Thames Tideway Tunnel
Thames Water Utilities Limited

Development Consent Order

Application Reference Number: WWO10001

Documents for Certification
September 2014

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

Lindsay Speed   Sarah Fairbrother

September 2014

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

Thames Tideway Tunnel
Thames Water Utilities Limited

Thames Water

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.21**

Volume 21: King Edward Memorial Park Foreshore site assessment

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

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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 King Edward Memorial Park site.

1.1.2 The proposal at this site is to intercept an existing combined sewer overflow (CSO), known as the North East Storm Relief (NESR), which currently discharges approximately 31 times in a typical year from an outfall on the southern edge of the park. The total volume discharged is approximately 782,000m^3 in a typical year. A new CSO drop shaft would be built in the foreshore at this site and interception structures built to connect the new drop shaft to the existing NESR. The drop shaft would be online with the main tunnel and there would be no connection tunnels.

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 (see Vol 21 King Edward Memorial Park Foreshore figures and Vol 21 King Edward Memorial Park Foreshore appendices). In addition, there is a separate glossary and abbreviations document which explains technical terms used within this assessment.

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Section 2: Site context

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2 Site context

2.1.1 The proposed development site is located within the London Borough (LB) of Tower Hamlets on and adjacent to the northern bank of the River Thames. It would comprise an area of the River Thames foreshore, a portion of King Edward Memorial Park and a section of Glamis Road and its junction with the Highway (A1203). The site is defined by the limits of land to be acquired or used (LLAU) and would cover an area of approximately 2 hectares. The site context is indicated in Vol 21 Figure 2.1.1 (see separate volume of figures).

2.1.2 The site is bounded to the north by the park, with The Highway (A1203) beyond this. A 20th Century block of residential flats known as Free Trade Wharf is adjacent to the park to the northeast. The River Thames forms the southern boundary of the site. To the southwest of the site is Shadwell Basin Outdoor Activity Centre. The western edge of Glamis Road forms the western boundary of the site. Vol 21 Plate 2.1.1 below provides an aerial view of the site.

Vol 21 Plate 2.1.1 King Edward Memorial Park Foreshore – aerial photograph

2.1.3 The proposed site predominantly comprises River Thames foreshore, with a smaller area of the adjacent park, hardstanding areas, a small children's playground and maintenance buildings. Vol 21 Figure 2.1.2 (see separate volume of figures) shows the general pattern of existing land uses within and around the site.

2.1.4 There are two existing vehicle accesses to the park from Glamis Road (see Vol 21 Plate 2.1.2) and a further four pedestrian accesses at various points around the perimeter of the park. The closest railway station is

Wapping railway station located approximately 650m to the southwest of the site. The Thames Path which runs along the southern edge of the park, adjacent to the foreshore is the main pedestrian route through the park, which is closed at night. This portion of the Thames Path is not a public right of way (PRoW).

Vol 21 Plate 2.1.2 King Edward Memorial Park Foreshore − park access from Glamis Road

2.1.5 There are a number of receptors in close 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 Free Trade Wharf – 6m northeast of the hoarding

  ii residential properties on Shadwell Pierhead – 4m south of the hoarding

b. educational

  i pre-school (Pier Head Preparatory (Montessori) School) located in the Shadwell Basin Outdoor Activity Centre premises 4m to the south

  ii Lifelong Learning Service (The Shadwell Centre) on The Highway 118m to the northeast

c. commercial

i Prospect of Whitby pub 145m south west of hoarding

d. recreational

i River Thames – within cofferdam area

ii Thames Path National Trail – within the site boundary (diversion required)

iii Shadwell Basin Outdoor Activity Centre – 4m to the south of the hoarding

iv King Edward Memorial Park – within and adjacent to the hoarding.

Vol 21 Plate 2.1.3 King Edward Memorial Park Foreshore − view of Park from River Thames

2.1.6 Environmental designations for the site and immediate surrounds are shown in Vol 21 Figure 2.1.3 (see separate volume of figures).

2.1.7 The whole borough of Tower Hamlets has been declared an Air Quality Management Area (AQMA) in terms of both nitrogen dioxide (NO_2) and particulate matter (PM_{10}).

2.1.8 The foreshore part of the site lies within the River Thames and Tidal Tributaries Site of Importance for Nature Conservation (SINC) (Grade III Metropolitan importance). The site is also situated immediately adjacent to Shadwell Basin SINC. Lavender Pond Local Nature Reserve (LNR) is within 1km of the site on the opposite bank of the River Thames.

2.1.9 There are no listed buildings within the site. The Thames (Rotherhithe) Tunnel designed by Marc Isambard Brunel is located immediately to the south of the site. An associated air shaft is Grade II listed and lies adjacent to the southern edge of the site (visible in Vol 21 Plate 2.1.3Vol 21 Plate 2.1.3). There is also a Grade II listed slipway approximately 40m to the south of the site used by the Shadwell Basin Outdoor Activities Centre to access the river and foreshore.

2.1.10 The site, including the foreshore area, lies within the Wapping Wall Conservation Area.

2.1.11 There are no Tree Preservations Orders (TPOs) on the site, however as the site is in a Conservation Area, the trees on site have the same level of protection against removal.

2.1.12 Potentially contaminating activities, including refrigeration works, wharves and dust yard formerly occupied the river bank area. Local geology comprises River Terrace Deposits, London Clay, Lambeth Group and Thanet Sand with Chalk at depth.

2.1.13 The part of the proposed site located within the River Thames foreshore constitutes part of an active floodplain and is classified as Flood Zone 3b. The other terrestrial parts of the site are within the defended floodplain and are within Flood Zone 3a.

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Volume 21: King Edward Memorial Park Foreshore site assessment

Section 3: Proposed development

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3 Proposed development

3.1 Overview

3.1.1 The proposed development at King Edward Memorial Park Foreshore would intercept the existing North East Storm Relief CSO. A cofferdam area would be constructed in the foreshore in front of King Edward Memorial Park to provide a construction platform to build a CSO drop shaft. The base of the CSO drop shaft would be connected to the main tunnel. Flows from the existing North East Storm Relief Sewer would be diverted via a new interception chamber into the new drop shaft and then into the main tunnel.

3.1.2 The geographic extent of the proposals for which development consent is sought is defined by the LLAU.

3.1.3 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 include 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.

3.1.4 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 21 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 21 Table 3.2.1 below sets out documents and plans for which consent is sought and which have been assessed.

