would be constructed almost entirely within London Clay although it is envisaged that the base would be within the water bearing Lambeth Beds. The construction of the main tunnel shaft and associated infrastructure would require dewatering. Ground treatment is not anticipated to be required. See Section 13 of this volume for further details on the dewatering requirements.

14.2.5 The construction of the temporary campshed or jetty with associated campshed could affect the river regime with the potential that localised increases in flow velocity could cause scour of the river bed and foreshore, or deposition of sediments. Any potential scour development during construction would be monitored and if trigger levels are reached, appropriate protections measures would be provided (see Vol 3 Appendix L.4 for the *Scour and Accretion Monitoring and Mitigation Plan for Temporary Works in the Foreshore*).

Code of construction practice

14.2.6 There is a direct pathway for pollutants to be discharged to the tidal Thames due to the location of part of the construction area within the river channel. The *Code of construction practice (CoCP)*[i] Part A (Section 8) includes a number of measures to minimise the potential for impacts to surface waters, including impacts such as discharge of pollutants via surface water drains and these are summarised below.

14.2.7 Appropriate drainage, sediment and pollution control measures are included in the *CoCP* Part A (Section 8). These are in accordance with the relevant Pollution Prevention Guidelines (PPGs) issued by the Environment Agency (EA) and other Construction Industry Research and Information Association (CIRIA) documents.

14.2.8 All site drainage would be drained and discharged to mains foul or combined sewers. Where this is not practicable, the site would be drained such that accumulating surface water would be directed to holding or settling tanks, separators and other measures prior to discharge to the surface water drains. Foul drainage from the site welfare facilities would be connected to the mains foul or combined sewer.

14.2.9 Suitable spill kits would be provided and positioned in vulnerable areas, staff would be trained in their use and a record would be kept of all pollution incidents or near-misses, to ensure appropriate action is taken and lessons are learned from any incidents. Regular ‘toolbox talks’ would be held to raise staff awareness of pollution prevention and share lessons learned from any recorded incidents. There would be written procedures in place for dealing with spillages and pollution (the *Pollution Incident Control Plan* or *PICP*).

14.2.10 There is one site-specific measures incorporated in the *CoCP* Part B (Section 8) relevant to the surface water assessment, this relates to the incorporation of permeable surfacing on hardstanding for pollution control.

14.3 Assessment methodology

14.3.1 The methodology used for the assessment of effects on surface water differs from the standard Website Transport Analysis Guidance (WebTAG) (DFT, 2003)[2] environmental impact assessment (EIA) methodology for water resources, in that the requirements of the *Water Framework Directive* (*WFD*) have also been taken into account. In the absence of an EIA specific assessment methodology for *WFD* compliance, an assessment methodology has been derived specifically for the Thames Tideway Tunnel project to assess significance of effects. The methodology also takes into consideration the requirements of the *Urban Waste Water Treatment Directive* (*UWWTD*)[3] and is outlined in Volume 2 Environmental assessment methodology. A *WFD* assessment for the project as a whole is presented in Vol 3 Appendix L.2.

Engagement

14.3.2 Vol 2 documents the overall engagement which has been undertaken in preparing the *Environmental Statement*. Vol 2 Section 14 summarises the

[i] The *CoCP* is provided in Vol 1 Appendix A. It contains general requirements (Part A), and site specific requirements for this site (Part B).

engagement that has been undertaken for the surface water assessment and the relevant consultation responses.

14.3.3 There are no site specific engagement comments relevant to the surface water assessment at the Carnwath Road Riverside site.

14.3.4 The *Scoping Report* was prepared before Carnwath Road Riverside had been identified as a preferred site. The scope for the assessment of surface water for this site has therefore drawn on the scoping responses from other London Boroughs in relation to groundwater and is based on professional judgement as well as experience of similar sites.

Baseline

14.3.5 The baseline methodology follows the methodology described in Vol 2 Section 14. There are no site-specific variations for identifying baseline conditions for this site.

Construction

14.3.6 The assessment methodology for the construction phase follows that described in Vol 2 Section 14. There are no site-specific variations for undertaking the construction assessment of this site.

14.3.7 The assessment year for construction effects is Site Year 1 when construction would commence. No modelled water quality data are available for this year. The water quality conditions for the base case have therefore been derived from available modelled simulation data which uses population projections for 2021. This assumption is considered reasonable as substantial changes in water quality are considered unlikely between 2016 and 2021.

14.3.8 The Lee Tunnel and the sewage works upgrades at Mogden, Beckton, Crossness, Long Reach and Riverside sewage treatment works (STWs) would be operational by the time construction of the Thames Tideway Tunnel project commences, as described in Vol 2 Section 14. Significant improvements in the water quality in the tidal Thames are anticipated as a result of these projects. The base case would therefore be the water quality in the tidal Thames with the Lee Tunnel and sewage works upgrades in place.

14.3.9 The construction base case has considered the developments that are scheduled to be complete and in operation by Site Year 1 (presented in Vol 10 Appendix N). The developments in Vol 10 Appendix N would not result in additional surface water receptors (ie, waterbodies) and are considered unlikely to result in changes in water quality as the majority are remote from the tidal Thames. It is considered unlikely that the proposed Environmental Education Centre development would affect water quality as the development would be located on an existing jetty (adjacent to 51 Townmead Road). The base case would therefore not change from that outlined above.

14.3.1 The phases of the Wandsworth Riverside and Battersea Reach developments that would be under construction during Site Year 1 have been considered in the cumulative effects assessment (Section 14.7).

14.3.2 The assessment area for the assessment of effects of construction activities at Carnwath Road Riverside site would be limited to two sections of the river, namely the Thames Upper and Middle, and the river Wandle as listed in Vol 10 Table 14.4.1.

14.3.3 Section 14.5 details the likely significant effects arising from the construction at the Carnwath Road Riverside site. There are no other Thames Tideway Tunnel project sites which could give rise to additional effects on surface water within the assessment area for this site, therefore no other Thames Tideway Tunnel project sites are considered in this assessment.

Assumptions and limitations

14.3.4 The assumptions and limitations associated with this assessment are presented in Vol 2 Section 14. As the base of main tunnel shaft would be within the water bearing Lambeth Beds it is assumed that dewatering and/or ground treatment would be required. There are no other assumptions and limitations specific to the assessment of this site.

14.4 Baseline conditions

14.4.1 The following section sets out the baseline conditions for surface water within and around the site. Future baseline conditions (base case) are also described.

Current baseline

Water quality

14.4.2 A list of all surface water receptors and their WFD status given in the River Basin Management Plan (RBMP) (EA, 2009)[4], which are either adjacent to the site or downstream of the site and therefore have the potential to be affected by the proposed development, is included in Vol 10 Table 14.4.1.

14.4.3 The overall classification of status or potential under the WFD is a detailed process, which includes an assessment of water quality, physico-chemical and hydromorphological elements. Reference should be made to the United Kingdom Technical Advisory Group (UKTAG)[5] guidance, as given in the RBMP (EA, 2009)[6].