Vol 21 Table 3.2.1 King Edward Memorial Park − 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 21 King Edward Memorial Park figures – Section 1
Demolition and site clearance plan	For approval	Vol 21 King Edward Memorial Park figures – Section 1
Access plan	For approval	Vol 21 King Edward Memorial Park figures – Section 1
Proposed landscape plan - overall	Illustrative (but scale of above-ground structures is indicative)	Vol 21 King Edward Memorial Park figures – Section 1
Proposed landscape plan - foreshore	Illustrative (but scale of above-ground structures is indicative)	Vol 21 King Edward Memorial Park figures – Section 1
Design Principles: Generic	For approval	*Design Principles* report Section 3 (see Vol 1 Appendix B)
Design Principles: Site Specific principles (King Edward Memorial Park Foreshore)	For approval	*Design Principles* report Section 4.17 (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 (CoCP) Practice Part B: Site-specific Requirements (King Edward Memorial Park Foreshore)	For approval	*CoCP* Part B King Edward Memorial Park Foreshore (see Vol 1 Appendix A)

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. 24a:** King Edward Memorial Park CSO drop shaft – A shaft with an internal diameter of 20 metres and a depth (to invert level) of 60 metres

Associated development

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

a. **Work No. 24b:** King Edward Memorial Park Foreshore associated development – Works to intercept and divert flow from the North East Storm Relief Sewer CSO to the King Edward Memorial Park Foreshore drop shaft (Work No. 24a) and to the main tunnel (east) (Work No. 1d), including the following above and below ground works and structures:

   i demolition of existing park maintenance buildings and other structure

   ii dredging and construction of a cofferdam including fluvial training walls and the placement of fill material, connection to the existing river wall and construction of a campshed

   iii removal of existing CSO apron in the foreshore

   iv partial demolition of existing river wall and construction of new river wall including connection to and alteration of the existing river wall to reclaim land and to enclose Work Nos. 24a and 24b(vi),

(vii) and (viii), scour protection works, relocation of existing CSO, and new CSO outfall apron

v works to protect existing river wall to the west of Work No. 24(b)(iv)

vi construction of an interception chamber, hydraulic structures, chambers with access covers and other structures including culverts, pipes and ducts to modify, connect, control, ventilate, de-aerate, and intercept flow

vii construction of structures for air management equipment including filters and ventilation columns and associated below ground ducts and chambers

viii construction of electrical and control kiosk and local control pillar

ix construction of pits, chambers, ducts and pipes for cables, hydraulic pipelines, utility connections, utility diversions and drainage

x construction of temporary and then permanent access from Glamis Road

xi removal of the existing band stand

xii demolition of existing children's playground and construction of new playground within the park

xiii refurbishment of existing multi-sports area.

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 CSO drop shaft = 8m (with minimum 5.0m)

b. ventilation column(s) serving the interception chamber = 6.0m

c. electrical and control kiosk = 3.0m

d. local control pillar = 1.2m

3.2.9 In addition, further works are required at this site that constitutes associated development within the meaning of section 115(2) of the Act. 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 and l (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

3.2.13 The works defined by bullets b, c and d are not considered likely to be applicable to the works proposed at this site.

Design principles

3.2.14 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).

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

3.2.16 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.

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

Site features and landscaping

3.2.18 Both the electrical and control kiosk and the ventilation structures are shown at indicative scale on the Proposed site features plan (see separate volume of figures – Section 1) and the scales of these structures (in addition to the defined heights) have been considered within the assessments as appropriate. The possible locations of these above-ground structures, as well as the CSO drop shaft, are defined by the zones on the Site works parameter plan (see separate volume of figures – Section 1).

3.2.19 All other features on the Site features plan are illustrative only and have not been assessed. There are no other landscaping proposals, other than those captured by the design principles, either for approval or indicative, for this site (see *Design Principles* report Section 4.17).

Code of Construction Practice

3.2.20 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.

3.2.21 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 King Edward Memorial Park Foreshore 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. However the maximum extent of the temporary works platform within the river is shown on the Site works parameter plan (see Section 3.2 and separate volume of figures – Section 1) and is for approval.

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 EA (including Flood Defence Consents, Abstraction Licenses and Discharge Consents) and the 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 likely to be completed by 2020 (Site Year 4). The site would only become operational in 2023 when the Thames Tideway Tunnel project as a whole becomes operational.

3.3.6 Construction is anticipated to take approximately three and a half years and would involve the following main works (with some overlaps):

a. Site Year 1 – Site setup (approximately seven months)

b. Site Years 1 to 2 – CSO drop shaft construction (approximately 12 months)

c. Site Years 2 to 4 – Construction of other structures (approximately 20 months)

d. Site Year 4 – Completion of works and site restoration (approximately six months).

3.3.7 This site would operate to the standard and extended 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 drop shaft construction and secondary lining as described below.

3.3.8 Extended working hours are required at this site to allow for major concrete pours for drop shaft construction including diaphragm wall panels, base slab, roof slab and other large elements. It is assumed that extended hours would be required approximately twice a week during diaphragm walling for a total duration of approximately three months, and for once a month during other major concrete pours. The exact timing of any extended hours of working would be consulted on, and notified to the LB of Tower Hamlets. During these periods only those activities directly connected with the task would be permitted within the varied hours.

Typical construction activities

3.3.9 Vol 21 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 principal construction phases and relevant activities:

Vol 21 Table 3.3.1 King Edward Memorial Park Foreshore – construction phase plans

Plan title	Activities	Status	Location
Construction phases – phase 1	Site setup	Illustrative	Vol 21 King Edward Memorial Park Foreshore figures – Section 1
Construction phases – phase 2	CSO drop shaft construction Tunnel works	Illustrative	Vol 21 King Edward Memorial Park Foreshore figures – Section 1
Construction phases – phase 3	Secondary lining Construction of other structures	Illustrative	Vol 21 King Edward Memorial Park Foreshore figures – Section 1
Construction phases – phase 4	Completion of works and reinstatement	Illustrative	Vol 21 King Edward Memorial Park Foreshore figures – Section 1

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

3.3.11 The following construction related activities are described:

a. site setup

b. shaft construction

c. tunnel works

d. shaft secondary lining

e. construction of other structures

f. completion of works and restoration.

g. excavated materials and waste

h. access and movement.

Site setup

3.3.12 The park contains many trees, a number of which would need to be removed or pollarded for preparation of the construction access road from Glamis Road.

3.3.13 Prior to any works commencing the construction site boundary would be established and secured which would encompass the access route. The boundary would consist of close boarded hoarding panels, with a planted finish on public facing sides, to the heights specified in the *CoCP* Part B

King Edward Memorial Park Foreshore Section 4, although the eastern half of the construction access road would include open mesh fencing to enable views to be maintained from the park to the river (see Construction phase plans 1-4 in separate volume of figures – Section 1). Welfare and office facilities would also be set up.