Vol 10 Table 14.4.1 Surface water – receptors

Waterbody name/ID	Hydro-morphological status	Current ecological quality	Current chemical quality	2015 Predicted ecological quality	2015 Predicted chemical quality	2027 target status
Thames Upper GB530603911403	Heavily modified	Moderate potential	Good	Moderate potential	Good	Good
Thames Middle GB530603911402	Heavily modified	Moderate potential	Fail	Moderate potential	Fail	Good
Wandle (Croydon to Wandsworth) and the R. Gravney GB106039023460	Heavily modified	Poor potential	Good	Moderate potential	The RBMP states that this waterbody “Does not require assessment”	Good

14.4.4 The River Thames and its tidal Tributaries are designated as a Site of Importance for Nature Conservation (Grade III of Metropolitan Importance). The Thames Upper (which stretches from Teddington to Battersea Bridge), the Thames Middle (which stretches from Battersea Bridge to Mucking Flats) and the River Wandle waterbodies are considered to be high value waterbodies, although their current and predicted status in 2015 (target date from RBMP [EA, 2009][7]) is moderate potential; a status objective of good by 2027 has been set for all three. In addition, the tidal Thames is a valuable water resource, habitat, and source of amenity, recreation, and transport route throughout London.

14.4.5 Sediment levels within the tidal Thames are estimated to currently reach a peak of 4,000kg/s in the lower tidal Thames estuary, ie more than 40,000t (or 20,000m^3 assuming an in-situ density of 2t per m^3) of sediment a day during spring tides (HR Wallingford, 2006)[8.]

14.4.6 There are no licensed surface water abstractions within 1km of the Carnwath Road Riverside site.

14.4.7 The Carnwath Road Riverside main site lies between the Cadogan and Putney Automatic Quality Monitoring Stations (AQMS) monitoring points, approximately 2km upstream of Cadogan and approximately 2km downstream of Putney, as shown on Vol 10 Figure 14.4.1 (see separate volume of figures). 2011 summary data from these two AQMS monitoring points, which gives 90 percentile values for ammonium (concentration that is exceeded 10% of the time) and 10% percentile values for dissolved oxygen (concentration exceeded 90% of the time), are presented below in Vol 10 Table 14.4.2 and Vol 10 Table 14.4.3.

Vol 10 Table 14.4.2 Surface water – Cadogan Pier AQMS 2011

Month	DO* (mg/l) (10%)	Ammonium (mg/l) (90%)
January	11.06	4.15
February	9.18	0.57
March	8.44	0.84
April	5.89	1.54
May	6.15	1.84
June	3.7	1.68
July	3.17	1.90
August	3.04	3.06
September	4.34	4.04
October	5.60	6.24
November	5.22	4.80
December	8.09	4.41

Vol 10 Table 14.4.3 Surface water – Putney Pier AQMS 2011

Month	DO (mg/l) (10%)	Ammonium (mg/l) (90%)
January	11.00	0.94
February	9.76	0.89
March	8.66	0.67
April	6.17	1.10
May	5.31	1.76
June	3.03	1.78
July	2.62	1.60
August	3.08	1.40
September	3.67	2.99
October	4.70	2.96
November	6.15	3.50
December	10.16	3.36

14.4.8 The data presented above demonstrate that the dissolved oxygen (DO) levels in the tidal Thames decrease in the summer months, as there is an inverse relationship between temperature and oxygen saturation ie, warmer water holds less DO than colder water. The discharges from CSOs along the tidal Thames have the effect of depleting DO as a result of the biological breakdown of organic matter in the discharges. Vol 3 Section 14 details half-tide plots displaying the changes in DO levels along the tidal Thames.

14.4.9 The Carnwath Road Riverside site is within an area of past potentially contaminative industrial uses. Historic contamination of underlying soils and also groundwater as a result of former industrial use (wharves, asphalt works, cement works and timber yards) is thought likely. Contamination associated with these types of uses includes metals, polycyclic aromatic hydrocarbons (PAH), fuel and oil hydrocarbons, cyanide, sulphates, asbestos and volatile organic compounds.

14.4.10 In addition, there is historic shallow contamination of foreshore sediments associated with nearby historic activities (adjacent wharves), with elevated levels of PAHs and heavy metals/metalloids including chromium, copper, lead and zinc found above limits contained in approved sediment guidelines[ii] [9]. An assessment of potential on-site contamination is provided within Section 8 of this volume.

[ii] In order to assess potential risk to aquatic organisms, reference has been made to the Port of London authority approved sediment quality guidelines, namely the Canadian Sediment Quality Guidelines for the Protection of Aquatic Life. The guidelines provide contaminant concentration limits in the form of Threshold Effect Level (TEL) and Probable Effect Level (PEL).

Construction base case

14.4.11 As explained in Section 14.3 the base case would be the water quality in the tidal Thames with the Lee Tunnel and sewage works upgrades in place.

14.4.12 The base case in Site Year 1 of construction taking into account the schemes described in Section 14.3 would not change since no new sensitive receptors would be introduced.

14.5 Construction effects assessment

14.5.1 This section presents the construction impacts that could occur at the site and identifies where no further assessment of effects is required (eg, where the impact pathway has been removed). The second part of the section identifies any effects that may occur and the likely significance of these effects.

Construction impacts

Temporary land take and morphological changes

14.5.2 In order to accommodate the temporary works at the Carnwath Road Riverside site, construction of a temporary campshed or jetty (with a campshed) within the river channel would be required as described in Section 3. Modelling has shown that the jetty would result in an increase in the flow velocities on the southern bank and a decrease on the northern bank (see Vol 3 Appendix L.3).

14.5.3 As the campshed against the rebuilt river wall would be located in the foreshore this would cause a temporary loss of foreshore while the campshed is in place. The option to use a jetty (with a campshed) would not affect land take because the jetty would be piled and so there would be minimal impact.

Pollution during in river works and river wall strengthening or rebuilding

14.5.4 The main pathways for surface water quality impacts during construction at the Carnwath Road Riverside site are as a result of the requirement for a campshed (or a jetty with a campshed) to be constructed in the river channel and the potential for strengthening works to the river wall or rebuilding of the river wall. If a jetty is used, it would support a conveyor, which would deposit excavated material directly into barges. There is the potential for pollution of the tidal Thames if materials are dropped or spilled during the loading and unloading of barges.

14.5.5 As the works would be in the river channel, there would be a direct pathway for pollutants to be discharged to the river during the construction which could impact on water quality in this location of the tidal Thames. The adoption of appropriate pollution control measures as included in the *CoCP* Part A (Section 8) (see para. 14.2.6) should remove the impact pathway and this is not considered further in the assessment.

Release of sediments from dredging, piling and scour

14.5.6 At Carnwath Road Riverside site some dredging may be required to allow barges to moor to the temporary works. Dredging would be carried out during restricted periods to avoid sensitive periods for fish spawning (as outlined in the *CoCP* Part A Section 8). In addition, monitoring of the river morphology at this point would be carried out, to ensure no emergency dredging would be required, particularly during the sensitive periods. The proposed dredge volume at this site is estimated as 3,500m^3. It has also been estimated that there would be a loss of 5% of the dredged material to the water column, and therefore an estimated 175m^3 (or 350t assuming an in-situ density of 2t per m^3) of sediment being released during the dredging operation[iii].