3.3.14 Power and water supplies would be required on site, and utility diversions would be undertaken as necessary. The children's playground would be relocated in this phase to its new location in the park.

3.3.15 Due to work along the tidal Thames embankment, the Thames Path would require diversion around the eastern part of the works with a controlled crossing across the construction access, east of Glamis Road.

3.3.16 Construction lorries would take the route of minimum impact via the Transport for London Route Network (TLRN). It is envisaged that the site would be accessed via the A13, The Highway (A1203), and south along Glamis Road to the proposed site access at the southwest corner of the park. Local signing would be provided from the main road network.

3.3.17 A 7.5t weight restriction applies on Glamis Road to the south of the access to site and therefore would not affect the works. Minor works on Glamis Road are likely to include the suspension or relocation of on street parking and the removal of existing traffic calming during construction works. This area, as well as the signalised junction with the Highway, is included within the LLAU for the site.

3.3.18 New access gates would provide access from Glamis Road although this would utilise an existing entrance and dropped kerb, but both would need to be extended to permit adequate lorry movements.

3.3.19 Full pedestrian access would be retained along Glamis Road and appropriate site access signing would be provided to inform and remind pedestrians and lorry drivers of pedestrian safety.

3.3.20 The extent of demolition and site clearance works are shown on the Demolition and site clearance plan (see separate volume of figures – Section 1). It is assumed that demolition would take approximately one month. The approach to any land remediation that might be required cannot be defined at this stage. However, it is assumed that any remediation that is required (probably unlikely at this site) would occur within this earliest phase of construction and that any associated lorry movements are substantially lower than the subsequent peak during the main construction phases.

3.3.21 It has been assumed that a temporary works cofferdam would extend out from the land from the existing river wall to create a working platform during construction. The maximum extent of the temporary works in the river is defined on the Site parameter plan (see separate volume of figures – Section 1 and Section 3.2).

3.3.22 A concrete campshed would be constructed along the southern face of the temporary cofferdam for barges to sit safely on the river bed. The area of the campshed has been assumed to be approximately 1,100m^2. It is assumed that no dredging would be required at this site, although it is likely that there would be some disturbance to the riverbed during construction of the cofferdam and campshed.

3.3.23 The piles used to form the temporary cofferdam would be driven into the impermeable clays from a jack-up barge. The top level of the outer wall of the cofferdam would be set to existing flood defence level to maintain the level of defence during construction.

3.3.24 For the purpose of this assessment it is assumed that the piles would be driven using vibration piling techniques although the intention would be to seek to utilise silent piling techniques where reasonably practical.

3.3.25 It is assumed for the assessment that the majority of foreshore material within the temporary cofferdams would remain *in-situ*. For structural reasons, soft material located adjacent to the perimeter of the temporary cofferdams and adjacent to the river wall would be removed. The soft material includes silt, peat and other materials. Removal of this material would ensure that any settlement of the cofferdam fill material does not adversely affect the ties between the walls of the twin walled temporary cofferdam, which could lead to structural difficulties. All soft material within permanent cofferdams would be removed to ensure sound foundations for permanent construction.

3.3.26 The exact extent and depth of the foreshore deposits to be removed at each site would be informed by geotechnical investigations. Areas of removed material would be filled with gravel similar to the existing bed material. Cofferdam fill material would then be placed onto the foreshore on top of a geotextile layer. Suitable sized plant would be utilised to reduce potential load impacts on the foreshore. A drain sump would be maintained within the filled cofferdam to enable any water entering the cofferdam to be pumped back to river.

3.3.27 The drop shaft construction (see below) would commence once the cofferdam is in place as described.

3.3.28 The existing outfall for the NESR sewer would need to be channelled through the cofferdam and it is assumed that this would be by using a purpose built flume structure within sheet piles and that new temporary flap valves could be installed on the outer edge of the cofferdam.

3.3.29 The Cole Stairs storm relief sewer outfall, which would not be intercepted, would still need to be extended through the temporary cofferdam but would be retained in its current location in the permanent layout.

3.3.30 Monitoring of potential scour would be undertaken during the temporary construction works. The need for scour protection to the cofferdam would be identified using the approach set out in the *Scour Monitoring and Mitigation Strategy* (see Vol 3 Appendix L.4).

3.3.31 Internal site roads, plant and material storage areas would be established on the cofferdam.

Shaft construction

3.3.32 Major plant required for the drop shaft construction would include cranes, a clamshell grab, diaphragm wall rigs, bentonite silos, separation plant, water tanks, mixing pans, compressors, air receivers, excavators and dumpers.

3.3.33 The drop shaft would be constructed by diaphragm wall construction techniques. The first stage in the construction of each panel of diaphragm wall would be the excavation and forming of inner and outer guide walls. These guide walls would provide secure supports between which excavation for the diaphragm walls would be undertaken. During diaphragm wall excavation the trench would be filled with bentonite for ground support; on completion of the excavation cycle, steel bar reinforcement cages would be lowered in, before concrete is pumped into the trench in order to displace the bentonite and form a solid wall panel.

3.3.34 This process would be repeated for each diaphragm wall panel in order to create the full circle of the shaft. Diaphragm wall excavated material would be processed as required and then loaded onto a lorry for transport off-site.

3.3.35 The size of the diaphragm wall panels would require an extended working day to enable the concrete pour to be completed.

3.3.36 The diaphragm wall would be taken to a depth suitable to reduce the flow of water into the drop shaft. Grouting at the toe of the diaphragm wall and base would also be required to reduce the inflow of water. Dewatering would need to be undertaken as described below.

3.3.37 The drop shaft excavation would commence after the diaphragm walls are complete. The guide walls would be broken out, and the soil within the diaphragm walls excavated to expose the walls. The excavator within the drop shaft would load shaft skips, hoisted by crawler crane, depositing the excavated material within the handling area. Excavated material would be put into skips within the drop shaft working area and hoisted by crawler crane from the drop shaft and deposited in a suitable storage area. After any required treatment, the material would be loaded onto a barge for transport off-site. Once the excavation is complete, a steel reinforced concrete base plug would be formed at the base of the drop shaft.

3.3.38 It is anticipated that dewatering would be required. Dewatering wells would be drilled from the surface from within the drop shaft (a process known as ‘internal dewatering’) and groundwater extracted via pumps. These pumps would be operational during drop shaft excavation. For the purpose of this assessment it has been assumed that the pumps would be maintained to ease the reception of the TBM from Chambers Wharf and the re-launch of the TBM towards Abbey Mills Pumping Station. It is assumed that extracted ground water would be discharged directly into the River Thames after being treated through a settlement system. Extracted water would be sampled on a regular basis to check water quality.