14.5.7 Further amounts of sediment could be released during piling operations. The total volume of sediment released to the tidal Thames by the proposed pilling activity at all construction sites has been estimated to be 890t. The proportion of this estimate that would originate from the Carnwath Road Riverside site, if the jetty option is taken forward, is approximately 45t.

14.5.8 It is also possible that the temporary campshed or jetty (with a campshed) would affect the river regime with the potential that localised increases in flow velocity cause scour of the river bed and foreshore and could result in the mobilisation of suspended solids. Scour modelling has shown that scour is unlikely to occur as a result of the campshed, although some scour could arise from the jetty option (see Vol 3 Appendix L.3). Any potential scour development during construction would be monitored and protection measures provided if set trigger levels are reached (see Vol 3 Appendix L.4).

14.5.9 The tidal Thames is a high sediment environment and levels already present within the tidal Thames are estimated to be a peak of 4,000kg/s in the lower tidal Thames estuary or more than 40,000t (or 20,000m^3) of sediment passing the main site four times a day during spring tides (HR Wallingford, 2006)[10]. In this context, the volumes that would be produced by the construction works from dredging, piling or scour would not be detectable against natural fluctuations in sediments and would not have an impact on surface water resources and are therefore not considered further within the assessment.

Foreshore and contamination within the river channel

14.5.10 Sampling of shallow foreshore sediments indicated historic shallow contamination of foreshore sediments associated with nearby historic activities (adjacent wharves), with elevated levels of PAHs and heavy metals/metalloids including chromium, copper, lead and zinc found above approved sediment guidelines (see Section 8 of this volume).

[iii] An assessment of the potential sediment losses anticipated from construction activities within the foreshore is provided in the *Habitats Regulation Assessment: No Significant Effects Report.*

14.5.11 Given the current environment (ie, significant water flow and sediment movement), it is expected that the majority of mobile contaminants have already been leached from the sediment, although any further disturbance of sediments caused by the proposed construction works could cause additional sediment contamination to be leached.

14.5.12 Any additional sediment input to the river as a result of construction processes would be minimal in comparison to the already high background levels (see para. 14.4.5); any mobilised contaminants would be expected to be rapidly diluted and their potential impact on water quality attenuated. Sediments mobilised by the construction works are therefore likely to pose only a low risk of causing deterioration in water quality. Such sediments are continually transported along the tidal Thames as part of natural erosion and deposition, as well as by other dredging operations and river users.

14.5.13 Therefore, there is considered to be no impact from this source and this is not considered further within this assessment.

Surface water drainage

14.5.14 The construction within the river channel would create a direct pathway to the river for contaminated runoff, high suspended solids and other pollution from the site. As the remainder of the working area would be behind the flood defences, there would be an indirect pathway for contaminated runoff, high suspended solids and other pollution from the site via surface water drains. However, appropriate site drainage would be used to control pollutants in the general site runoff, preventing the discharge of pollutants via combined or surface water drains as part of the surface water discharge from the construction site (see *CoCP* Part A Section 8). This would enable the pollution pathway to be removed and therefore there is considered to be no impact from this source. Surface water drainage is not considered further within this assessment.

Dewatering

14.5.15 It is likely that the base of the main tunnel shaft would be within the water bearing Lambeth Beds and therefore the base of the main tunnel shaft would require dewatering and/or ground treatment. See Section 13 of this volume for further details on the dewatering requirements. As dewatering would be required, there is the possibility of pollution from the discharge of contaminated groundwater into the tidal Thames.

14.5.16 However, potential pre-construction remediation and settlement of suspended solids within the dewatering would minimise the levels of contaminants within the effluent, which tend to be associated with particulates. Additional treatment of the dewatering effluent, or remediation of groundwater, may also be carried out, if required and it is therefore considered that there is no pollution pathway, and hence no impact from dewatering.

Construction effects

14.5.17 The potential surface water impacts identified above as a result of construction at Carnwath Road Riverside site have been assessed for their likely effects on WFD objective compliance, compliance with other legislation and effects on other users of the surface water. The surface water receptors are identified in Vol 10 Table 14.4.1.

14.5.18 The WFD objectives set out in Article 4 of the WFD are as follows:

a. WFD1 – Prevent deterioration of the status of all bodies of surface water

b. WFD2 – Protect, enhance and restore all bodies of surface water, with the aim of achieving good surface water status by 2015

c. WFD3 – Protect and enhance all artificial and heavily modified bodies of water, with the aim of achieving good ecological potential and good surface water chemical status by 2015

d. WFD4 – Reduce pollution from priority substances and cease or phase out emissions, discharges and losses of priority hazardous substances.

14.5.19 The significance of these effects has then been assessed based on the magnitude of the impacts as described in Vol 2 Section 14.5.

Temporary land take and morphological changes

14.5.20 The presence of the temporary works in the channel would impact on the flow regime at this location (see Vol 3 Appendix L.3). The construction of the campshed would also result in temporary land take, however the option for a jetty would not result in land take as it would be constructed on piles. The riverbed would be reinstated following the removal of the campshed. This would be due to the natural circulation of sediments within the estuary and the accumulation of silt and estuarine mud is likely to occur. The temporary change is unlikely to deteriorate the morphological condition beyond the existing limitations of the channel, which is already modified by flood defences and channel dredging.

14.5.21 In addition, the temporary land take is unlikely to alter the ‘in place’ mitigation measures identified in the RBMP as necessary to achieve good ecological potential. Therefore, because mitigation measures required to meet the WFD objective of Good Ecological Potential could still be implemented irrespective of the proposed development at this site, works at this site would not prevent any of the WFD objectives being met in the future. However, there would be a measurable change in foreshore morphology during construction and hence the effect is considered to be **minor adverse**.

14.5.22 Temporary land take can have an effect on ecological receptors by changing habitat availability. This effect is assessed in Section 5 of this volume.

14.6 Operational effects assessment

14.6.1 As explained in para. 14.1.3, the operational phase has not been assessed for surface water as there is no CSO interception at the Carnwath Road Riverside site and no likely significant effects are anticipated from the proposed development during operation.

14.7 Cumulative effects assessment

14.7.1 Considerable improvements in the water quality of the tidal Thames will occur as a result of the works with the Lee Tunnel and the sewage works upgrades. These already form part of the base case and so are not considered as part of the assessment of cumulative effects.

14.7.2 Of the projects described in Vol 10 Appendix N which could potentially give rise to cumulative effects with the proposed development at Carnwath Road Riverside site, it is not considered that any would lead to cumulative effects on surface water. This is because the majority are remote from the tidal Thames. It is considered unlikely that the proposed Environmental Education Centre development (adjacent to 51 Townmead Road) would affect water quality as the development would be located on an existing jetty.

14.7.3 No significant cumulative effects have therefore been identified for the construction phase at this site and therefore the effects on surface water would remain as described in Section 14.5 above.

14.8 Mitigation

14.8.1 No significant adverse effects have been identified and no mitigation is required.

14.9 Residual effects assessment

Construction effects

14.9.1 As no mitigation measures are proposed, the residual construction effects remain as described in Section 14.5. All residual effects are presented in Section 14.10.

14.10 Assessment summary

14.10.1 This topic assessment has considered both options for barge berthing using a jetty and or a campshed and given that there are not anticipated to be any differences, the assessment summary table reflects both options.

Vol 10 Table 14.10.1 Surface water – construction assessment summary

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Thames Upper, Thames Middle	Temporary changes to the riverbed due to construction of the campshed or jetty	Minor adverse	None	Minor adverse

References

[1] HM Government. *National Policy Statement for Waste Water: A framework document for planning decisions on nationally significant waste water* (March 2012). Available at: http://www.defra.gov.uk/publications/files/pb13709-waste-water-nps.pdf

[2] Department for Transport (DFT). *Transport Analysis Guidance* (WebTAG) (2003). Available at: http://www.dft.gov.uk/webtag/documents/overview/unit1.2.php last accessed December 2012

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.10**

Volume 10: Carnwath Road Riverside site assessment

Section 15: Water resources - flood risk

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

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Thames Tideway Tunnel

Environmental Statement

Volume 10: Carnwath Road Riverside site assessment

Section 15: Water resources – flood risk

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15 Water resources – flood risk

15.1 Introduction

Background

15.1.1 This section forms a Flood Risk Assessment (FRA) for the Carnwath Road Riverside site. This FRA has been developed in line with the requirements of the *National Policy Statement* (*NPS*) for Waste Water (Defra, 2012)[1] Section 4.4 and includes a qualitative appraisal of the flood risk posed to the site, the potential impact of the development on flood risk on and off the site and an appraisal of the scope of possible measures to reduce the flood risk to acceptable levels. Further details on how the NPS requirements relevant to flood risk have been met can be found in Volume 2 Environmental assessment methodology Section 15.3.

15.1.2 The proposed development is described in Section 3 of this volume. Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Volume 10 Carnwath Road Riverside Figures).

15.1.3 A summary of the regulations and policy that have informed the assessment are presented in this section. Section 15.2 provides a summary of the proposed development in relation to flood risk. Section 15.3 provides an assessment of the flood risk to the site and elsewhere as a result of the development, during both the construction and operational phases. Section 15.4 provides details of the design measures that have been adopted within the proposals to ensure the flood risk to the site is not increased and ensure that flood risk does not increase elsewhere.

15.1.4 The assessment of flood risk should be considered in conjunction with the assessment of other water resources ie, groundwater and surface water. The assessment of effects on groundwater and surface water is presented in Section 13 and Section 14 of this volume respectively.

15.1.5 A project-wide FRA has been undertaken and is presented in Volume 3 Project-wide effects assessment.

Regulatory context

15.1.6 The NPS seeks to ensure that where the development of new waste water infrastructure is necessary in areas at risk of flooding, flood risk from all sources of flooding is taken into account at all stages in the planning process in order for the development to be safe without increasing flood risk elsewhere.

15.1.7 A review of planning policy relevant to the proposed development is provided in Vol 10 Appendix M.1.

NPS Sequential and Exception Tests

15.1.8 The *Waste Water NPS* aims to direct development towards low risk areas through the use of a sequential approach which avoids inappropriate development in areas at risk of flooding. Using this approach, preference should be given to locating projects in Flood Zone 1 although if there is no "reasonably available site" in Flood Zone 1 then projects should be located in Flood Zone 2. However if there is no "reasonably available site" in Flood Zones 1 or 2, then nationally significant waste water infrastructure projects can be located in Flood Zone 3 subject to the Exception Test.

15.1.9 The *NPS* states that the Exception Test should be applied where it is not possible for the project to be located in zones of lower probability of flooding than Flood Zone 3.

15.1.10 The Exception Test is detailed in Section 4.4.15 of the *NPS*. The test requires overall sustainability benefits (part a) to outweigh flood risk, whilst ensuring the development is safe and does not increase flood risk elsewhere (part c) and is preferably located on previously developed land (part b).

15.1.11 The overall Thames Tideway Tunnel project is considered to pass the Sequential Test, as detailed in Vol 3 Section 15. The project wide Exception Test is also detailed in Vol 3 Section 15.

15.1.12 The proposed development at Carnwath Road Riverside would form an integral part of the Thames Tideway Tunnel project and so would help achieve the project-wide sustainability benefits outlined in the *Sustainability Statement*. Given the project-wide sustainability benefits, the proposed development is considered to satisfy part a) of the Exception Test.

15.1.13 The proposed permanent works would be located on previously-developed land, therefore satisfying part b) of the Exception Test.

15.1.14 This FRA shows that the proposed development would be appropriate for the area as flood risk to the development would be managed through appropriate design measures and the development would not lead to an increase in flood risk on the surrounding areas. Therefore, part c) of the Exception Test has also been met.

15.2 Elements of the proposed development relevant to flood risk

15.2.1 The proposed development at this site is described in Section 3 of this volume. It should be noted that the proposed highways works have not been included in this assessment as they are not relevant to flood risk.

15.2.2 The elements of the proposed development relevant to flood risk are set out below.

Construction

15.2.3 The construction elements of the proposed development relevant to flood risk include:

a. Rebuilding approximately 200m of river wall.

b. A temporary jetty with associated campshed or a campshed within the tidal foreshore for the loading and unloading of material.

c. Maintenance of the flood defences to the statutory level for the excavation of the foreshore and the replacement of the river wall.

d. An overhead conveyor to be used for the transport of material to and from the barges.

e. The construction of the main tunnel drive and reception shaft at the intersection of the main tunnel and the Frogmore connection tunnel, thus providing access to both tunnels.

Code of Construction Practice

15.2.4 Appropriate guidance regarding flood defence construction and emergency planning are included in the *Code of the Construction Practice (CoCP)*. The *CoCP* is provided in Vol 1 Appendix A. It contains general requirements (Part A), and site specific requirements for this site (Part B).

15.2.5 The *CoCP* (Section 4) states that no temporary living accommodation would be permitted onsite and that an evacuation route and safe refuge would be provided in the event of a flood event.

15.2.6 The *CoCP* (Section 8) states that the contractor would be responsible for providing and maintaining continuous flood defence provision, for both permanent and temporary works, to the statutory flood defence level[i] as detailed within the FRA. This is a requirement of the Thames River Protection of Floods Amendment Act 1879[2].

Operation

15.2.7 As part of the permanent works the following elements relevant to flood risk are proposed:

a. An above ground ventilation building to house air management plant and equipment (ventilation building) and ventilation column. The building to house the air management plant would include a brown roof as part of the overall sustainable urban drainage systems (SuDS) measures.

b. Replacement of the river wall.

c. There would be no permanent works in the foreshore.

d. As the site is adjacent to the River Thames, surface water runoff associated with the impermeable surfaces would be discharged directly into the tidal reaches of the River Thames (tidal Thames) without attenuation.