3.3.39 It is anticipated that ground treatment would be required within the chalk beneath the base slab and that treated blocks would be constructed either side of the drop shaft to facilitate TBM break in / break out.

Tunnel works

3.3.40 As King Edward Memorial Park Foreshore drop shaft is online with the main tunnel, there is no connection tunnel to be constructed. A temporary cradle would be constructed to receive the main tunnel TBM from Chambers Wharf and re-launch it to Abbey Mills Pumping Station. This gives the opportunity for maintenance to be undertaken to the TBM.

3.3.41 Tunnel portals with launch and reception seals would be formed in the drop shaft lining. The portals would be formed by cast *in-situ* concrete with a sealing arrangement bolted to the drop shaft lining.

Secondary lining of shaft

3.3.42 It is assumed that the secondary lining of the drop shaft would be made of reinforced concrete placed inside the drop 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 drop shaft and sections of reinforcement installed and lining cast progressively up the shaft. Concrete would be supplied by ready mix concrete mixer trucks.

3.3.43 Any reinforced concrete structures internal to the drop shaft and the roof slab would be constructed in a similar manner progressively from the shaft bottom. In some cases precast concrete members are likely to be used.

Construction of other structures

3.3.44 An interception chamber, connection culvert and valve chamber would be constructed to intercept the NESR and connect it to the CSO drop shaft. An underground storm overflow chamber would be constructed to allow the NESR to overflow to the River Thames after periods of exceptionally high rainfall when the main tunnel is full. In addition, air management structures comprising an underground chamber, ventilation column and underground louvre chambers for ventilation control and an electrical and control kiosk would be constructed on the site.

3.3.45 Sheet pile walls would be used to provide support within which the underground chambers would be constructed. Walls would be constructed to a depth to minimise ground water ingress into the excavation, but small pumps would be utilised to manage any ground water that does seep through. The pumps would discharge to the River Thames after being treated through a settlement system.

3.3.46 Secant or sheet piled walls would be used to support the toe of the existing river wall. It is also anticipated that some grouting would be required to the toe of the existing river wall prior to the excavation beneath this level for the interception chamber works.

3.3.47 The walls, bases and roofs of the chambers and shallow foundations for above-ground structures would be formed by *in-situ* concrete techniques. It has been assumed that onsite batched concrete would be pumped or skipped to the chamber. The piled walls would be extended to the drop shaft to allow the connecting culvert to be constructed in a similar manner to the chambers.

3.3.48 It is assumed that bored reinforced concrete piles would be used to support the underground chambers. The diameter, depth and spacing would depend on the structure design and ground conditions.

3.3.49 For the above-ground structures, including the kiosk and ventilation column, the components would be delivered by road and assembled on-site using suitable lifting equipment.

3.3.50 The new river wall would be built within the temporary cofferdam. It is assumed that the new river wall would be constructed as a piled wall which incorporates both driven tubular and steel sheet piles and a reinforced concrete structure.

Completion of works and site restoration

3.3.51 On completion of the construction (outlined above), the final treatments of the new river wall would be completed prior to removal of the temporary cofferdam.

3.3.52 Once the cofferdam fill is removed, the geotextile separating layer would be removed and the area of the foreshore where permanent scour protection is required would be excavated by approximately 1.5m by an excavator. For areas that are below low water or outside the temporary cofferdam, it is assumed that the material would be removed by a long reach excavator or grab working either from the cofferdam or from a barge. The stone would be placed in the same manner.

3.3.53 It is assumed for the assessment that permanent scour protection and new outfall apron would consist of loose large stone placed just below foreshore level. The size and type of the stone is to be defined. It is assumed therefore that a 1m depth of stone would be placed up to 0.5m below the existing foreshore level within the zone indicated on the Site works parameter plan (see separate volume of figures – Section 1).

3.3.54 Once the permanent scour protection is in place, the bed would be reinstated to match the existing river bed conditions as required and the sheet piling forming the temporary cofferdam would then be removed by pulling.

3.3.55 Once the main elements of construction are completed, the final landscaping works would be undertaken including final treatments and surfaces, planting and installation of street furniture.

Excavated materials and waste

3.3.56 The construction activities described above and in particular the construction of the drop shaft would generate a large volume of excavated material which would require removal. This is estimated at 130,000 tonnes, the main elements of which would comprise approximately 61, 000 tonnes of imported fill (which would require later removal), 17,000 tonnes of mixed materials from the diaphragm wall construction, 18,000 tonnes of Lambeth group, 10,000 tonnes of Thanet sands and 21,000 tonnes of chalk.

3.3.57 In addition, it is estimated that approximately 3,400 tonnes of construction waste would be generated including 1,900 tonnes of imported fill and 1,200 tonnes of concrete.

3.3.58 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

3.3.59 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 'barge'.

3.3.60 The *Transport Strategy* requires that the importation of granular fill for the formation of the temporary working area and the subsequent removal of the fill would be by barge. The removal of all drop shaft excavations and 'other' excavated material would also be by barge. The assessment assumes that 90% of these materials are taken by river, with the residual 10% transported by road, to account for periods where river transport is not available or the material is unsuitable for transport by barge.

3.3.61 The highest barge movements would occur during removal of the temporary cofferdam. 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 210, equivalent to 420 barge movements over the construction period. Barge numbers are based upon an assessed barge capacity of 1000t. It is estimated that tugs would be present at this site for approximately 20 minutes during these barge movements.

3.3.62 The highest lorry movements at the site would occur during drop shaft construction. The peak daily vehicle numbers at this time, averaged over a one month period, would be 41 HGV lorries, equivalent to 82 movements per day. It is estimated that total vehicle numbers for this site would be in the order of 10,750 HGV lorries, equivalent to 21,500 movements over the construction period.

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

3.3.64 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 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.

3.4.4 Once operational the project would divert the majority of current NESR CSO discharges via the new CSO drop shaft to the main tunnel and then via the Lee Tunnel for treatment at Beckton Sewage Treatment Works. The number of discharges from the NESR CSO would be reduced by 27 spill events to approximately 4 per typical year with an average volume of discharge of 85,000m^3 per year.

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 the proposed schedule of work description in 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 heights of the main ventilation columns, the electrical and control kiosk, and the local control pillar are defined and also 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 and other 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 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 drop shaft are described in Section 3.2. Ground level access covers on the drop shaft would be used for access/egress by maintenance vehicles and personnel during planned inspections of the drop shaft and main tunnel. The access covers to the drop shaft which are only used for the ten yearly inspections (see below) would generally be buried under surface landscape treatments and would not be visible.

Chambers and culverts

3.4.11 The chambers and related culverts are defined in Section 3.2. The interception chamber, valve chamber, connection culvert, and storm overflow chamber to the River Thames would be below finished ground level. There would be covers on top of the chambers at ground level to allow access for inspection although those access covers which are only used for infrequent access (see below) would generally be buried under surface landscape treatments and would not be visible. All of these elements would be situated within the new foreshore structure.

River wall

3.4.12 The location of the new river wall is defined in Section 3.2. It would be constructed along the front of the new foreshore structures, built to the flood defence level and tied in with existing flood defences at both ends.

Air management structures

3.4.13 The heights and locations of above-ground air management structures, which comprise the ventilation columns, are defined in Section 3.2. In addition to these structures, two ground level ventilation grills would allow air movement within the valve, interception and outfall chambers.

3.4.14 The underground air treatment chamber would contain filters and would be connected to the ventilation columns. The air treatment chamber would have ground level covers to allow access and inspection.

Electrical and control kiosk

3.4.15 The height and location of the above-ground electrical and control kiosk and a small local control pillar are defined in Section 3.2. The electrical and control kiosk would contain gas monitors, electrical and control panels and metering equipment.

Permanent restoration and landscaping

3.4.16 The Proposed site features plan is presented in a see separate volume of figures (Section 1). The final design on the landscape and restoration proposals would be subject to both the generic and site-specific design principles (see Section 3.2).

3.4.17 The new section of river wall and approximately 0.2ha of reclaimed foreshore which is required to enclose the underground operational structures, including the CSO drop shaft, would be publically accessible and become part of the park.

3.4.18 The area around the drop shaft and chambers would be paved to provide operational access for cranes and maintenance vehicles to the structures. This hardstanding would be publicly accessible but Thames Water would retain a right of access over it and would install temporary security fencing when the area is required for maintenance.

3.4.19 Vehicular access to the operational site would be along the same route as during construction, ie, from The Highway and along Glamis Road. A new access route from Glamis Road across the southern edge of the park would be maintained to allow both cranes and light commercial vehicles to access the CSO drop shaft, interception chamber and associated infrastructure. This permanent access route would be fully integrated with the landscaping proposals for the park, namely as part of a new area of well designed public realm and with the existing Thames Path. It would be publicly accessible for pedestrians and cyclists while the park is open. The entrance at Glamis Road would be gated to allow the park to be secured when it is closed.

3.4.20 It is assumed that the children's playground would be relocated prior to the main construction commencing and would be further extended at the end of the construction phase.

Typical maintenance regime

3.4.21 A light commercial vehicle would require access, to allow maintenance works to be undertaken every three to six months. 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 also 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 21 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 King Edward Memorial Park Foreshore are listed below. A map showing their location is included in Vol 21 Figure 3.5.1 (see separate volume of figures).

a. John Bell House, King David Lane

b. Former land bounded by Schoolhouse Lane, Cable Street and Glasshouse Fields On-site alternatives.

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 21 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 21 Table 3.6.1 King Edward Memorial Park Foreshore – on-site alternatives

Item	Alternatives considered	Main reasons that the alternative (given left) was not progressed
Vehicular access	Access directly from the Highway, west of free trade Wharf	• Considered less safe than proposed route. • Proposed route avoids wild flower meadow and vehicle movements past free trade Wharf. • TfL and LBTH preference for proposed route.
Size of temporary works in foreshore	Much larger temporary works in foreshore (but with less works in the west of the park)	• Would create more damage to foreshore habitats, more scour and create high navigation risks. • Using hard standing areas in the west of the park provides opportunity to improve those facilities. • PLA and EA preference for smaller worksite in the river.

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.21**

Volume 21: King Edward Memorial Park Foreshore 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 21: King Edward Memorial Park 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 King Edward Memorial Park Foreshore site. 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. emissions from tugs pulling river barges (air quality)

c. emissions from construction plant (air quality)

d. construction-generated dust (air quality)

e. 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 King Edward Memorial Park Foreshore 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 likely 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 Vol 2 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 21 King Edward Memorial Park Foreshore figures). Appendices supporting this site assessment are contained in Vol 21 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 monthly number of lorry movements in any one year at the King Edward Memorial Park Foreshore site would occur during the shaft construction (Site Year 1 of construction). The average daily number of vehicle movements during the peak month would be approximately 82 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 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 in any one year is Site Year 1 of construction when there would be four barge movements a day averaged over a one month period. The emissions associated with the tugs pulling the barges are presented in Vol 21 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 King Edward Memorial Park Foreshore site in the peak construction year and associated emissions data are presented in Vol 21 Appendix B.4.

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

Construction dust

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

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 King Edward Memorial Park Foreshore site there would be approximately 640m^3 of demolition material generated while the amount of amount of material moved during the earthworks would be approximately 130,000 tonnes. The volume of building material used during construction would be approximately 25,000m^3.

Code of Construction Practice

4.2.13 Appropriate dust and emission control measures are included in the *Code of Construction Practice (CoCP)*[ii] *Part A* (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 King Edward Memorial Park Foreshore site.

4.2.14 The *CoCP* Part B (Section 7) contains some site-specific measures for the King Edward Memorial Park Foreshore site. These are:

a. 12 months PM_{10} monitoring shall be undertaken prior to the works commencing. Real-time monitoring shall be utilised for the duration of the works

b. in the event of potentially contaminated soil being found onsite, chemical composition analysis will be undertaken in agreement with LB of Tower Hamlets.

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

Operation

4.2.16 A ventilation structure would treat air released from the tunnel. The air would be treated by passing air through two carbon filters housed in a below ground air treatment chamber. Natural pressure during tunnel filling

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[ii] 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).

would allow air to pass passively without the need for fans. The capacity of each passive filter would be 2m^3/s. The maximum air release rate through each filter during a typical year is expected to be 1.4m^3/s; therefore all air in a typical year would be treated through the passive filter. No nuisance odours are therefore expected.

4.2.17 Air would be released from the ventilation columns for about 50 hours in a typical year, all of which would have passed through the passive filter. For the remaining hours, no air would be released, although air intake would occur as the tunnel is emptied.

Environmental design measures

4.2.18 A carbon filter would be included as part of the ventilation structure design and construction. The passive filter would remove odours by adsorption onto the filter. 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 21 Table 4.3.1).