15.3 Assessment of flood risk

Introduction

15.3.1 The NPS requires that all potential sources of flooding that could affect the proposed development are considered.

[i] The level to which the flood defences must be maintained to ensure that both the sites themselves and third-party land and assets in the surrounding area are protected from flooding.

15.3.2 This assessment is based on a FRA screening exercise that identified relevant potential flood sources and pathways. The tidal and fluvial assessments have been based on Environment Agency (EA) flood zones which do not take account of the presence of existing defences.

15.3.3 The assessment of flood risk from the proposed development takes into account the proposed design measures detailed in Section 15.4.

15.3.4 It should be noted that due to the nature of a flood risk assessment, the risk based approach outlined in the National Planning Policy Framework (NPPF) (Communities and Local Government, 2012)[3] was considered to be preferable to the general environmental impact assessment (EIA) methodology described in Vol 2 Section 3. This approach is based on the probability of an event occurring as a result of the proposed development rather than a direct change in conditions. This is detailed in the methodology (see Vol 2 Section 15).

Tidal flood risk to the proposed development

Level of risk based on the flood zones

15.3.5 The site is located to the north of the River Thames and to the west of Wandsworth Bridge. The EA flood map indicates the site to be within Flood Zone 3. The location of the site in relation to the flood zones is shown in Vol 10 Figure 15.3.1 (see separate volume of figures).

15.3.6 A temporary jetty and associated campshed or a campshed against the river wall would be constructed within the foreshore of the River Thames at this site. As this component of the site would be located within the foreshore, it is part of the active floodplain of the tidal Thames and subject to daily tidal inundation. This area is therefore considered as functional floodplain and is classified as Flood Zone 3b (land where water has to flow or be stored in times of flood). Due to the undefended nature of the floodplain at this location and the frequency at which tidal inundation occurs, the current risk of flooding to this foreshore part of the site (without the design measures) is considered to be very high (see Vol 2 Section 15).

15.3.7 The permanent works would be located behind the tidal Thames flood defences within Flood Zone 3a. Due to its location within Flood Zone 3a, the risk of tidal flooding to the operational part of the site is considered to be high (see Vol 2 Section 15).

Existing tidal defences

15.3.8 A raised flood defence wall follows the boundary of the tidal Thames and separates the inland part of the site and the adjacent tidal foreshore.

15.3.9 The EA has stated that the statutory flood defence level relevant to the Carnwath Road Riverside site is 5.41m Above Ordinance Datum (AOD). According to the National Flood and Coastal Defence Database (NFCDD) (EA, 2011)[4] the crest levels for the river wall within the site range from 5.41mAOD to 7.43mAOD and therefore meets the EA flood defence statutory levels. In addition the site is protected from tidal flood risk by the Thames Barrier located approximately 24km downstream.

15.3.10 Condition surveys carried out by the EA in April 2011 (EA, 2012)[5] state that the defences at this site are generally in good condition (Grade 2), with some defences in fair condition (Grade 3).

15.3.11 The Strategic Flood Risk Assessment (SFRA) for the London Borough (LB) of Hammersmith and Fulham (JBA and Entec UK Ltd, 2010)[6] quantifies the residual risk in the event of a breach in the local defence or the overtopping as a result of the failure of the Thames Barrier (in the case that this does not close during a tidal event). A breach event, modelled near Hurlingham Park as part of the SFRA, approximately 600m to the west of the site, shows the site to remain dry during all modelled scenarios. The results of the breach modelling show that Carnwath Road, to the north of the site, is inundated by floodwater. The SFRA concludes that the site has a high residual risk, as, although it would not be inundated during the modelled breach event, there would not be any dry access/egress routes from the site in the event of flooding as the surrounding area would be inundated with floodwater. However, this risk is residual and would not be considered likely to compromise the long term operational function of the main tunnel (see Vol.3).

Tidal flood level modelling

15.3.12 The most extreme flood risk scenario that could affect the site would be the combination of a high tide with a storm surge in the Thames Estuary. This scenario, assuming the Thames Barrier is operational, is the EA’s ‘design flood’ event, a hypothetical flood event representing a specific likelihood of occurrence, in this case the 1 in 200 year (0.5% Annual Exceedance Probability [AEP][ii]) flood event.

15.3.13 The EA *Thames Tidal Defences Joint Probability Extreme Water Level Study* (EA, 2008)[7] provides modelled tidal flood levels for the 1 in 200 year (0.5% Annual Exceedance Probability [AEP]) flood event for specific locations (model node locations) within the tidal Thames.

15.3.14 Vol 10 Table 15.3.1 presents the modelled tidal levels from this study for model node 2.25 which is the most relevant (ie, closest) to the site. It should be noted that the water levels are expected to decrease in the future due to an amended Thames Barrier closure rule which would be applied in the future (see Vol 2 Section 15) and so the 2005 scenario produces the highest water level.

15.3.15 Vol 10 Table 15.3.1 also shows that the existing defence levels at the site are above the 0.5% AEP tidal flood level; therefore the site is protected from tidal flooding to the statutory level.

Vol 10 Table 15.3.1 Flood risk – modelled water levels

Return period	Flood level (mAOD)	Statutory flood defence level (mAOD)
0.5% AEP (2005)	5.07	5.41
0.5% AEP (2107)	5.04	

[ii] A flood with a 0.5% Annual Exceedance Probability (AEP) has a one in 200 year probability of occurring in a given year

Tidal risk from the proposed development

15.3.16 Following construction of the proposed development at the Carnwath Road Riverside site there are no proposed changes to the flood defences adjacent to the site. The risk of tidal flooding would remain a residual risk, due to the defended nature of the operational site. As the permanent works would be located in Flood Zone 3a, the flood risk from this source is therefore considered to remain high.

Flood defence integrity

15.3.17 The tunnel excavation process using tunnel boring machines (TBMs) and other construction activities, as well as shaft construction have the potential to create differential settlement (that is a gradual downward movement of foundations due to compression of soil which can lead to damage if settlement is uneven), which could affect the level of some of the existing flood defences. The main tunnel and the Frogmore connection tunnel would pass under the existing defences in the vicinity of the site and therefore would have the potential to affect flood defences at the site.

15.3.18 The proposed design has been informed by consideration of settlement and the alignment and methods used have been selected to minimise it as far as possible.

15.3.19 A potential settlement of between 23mm to 45mm is estimated to occur across the river walls at the site (based on information provided by Thames Water). The flood defence level following settlement is estimated to range from 5.38mAOD to 7.41mAOD. Therefore, this potential settlement could result in sections of the river wall falling below the EAs statutory flood defence level of 5.41mAOD.