Vol 21 Table 4.3.1 Air quality and odour – stakeholder engagement

Organisation	Comment	Response
LB of Tower Hamlets, Position Paper, January 2011	Odour - potential down-drafting must be accounted for and reported on.	Building downwash has been taken into account in the odour modelling.
LB of Tower Hamlets, July 2011	Agree monitoring locations with LB of Tower Hamlets	Locations agreed with LB of Tower Hamlets Air Quality Officer.
LB of Tower Hamlets, July 2011	Odour complaints in the area should be considered.	No odour complaints have been registered in the vicinity of the King Edward Memorial Park Foreshore site in the last five years.
LB of Tower Hamlets, Position Paper, January 2011	Apart from looking at odour complaints for baseline data, baseline odour monitoring (possibly in the form of grab sampling) should be undertaken in the vicinity of the shafts in Tower Hamlets.	Baseline H_2S monitoring has been undertaken in the vicinity of the King Edward Memorial Park Foreshore site between August 2011 and October 2012.
LB of Tower Hamlets, Phase two	The whole borough of Tower Hamlets has been declared an Air Quality Management Area in terms	This has been noted in the baseline assessment. A full, detailed air quality

Organisation	Comment	Response
consultation, February 2012	of both nitrogen dioxide (NO_2) and Particulate Matter (PM_{10}). Therefore, the additional emissions from the construction vehicles will be a concern.	assessment using dispersion modelling has been undertaken to predict the effects of construction works in the vicinity of the King Edward Memorial Park Foreshore site.
LB of Tower Hamlets, Phase two consultation, February 2012	The content of the odour assessment for both sites is absent. The Council considers that .. the KEMP Foreshore option …. has the potential to have odour impacts during the operation of the tunnel, however, the difference (if any) between such impacts does not appear to have been quantified or qualified.	An odour assessment has been undertaken using dispersion modelling which has quantified the odour effects of the King Edward Memorial Park Foreshore site during operation of the Thames Tideway Tunnel.

Baseline

4.3.2 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

4.3.3 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.

4.3.4 Section 4.5 details the likely significant effects arising from the construction at the King Edward Memorial Park Foreshore site. There are no other Thames Tideway Tunnel project sites which could elevate construction dust nuisance effects within the assessment area (see para. 4.3.5 below). 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 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

4.3.5 The assessment area for the local air quality assessment during construction covers an area 800m by 600m centred on the King Edward Memorial Park Foreshore 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 King Edward Memorial Park Foreshore site are fully assessed. A distance of 200m is generally considered sufficient (Highways Agency, 2007)[2] to ensure that any significant effects are considered. The selected assessment area exceeds this considerably.

Construction assessment year

4.3.6 The peak construction year in terms of construction traffic movements (Site Year 1 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 the Thames Tideway Tunnel project) has been assessed against the base case (without the Thames Tideway Tunnel project) to identify likely significant effects of the Thames Tideway Tunnel project.

4.3.7 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

4.3.8 As indicated in the site development schedule (see Vol 21 Appendix N), there are two other new developments (John Bell House and a residential development on land bounded by School House Lane, Cable Street and Glasshouse Fields) identified within the assessment area for the King Edward Memorial Park Foreshore site, both of which are relevant to the air quality assessment, being sensitive properties that could be affected by construction activities. These developments are therefore considered as receptors in the air quality assessment. Trips associated with both of these developments are taken into account in the traffic data used for the air quality assessment.

4.3.9 Of the two developments identified, neither would be under construction at the same time as construction works at the King Edward Memorial Park Foreshore site. They are therefore not considered in the cumulative construction assessment.

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 King Edward Memorial Park Foreshore 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 500m by 450m centred on the King Edward Memorial Park Foreshore 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 As indicated in the site development schedule (see Vol 21 Appendix N), there are two other new developments (John Bell House and a residential development on land bounded by School House Lane, Cable Street and Glasshouse Fields) identified within the assessment area for the King Edward Memorial Park site, both of which are relevant to the odour assessment, being sensitive properties that could be affected in the operational phase. These developments are therefore considered as receptors in the odour assessment. Due to the nature of the developments, there are no cumulative operational odour effects to assess.

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 input are set out in Vol 21 Appendix B.1.

4.3.17 The site is close to the ventilation shaft for the Rotherhithe Tunnel. Emissions from this shaft have been included in the modelling. The emissions released within the Rotherhithe Tunnel Air Shaft were calculated based on the traffic flow, traffic speed, vehicle fleet composition data and tunnel length using the same emission factors as discussed in Vol 2 Section 4. The emission rates calculated were: 0.075g/s for NO_X and 0.004g/s for PM_{10} in 2010; and 0.040g/s for NO_X and 0.003g/s for PM_{10} in the base and development cases. The emissions released from the Rotherhithe Tunnel Air Shaft were assumed to be one quarter of those released within the tunnel (with the remainder released from the other shaft and the two portals) and were assumed to be released with an exit velocity of 2m/s.

Operation

4.3.18 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 - 4.2.17.

4.3.19 Odour dispersion modelling only includes emissions from the ventilation structures 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 specific complaints in the surrounding area over recent years (see para. 4.4.14) and seasonal spot measurements of hydrogen sulphide (H_2S) carried out in 2011/12 indicate that concentrations are typical of urban areas(Michigan Environmental Science Board, 2000)[3].

4.3.20 Following dispersion modelling, the maximum concentration predicted at any location was reported whether this was at a building where people could be exposed, or on open land. As a worst case assumption, it was assumed that this is a relevant receptor. This means that should the ventilation structure be moved within the identified parameter plan (see Site parameter plan, separate volume of figures – Section 1), the impact would not be worse than that reported in Section 4.6.

Limitations

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

Construction

4.3.22 There are no roadside PM_{10} monitoring sites located within the vicinity of the King Edward Memorial Park Foreshore site and so it has not been possible to verify PM_{10} modelling results. 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

4.3.23 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. 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.

4.4.3 There is no continuous NO_2 or PM_{10} monitoring undertaken in the vicinity of the site. The closest continuous monitoring site (Poplar (TH1)) is an urban background site measuring both pollutants which is located 1.8km from the site.

4.4.4 Five sites from the LB of Tower Hamlets NO_2 diffusion tube survey collect data pertinent to the King Edward Memorial Park site and associated construction traffic routes. The location of these is shown in Vol 21 Figure 4.4.1 (see separate volume of figures). Monitoring data for these sites for the period 2007-2011 are contained in Vol 21 Table 4.4.1 (NO_2 concentrations) and Vol 21 Table 4.4.2 (PM_{10} concentrations). The 2011 monitoring data for the Poplar monitoring site (TH1) are not yet fully ratified.

Vol 21 Table 4.4.1 Air quality – measured NO_2 concentrations

Monitoring site	Site type	Annual mean (µg/m^3)					Number of exceedances of hourly standard				
		2011	2010	2009	2008	2007	2011	2010	2009	2008	2007
Continuous monitoring site											
Poplar (TH1)	Urban background	34*	37**	36	38	37	0	NM	0	0	8
Diffusion tube monitoring sites											
Narrow Street (TH35)	Roadside	NM	**150**	**168**	**144**	**163**	NM				
Brodlove Lane (TH23)	Roadside	NM	**49**	**64**	**49**	**60**	NM				
Pitsea Street (TH34)	Roadside	NM	NM	NM	**52**	**60**	NM				
Wapping Wall (TH22)	Roadside	NM	**42**	**51**	**41**	**49**	NM				
Dellow Street (TH20)	Roadside	NM	**70**	**98**	**78**	**81**	NM				

*Note: NM indicates not measured. * Data capture 80%. ** Data capture 66%. Emboldened figures indicate an exceedance of the objective / limit value which is 40µg/m^3 for the annual mean. Codes in brackets represent monitoring site identifiers used in Vol 21 Figure 4.4.1 (see separate volume of figures).*

Vol 21 Table 4.4.2 Air quality – measured PM_{10} concentrations

Monitoring Site	Site Type	Annual Mean (µg/m^3)					Number of exceedances of daily standard				
		2011	2010	2009	2008	2007	2011	2010	2009	2008	2007
Poplar (TH1)	Urban background	23	22	22	23	23	18	6	7	15	19

Note: Codes in brackets represent monitoring site identifiers used in Vol 21 Figure 4.4.1 (see separate volume of figures).

4.4.5 The monitoring data at the roadside sites show that the annual mean NO_2 objective / limit value (40µg/m^3) has been exceeded for all sites over the last five years. No exceedances of the annual mean or hourly objectives were measured at the urban background site at Poplar over the last five years.

4.4.6 The PM_{10} monitoring indicates that the annual mean objective / limit value (40µg/m^3) or the daily objective / limit value (more than 35 exceedances of the daily standard) was not exceeded at the urban background site in any of the years.

4.4.7 As a result of previous exceedances of air quality objectives, the LB of Tower Hamlets has declared the whole Borough an AQMA for both NO_2 and PM_{10}.

4.4.8 In addition to the local authority monitoring, diffusion tube monitoring has been undertaken as part of the environmental impact assessment (EIA) to monitor NO_2 concentrations in the vicinity of the King Edward Memorial Park Foreshore site. This monitoring comprises six diffusion tubes based at the locations identified in Vol 21 Table 4.4.3. 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 (KEMM2); otherwise all the monitoring locations have single tubes.

Vol 21 Table 4.4.3 Air quality – additional monitoring locations

Monitoring site	Grid reference	Site type	2010 NO_2 annual mean (µg/m^3)
A1203 The Highway (KEMM1)	535403, 180774	Roadside	**90.9**
A1203 The Highway (KEMM2)	535638, 180797	Kerbside	**105.6**
A1203 The Highway/Butcher Row (KEMM3)	535956, 180870	Roadside	**120.9**
A126 Butcher Row (KEMM4)	535957, 181018	Kerbside	**83.5**

Monitoring site	Grid reference	Site type	2010 NO_2 annual mean ($\mu g/m^3$)
A13 Commercial Road (KEMM5)	535923, 181158	Kerbside	**96.0**
A13 Commercial Road/Yorkshire Road (KEMM6)	536109, 181123	Roadside	**91.1**

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

4.4.9 All six sites recorded concentrations above the NO_2 annual mean standard of $40\mu g/m^3$. 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 Tower Hamlets monitoring to define the baseline situation and also to provide input to model verification[iii].

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 to 2020. The background data relating to the King Edward Memorial Park Foreshore site are given in Vol 21 Table 4.4.4 for 2010 (baseline year).

Vol 21 Table 4.4.4 Air quality – 2010 background pollutant concentrations

Pollutant*	2010
NO_2 ($\mu g/m^3$)	50.6
PM_{10} ($\mu g/m^3$)	22.8

** Annual mean for 1km grid square centred on 535500, 180500.*

Odour

4.4.12 The LB of Tower Hamlets received seven odour complaints for the whole Borough over the last five years for non-industrial, non-domestic sources (LB of Tower Hamlets, 2012)[6]. The Thames Water complaints database was reviewed for an area within a 500m radius of the zones identified for

[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.

the proposed ventilation columns over the last five years and no complaints were identified.

4.4.13 Data gathering for the project included spot measurements of H_2S made near the site, the results of which are summarised in Vol 21 Table 4.4.5 and the monitoring locations shown in Vol 21 Figure 4.4.2 (see separate volume of figures). The highest concentrations, up to 31.5µg/m^3, were measured on 28 February 2012 during easterly wind conditions. These levels are typical of urban areas when a faint odour may be detectable on occasions (WHO, 2000)[7] [iv].

Vol 21 Table 4.4.5 Odour – measured H_2S concentrations

Location	Grid reference	Date	Time	H_2S concentration (µg/m^3)
North of bowling green (KEMS1)	535469, 180766	30/10/11	08:07:40	0.0
		30/10/11	08:08:12	4.6
		26/02/12	06:42:03	6.4
		26/02/12	06:42:34	4.4
North corner of playground (KEMS2)	535627, 180786	30/10/11	08:03:50	0.0
		30/10/11	08:04:21	0.0
		26/02/12	06:38:47	5.9
		26/02/12	06:39:22	6.4
South corner of playground (KEMS3)	535636, 180712	06/10/11	09:58:23	6.9
		06/10/11	10:00:02	5.3
		30/10/11	07:59:34	4.5
		30/10/11	08:00:07	4.4
		22/02/12	08:08:08	7.3
		22/02/12	08:09:16	7.3
		26/02/12	06:35:43	5.0
		26/02/12	06:36:18	4.3
		28/02/12	15:10:27	7.2
		28/02/12	15:11:29	6.7
		18/05/12	18:16:32	7.2
		18/05/12	18:17:39	6.8

[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 ($\mu g/m^3$)
Near Shadwell Dock stairs (KEMS4)	535533, 180633	06/10/11	09:52:24	5.5
		06/10/11	09:54:02	4.9
		30/10/11	07:54:53	0.0
		30/10/11	07:55:22	0.0
		22/02/12	08:05:27	10.8
		22/02/12	08:06:31	7.8
		26/02/12	06:32:57	6.5
		26/02/12	06:33:29	4.9
		28/02/12	15:07:22	31.5
		28/02/12	15:08:58	8.4
		18/05/12	18:13:38	8.2
		18/05/12	18:14:53	7.8
Meteorological conditions: 06/10/11 SW wind up to 3.4m/s, partially cloudy. 30/10/11 S/W wind at 0.5m/s, cloudy, last rain 27/10/11. 22/02/12 E wind up to 3.5m/s, cloudy. 26/02/12 Last rain was light, occasional light breeze from SW. 28/02/12 W wind, average speed 0.7m/s, sunny. 18/05/12 W wind, average speed 2.5m/s, cloudy.				