15.3.20 An initial assessment of the effect of construction activities on the structural integrity of flood defences at this site was undertaken by Thames Water. This considered effects from ground movement as well as a range of other construction-related impacts where applicable. The assessment indicated potential structural impacts on the flood defences at the site arising from additional surcharge loading, excavation in the vicinity of tie-rods, excavation in front of wall and tie-rod stress increase[iii].

15.3.21 The proposed schedule of works (Schedule 1 of *The Draft Thames Water Utilities Limited (Thames Tideway Tunnel) Development Consent Order*) includes a provision for "works for the benefit of the protection of land or structures affected by the authorised project" which would provide the powers to mitigate for any impact that might affect the flood defences at the site.

Flood defence line

15.3.22 Both temporary and permanent works for the flood defences have the potential to influence the level of tidal flood risk to the surrounding area.

[iii] Tie-rod stress analysis aims to determine the likely tie-rod stress change as a result of differential ground movement between a river wall and its anchor, caused by tunnel construction.

15.3.23 The river wall has been identified from site surveys (undertaken on behalf of Thames Water) as being in a poor condition and not strong enough to withstand the proposed construction loads. Therefore it is proposed to replace the existing flood defence wall where the campshed would be located with a new flood defence river wall using a landward construction technique (ie no cofferdam is proposed for this work). This would extend over approximately 200m. It is assumed that 5m of ground would be removed behind the flood defences and placed in front of the foreshore as a toe constraint.

15.3.24 The proposed new flood defence wall would be constructed along the line of the existing river wall and to the same height as the existing flood defences ensuring the current standard of protection is maintained.

15.3.25 Under the existing river wall there is an old river wall which would remain in situ. The old river wall and high ground behind the existing flood defence would act to provide basic flood defence protection during the construction period. This approach ensures that the level of tidal flood risk to the site and surrounding area would not change.

Scour management

15.3.26 The TE2100 Plan (EA, 2012)[8] includes an assessment of the tidal Thames foreshore at this location where there are long lengths of naturally eroding reaches of the tidal Thames. Results from the TE2100 Plan show that works within the foreshore at this site may have an influence on downstream river structures if the pattern of sediment movement is greatly changed. In addition, should any permanent and temporary works within the river cause the channel width to be considerably altered, the flow velocity of the river at this point may vary, thereby altering contraction scour across the channel bed.

15.3.27 A scour summary report summarises the modelling studies that have been undertaken to determine the magnitude of scour associated with both the temporary and permanent works at ten foreshore sites on the River Thames (Vol.3, Appendix L.3) including the Carnwath Road Riverside site.

15.3.28 Scour is predicted at the Carnwath Road Riverside site during construction with maximum estimated scour depths at the temporary works of up to 1.3m. The contraction scour (ie scour across the bed) has been estimated during construction to be less than 0.1m and scour has been estimated to be than 0.1m at the adjacent river walls at the site. Therefore the temporary works have the potential to influence scour and /or deposition rates within the river and affect river structures including flood defences.

15.3.29 There are no permanent works proposed in the foreshore.

Loss of volume from the tidal Thames

15.3.30 The presence of temporary structures within the foreshore has the potential to reduce the availability of flood storage within the tidal Thames. The impact of the removal of flood storage on flood levels may propagate throughout the hydrological unit of the tidal Thames reach and has been considered on a project-wide basis (Vol. 3 – Section 15).

15.3.31 The Carnwath Road Riverside site is located within the reach of Chelsea-Westminster in the tidal and fluvial modelling study. The modelling identifies that for this reach the potential maximum decrease in peak water level is 0.029m during the temporary works scenario reducing to 0.014m during the permanent scenario. The modelling also identifies a potential maximum increase of 0.013m in peak water level during the temporary works scenario reducing to 0.004m during the permanent scenario. As identified in para. 15.3.9 the flood defences at this site are above the statutory flood defence level and when compared to the 1 in 200 year tidal level for the year 2107 would provide between 0.34-2.36m in freeboard. These predicted changes in water level and therefore freeboard are not considered to reduce flood protection at this site below design standard requirements and are therefore not deemed significant.

15.3.32 The results of the above modelling exercise show that the proposed project –wide works (both temporary and permanent works) are not considered to have a detrimental impact on the flood storage or tidal levels within the tidal Thames. This is discussed further in Vol 3 Section 15.

Fluvial flood risk to the proposed development

Level of risk based on the flood zones

15.3.33 At this location along the tidal Thames, both fluvial and tidal inputs are component parts of the resulting water level. The impacts of flooding from the tidal influence of the tidal Thames are judged to be of greater importance than those from fluvial influences (see Vol 2 Section 15). As the proposed permanent works at the Carnwath Road Riverside site would be located within Flood Zone 3a, and as the tidal and fluvial floodplain cannot be distinguished from each other in this location, the risk of flooding from this flood source is considered to be high (see methodology in Vol.2).

15.3.34 As the temporary works within the foreshore would be located within functional floodplain and therefore Flood Zone 3b, and as the tidal and fluvial floodplain cannot be distinguished from each other in this location, the risk of flooding from this flood source is considered to be very high.

Fluvial flood risk from the proposed development

15.3.35 Fluvial influences were also considered when developing the hydraulic modelling summarised in para. 15.3.31. Overall, the results of the modelling exercise show that the proposed project-wide works are not considered to have a detrimental impact on the flood storage or tidal levels within the tidal Thames. This is discussed further in Vol 3 Section 15.

15.3.36 There are no permanent works proposed in the foreshore for this site, therefore there would be no change to flood storage and the risk of fluvial flooding as a result of the proposed development would remain unchanged.

Surface water flood risk to the proposed development

15.3.37 Flooding of land from surface water runoff is usually caused by heavy rainfall that is unable to infiltrate into the ground or drain quickly enough into the local drainage network. Flooding can also occur at locations where the drainage network system is at full capacity and floodwater is not able to enter the system. This form of flooding often occurs in lower lying areas where the drainage system is unable to cope with the volume of water.

15.3.38 The permanent works area is mainly hard standing and therefore impermeable. Ground levels slope down from the east of the site to the west. The highest elevation is at 5.44mAOD at the west of Hurlingham Wharf and the lowest point is at 5.11mAOD at the south western corner of Whiffin Wharf. The current site entrance slopes away from the site towards Carnwath Road. The surrounding area is approximately level, with no direct flow paths towards the site. Surface water from the site is either drained to a combined sewer along Carnwath Road or discharged directly to the tidal Thames.

15.3.39 JFLOW[iv] pluvial modelling undertaken for the LB Hammersmith and Fulham SFRA[6] indicates that a rainfall event of 1 in 100 year (1% AEP) rainfall event would not result in flooding at the site. Therefore the site is not situated in an area at increased risk of surface water ponding.

15.3.40 No historical records of surface water flooding have been identified in the vicinity of the site.

15.3.41 Given that the site is not located in an area at risk of surface water ponding and no records of flooding in the vicinity of the site have been identified, the risk of surface water flooding at the site is therefore considered to be low (see methodology in Vol.2).

Surface water flood risk from the proposed development

15.3.42 An assessment of the likely significant effects of surface water from the Carnwath Road Riverside site is provided in Section 14 of this volume.

15.3.43 The *Waste Water NPS* requires that surface water runoff on new developments is effectively managed so that the risk of surface water flooding to the surrounding area is not increased. In accordance with NPS, runoff rates following the proposed development should not be greater than the existing (pre-development) rates. The *London Plan 2011* (GLA, 2011)[9] and the *Mayor's Water Strategy* (Mayor of London, 2011)[10] set out a preferred standard of attenuation to the greenfield runoff rate and an essential standard of 50% attenuation of the peak surface water runoff rate at peak times.

15.3.44 In agreement with the EA (as set out in their phase two consultation response), surface water runoff from the proposed site would be discharged directly to the tidal Thames. Due to the tidal nature of the receiving watercourse, surface water runoff to the tidal Thames is not anticipated to increase surface water flood risk to the site or surrounding area and would therefore not require attenuation prior to discharge.

15.3.45 In the event of a storm coinciding with a high tide event, surface water drainage from the site may be restricted and would need to be stored on

[iv] JFLOW hydraulic modelling forms the basis of the EA flood zones mapping

site. This would ensure no flooding for the 1 in 100 year plus climate change rainfall event.

15.3.46 Following the implementation of the above approach to surface water management, the risk of flooding from this source as a result of the proposed development would be unchanged and remain as low.

Groundwater flood risk to the proposed development

15.3.47 Groundwater flooding occurs where groundwater levels rise above ground surface levels.

15.3.48 The nearest borehole to the site (SR1102A) is located approximately 160m away to the southeast, on the opposite bank of the tidal Thames. Recorded groundwater levels in the River Terrace Deposits (from October 2009 and December 2011) at this borehole range from 3.3 to 5.69 metres below ground (mbg) level, showing fluctuations with the tidal cycle and seasonal variations.

15.3.49 The ground investigation at borehole SR1102A suggests that the surface geology at the site comprises impermeable made ground and alluvium layers. These would frequently act as a confining layer to groundwater.

15.3.50 The LB of Hammersmith and Fulham SFRA does not provide any evidence to suggest that groundwater flooding has occurred in the vicinity of the site past.

15.3.51 As the upper aquifer is confined[v], there is no pathway for groundwater to reach the surface of the site. There is therefore no risk of groundwater flooding to the site (see methodology in Vol.2).

Groundwater flood risk from the proposed development

15.3.52 A full assessment of the likely significant effects on groundwater at the Carnwath Road Riverside site is provided in Section 13 of this volume.

15.3.53 The main tunnel shaft would pass through made ground, alluvium, river terrace deposits and London Clay. The base slab, at the bottom of the shaft would extend into the top of the Lambeth Group.

15.3.54 The main tunnel shaft would pass through the upper aquifer of the River Terrace Deposits. It is not anticipated that dewatering of the river terrace deposits would be required. The Lambeth Group is considered to act as an aquitard, in which groundwater is present in several confined groundwater bodies.

15.3.55 There is the potential for the base of the shaft to be inundated by groundwater from the Lambeth Group, therefore depressurisation and dewatering is anticipated during the construction phase to manage the groundwater levels. Groundwater brought to the surface as a result of dewatering during construction would be pumped from the construction site to the tidal Thames, following appropriate treatment.

[v] Confined - a term used to describe an aquifer in which water is held under pressure, such that groundwater in a borehole penetrating a confined aquifer would rise to a level above the top of the aquifer

15.3.56 The presence of the main tunnel shaft may create a physical barrier and disrupt groundwater flows. It is estimated (see Section 13 of this volume) that the groundwater levels would rise by approximately 0.4m. The predicted rise in water levels would result in increased hydraulic pressure within the confined unit rather than an increase of the water table. Therefore there is no pathway for groundwater to reach the surface of the site. As a result, there is no risk of an increase in groundwater flooding to the site as a result of the development.

Sewers flood risk to the proposed development

15.3.57 Two combined sewers of 300mm diameter run in an easterly direction in Carnwath Road. There are also several small surface water and foul sewers located within Whiffin Wharf and Hurlingham Wharf.

15.3.58 If the capacity of the sewers were exceeded, sewage could surcharge through outlets such as man holes and gullies located along the length of the sewers. As the surrounding area is generally level, sewage that has surcharged to the ground level would remain locally as there are no likely flow paths or low points in the topography where sewage would accumulate.

15.3.59 Flooding records (Thames Water, 2012)[11] show that there has been one sewer flooding incident with unknown cause within 200m of the site since 1990. As there is no direct pathway from the local sewers to the site, the flood risk is considered to be low.

Sewers flood risk from the proposed development

15.3.60 No sewers would be intercepted by the main tunnel at this site. Surface water and combined sewers located in Whiffin Wharf and Hurlingham Wharf would be demolished, replaced, or retained depending on how the site construction details are developed.

15.3.61 Following the construction of the proposed development the risk of flooding from this source is considered to remain unchanged and therefore would be low.

Artificial source flood risk to and from the development

15.3.62 There are no nearby artificial flood sources eg, canals, reservoirs, which could lead to flooding of the site.

15.3.63 The flood risk from artificial sources both to and from the proposed development is not applicable at this site and therefore has not been assessed further.

15.4 Design measures

15.4.1 Measures have been incorporated into the design of the proposed development to ensure that the risk of flooding to and from the site and surrounding areas is not increased during the construction and operational phases. These measures are described below although many have already been referred to in the preceding section.

Tidal and fluvial

Construction

Flood defences

15.4.2 The proposed tunnel alignment passes under the river wall flood defence and would have the potential to affect the integrity of these defences. During construction the level of the flood defences at the site would be monitored and mitigated in agreement with the asset owner and the EA as appropriate, to ensure crest heights of the flood defences at the site are maintained to the existing crest level. With this strategy in place no effects of settlement are anticipated.

15.4.3 Design measures to preserve the structural stability of the flood defences at the site would be dependent on the contractor's construction methodology. Potential options may include replacement and/or strengthening of sections of the existing wall.

15.4.4 As discussed in para. 15.3.23 the new flood defence wall would be constructed to tie into the existing defences at the necessary statutory flood defence height. This would ensure that the current level of flood protection is maintained during construction. Further information is included in the *CoCP* (Section 8).

15.4.5 Appropriate Protection Provisions would be agreed with the EA for any works within 16m of the flood defences on the landward side and within the river.

Scour management

15.4.6 During construction, the formation of scour which may occur would be monitored and mitigation proposed if the scour exceeds agreed trigger values.

15.4.7 Mitigation options could include riprap or rock fill, articulated concrete blocks, gabion mattresses and grout filled mattresses. The detailed approach to the implementation of these mitigation measures would be informed by the monitoring results as well as site specific requirements. Further details are provided in *Scour Monitoring and Mitigation Strategy* (Vol 3 Appendix L.4).

Loss of volume from the tidal Thames

15.4.8 As discussed in paras. 15.3.30, the impact of removal of tideway flood storage on flood levels has been considered on a project-wide basis and is discussed further in Vol 3 Section 15. The loss of floodplain storage volume due to construction works has been minimised whilst maintaining fundamental engineering requirements and therefore no further design measures are proposed regarding flood storage.

Emergency plan

15.4.9 Appropriate emergency planning procedures would be adopted by the contractor during the construction phase to mitigate the potential consequences in the event of a breach in the flood defence wall at the site or a failure of the Thames Barrier. Further information is included within the *CoCP Part A* (Section 8).

Operation

Flood Defences

15.4.10 The permanent operational area would be protected from flooding through the provision of a new flood defence wall as outlined in para. 15.3.23. This would be located along a stretch of approximately 200m of river wall coinciding with the location of the campshed and would tie into existing flood defences, providing a continuous defence line along the Embankment at all times.

15.4.11 The new defences would be designed to ensure that future flood defence raising can be achieved to meet the TE2100 requirements.

15.4.12 As the new flood defence wall would be constructed to the same height as the existing flood defence level, the residual flood risk to the site would be unchanged compared to the existing scenario. As detailed in para. 15.5.6 and in Vol 3 Section 15, the residual risk to the site is considered to be appropriate and no further measures are required.

Scour management

15.4.13 No permanent works are proposed in the foreshore.

Emergency plan

15.4.14 During the operational phase the site would not be permanently staffed with the exception of visits from maintenance personnel. An emergency flood evacuation plan would only be required for staff undertaking maintenance visits.

Surface water

Construction

15.4.15 In accordance with the *CoCP* (Section 8) all site drainage during construction would be drained and discharged (after acceptable treatment) to mains foul or combined sewers and where this is not practicable, the site would be drained such that accumulating surface water would be directed to holding or settling tanks, separators and other measures prior to discharge to the combined or surface water drains. Foul drainage from the site welfare facilities would be connected to the mains foul or combined sewer. These design measures would ensure that the risk of surface water flooding is managed during construction but would not reduce the overall level of flood risk associated with surface water.

Operation

Scour management – surface water discharge

15.4.16 As outlined in para. 15.3.44 it is intended to discharge surface water from the operational site directly into the tidal Thames and this may require a new outfall. This outfall would be of appropriate size for the potential discharge flow rates. No scour protection is proposed for the outfall.

Surface water management

15.4.17 As described in para. 15.2.7d surface water runoff from the site would be discharged directly to the tidal Thames. Due to the tidal nature of the receiving watercourse, surface water runoff rates would not increase surface water flood risk to the site or surrounding area and would therefore not require attenuation prior to discharge.

Groundwater

Construction and operation

15.4.18 Groundwater monitoring is proposed during construction and operation. Further groundwater related measures regarding dewatering are described in Section 13 of this volume.

Sewers

Construction and operation

15.4.19 There are no proposed interceptions or diversions of the existing sewer network planned at this site. Furthermore, the proposed development would not increase the current surface water discharge into the existing local sewers network. Therefore no design measures are proposed.

15.5 Assessment summary

Flood risk

15.5.1 The permanent works area at the Carnwath Road Riverside site is located in Flood Zone 3a associated with the tidal Thames and benefits from the presence of flood defences ie, river wall.

15.5.2 In line with the NPS, this FRA shows that the proposed development would be appropriate for the area as flood risk to the development would remain unchanged as it would be managed through appropriate design measures and the development would not lead to an increase in flood risk on the surrounding areas. Therefore no significant flood risk effects are likely.

15.5.3 Vol 10 Table 15.5.1 provides a summary of the findings of the FRA undertaken for this site.

Residual risk to the development

15.5.4 The residual risk to the site is the risk that remains after all design measures have been incorporated.

15.5.5 The site is currently at residual risk of tidal flooding in the event of a breach in the local flood defence wall along the edge of the tidal Thames or overtopping of the defence wall as a result of a failure of the Thames Barrier.

15.5.6 It is considered that the consequence of a breach or failure of flood defences would not compromise the long term operational function of the tunnel and therefore no additional mitigation measure above those outlined above are proposed. Further detail is provided in Vol 3 Section 15.

Residual risk from the development

15.5.7 Following the incorporation of the design measures outlined in Vol 10 Table 15.5.1, the level of residual risk from the development to adjacent areas would remain unchanged. The project-wide residual risks are discussed in Vol 3 Section 15.

Vol 10 Table 15.5.1 Flood risk –FRA summary

Source	Pathway	Current flood risk to the proposed development*	Design measures (construction and operation)	Flood risk from the proposed development (post design measures)	Flood risk to proposed development post design measures
Tidal	Breaching/overtopping of the tidal Thames flood defences	Inland area – high (but residual) Foreshore – Very high	Flood defence height maintained. Monitoring of flood defence levels and repaired/replaced/strengthened as required to maintain existing crest level Scour management monitor and mitigate approach *Emergency Plan*	No increase in tidal flood risk as a result of proposed development.	Inland area – high (but residual only) Foreshore – very high (No change for existing situation)
Fluvial	Breaching/overtopping of the tidal Thames flood defences	Inland area – high (but residual) Foreshore – Very high	Flood defence height maintained. Monitoring of flood defence levels and repaired as required to maintain existing crest level Scour management monitor and mitigate approach *Emergency Plan*	No increase in fluvial flood risk as a result of proposed development.	Inland area – high (but residual) Foreshore – Very high (No change for existing situation)
Surface water	Surrounding area	Low	Discharge surface water to tidal Thames	No increase in surface water flood risk as a result of proposed development.	Low (No change for existing situation)

Source	Pathway	Current flood risk to the proposed development*	Design measures (construction and operation)	Flood risk from the proposed development (post design measures)	Flood risk to proposed development post design measures
Groundwater	Underlying geology and groundwater levels restricted pathway	No risk	Dewatering and depressurisation during construction. Monitoring proposed during construction and operation.	No increase in groundwater flood risk as a result of proposed development.	No risk (No change for existing situation)
Sewers	Local drainage system	Low	No measures proposed.	Risk unchanged as no sewers intercepted.	Low (No change for existing situation)
Artificial sources	None	Not applicable	Not applicable	Not applicable	Not applicable

** Definitions of these classifications are included in Vol 2 Section 15*
() indicate the flood risk is residual ie in the event of a failure or overtopping of flood defences

References

[2] *Thames River Protection of Floods Amendment Act 1879* London. Great Britain. The Stationery Office.

[3] Communities and Local Government. *National Planning Policy Framework* (March, 2012).

[4] Environment Agency. *National Flood and Coastal Defence Database* (October, 2011).

[5] Environment Agency. *Flood Defence Data* (received January 2012).

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

[7] Environment Agency. *Thames Tidal Defences Joint Probability Extreme Water Levels 2008 Final Modelling Report* (April 2008).

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

[9] Greater London Authority. *The London Plan Spatial Development Strategy for Greater London* (July 2011).

[10] Mayor of London. Greater London Authority. *Securing London's Water Future. The Mayor's Water Strategy* (October 2011).

[11] Thames Water. *Sewer flooding records* (received June 2012).

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