Receptors

4.4.14 As set out in Vol 2 Section 4, the air quality assessment involves the selection of appropriate receptors, which are shown in Vol 21 Figure 4.4.3 (see separate volume of figures) and the table below (Vol 21 Table 4.4.6) for the King Edward Memorial Park Foreshore 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.

4.4.15 It is noted that Vol 21 Table 4.4.6 includes receptors associated with John Bell House and a residential development on land bounded by School House Lane, Cable Street and Glasshouse Fields (see site development schedule in Vol 21 Appendix N) for consideration in the air quality and odour assessments.

Vol 21 Table 4.4.6 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, river tugs for barges and construction plant)	Construction dust (on-site demolition and construction processes)	Odour (ventilation column)
Residential - Shadwell Pierhead (KEMR4)	4m south	High (exposure relevant to annual mean, daily mean and hourly mean standards)	Medium	High
Residential - Free Trade Wharf (KEMR10)	6m northeast	High (exposure relevant to annual mean, daily mean and hourly mean standards)	Medium	High
Residential - John Bell House (KEMR1)*	150m northwest	High (exposure relevant to annual mean, daily mean and hourly mean standards)	Medium	High
Residential - Land off Schoolhouse Lane, Cable Street and Glasshouse Fields (KEMR12)*	300m northeast	High (exposure relevant to annual mean, daily mean and hourly mean standards)	Medium	High
Educational - Pier Head Preparatory (Montessori) School / Shadwell Basin Outdoor Activity Centre building (KEMR6)	4m south	High (exposure relevant to annual mean, daily mean and hourly mean standards)	Medium	Medium
Educational - Pier Head Preparatory (Montessori) School / Shadwell Basin Outdoor Activity Centre playground (KEMR5)	22m south	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, river tugs for barges and construction plant)	Construction dust (on-site demolition and construction processes)	Odour (ventilation column)
Place of Worship - St Paul's Church (KEMR2)	75m northwest.	Medium (exposure relevant to daily mean and hourly mean standards)	Medium	Medium
Public House - Prospect of Whitby PH (KEMR3)	145m southwest	Medium (exposure relevant to hourly mean standard)	Medium	High
Recreational - Tennis Courts (KEMR7)	Adjacent	Low (exposure is relevant for the hourly mean standard only).	Medium	Medium
Recreational - Thames Path (KEMR8)	Adjacent	Low (exposure is relevant for the hourly mean standard only)	Low	Low
Recreational - King Edward Memorial Park (KEMR9)	Adjacent	Low (exposure is relevant for the hourly mean standard only)	Medium	Medium
Recreational – River Thames (KEMR13)	Adjacent	Low (exposure is relevant for the hourly mean standard only)	Low	Low
Commercial – The Shadwell Centre (KEMR11)	118m north	Low (exposure is relevant for the hourly mean standard only).	Medium	Medium

** Denotes receptor that is altered or constructed after the baseline year.*

Construction base case

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

4.4.17 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 1 of construction. Euro standards define the acceptable exhaust emission limits for new vehicles sold in the European Union (EU). These standards are defined through a series of EU 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.

4.4.18 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, 2009)[9].

4.4.19 Background pollutant concentrations for Site Year 1 of construction (peak construction year) used in the modelling are shown in Vol 21 Table 4.4.7. The background NO_2 and PM_{10} concentrations have been taken from the Defra mapped background data5.

Vol 21 Table 4.4.7 Air quality – annual mean background pollutant concentrations

Pollutant	Baseline (2010)	Peak construction year (Site Year 1 of construction)
NO_2 ($\mu g/m^3$)*	38.2	30.1
PM_{10} ($\mu g/m^3$)*	22.4	20.6

** Annual mean for 1km grid square centred on 537500, 177500, adjusted to ensure local A roads are not double counted.*

4.4.20 As indicated in Section 4.3, the base case in Site Year 1 of construction takes into account John Bell House and a residential development on land bounded by School House Lane, Cable Street and Glasshouse Fields. These are included in the receptor list provided in Vol 21 Table 4.4.6.

Operational base case

4.4.21 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.

4.4.22 As indicated in Section 4.3, the base case for the odour assessment takes into account John Bell House and a residential development on land bounded by School House Lane, Cable Street and Glasshouse Fields, including them as receptor locations in the odour assessment. These are included in the receptor list provided in Vol 21 Table 4.4.6.

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 1 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 21 Table 4.4.6).

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 King Edward Memorial Park Foreshore site in line with the Defra guidance LAQM.TG(09)9. This checks the model performance against measured concentrations, using the six monitoring sites established for this assessment and three local authority sites (KEMM1 – KEMM6, TH20, TH23 and TH35 – see Vol 21 Table 4.4.1 and Vol 21 Table 4.4.3). Further details regarding the verification process are included in Vol 21 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 King Edward Memorial Park Foreshore site are also detailed in Vol 21 Appendix 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 21 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, with the receptors divided into two groups depending on 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 criteria are inferred from the annual mean concentration. Additionally, contour plots are provided (Vol 21 Figure 4.5.1 to Vol 21 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 21 Figure 4.5.4 (see separate volume of figures).

4.5.6 The modelled concentrations in Vol 21 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 but four modelled receptors due to the construction works at the King Edward Memorial Park Foreshore site.

4.5.7 Exceedances of the annual mean criterion (40µg/m^3) are predicted for all receptors in all scenarios, except at the Prospect of Whitby public house (KEMR3). In line with LAQM.TG(09)9, exceedances of the hourly NO_2 objective / limit value are expected at the John Bell House (KEMR1), Free Trade Wharf (KEMR10), Shadwell Centre (KEMR11), Land off Schoolhouse Lane, Cable Street, Glasshouse Fields (KEMR12), St Paul's Church (KEMR2) and King Edward Memorial Park (KEMR9) receptors in the baseline scenario, and at the St Paul's Church (KEMR2) and Shadwell Centre (KEMR11) receptors in the base and development case scenarios, as modelled concentrations are above 60µg/m^3.

Vol 21 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					
Shadwell Pierhead residential (KEMR4)	**55.1**	**44.2**	**44.3**	0.1	Negligible
Free Trade Wharf residential (KEMR10)	**62.5**	**51.6**	**52.2**	0.6	Small
John Bell House residential (KEMR1)*	**61.5**	**50.0**	**50.0**	0.0	Negligible

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		
Land off Schoolhouse Lane, Cable Street and Glasshouse Fields residential (KEMR12)*	**60.3**	**49.5**	**49.6**	0.1	Negligible
Pier Head Preparatory (Montessori) School / Shadwell Basin Outdoor Activity Centre building (KEMR6)	**52.6**	**42.1**	**42.5**	0.4	Small
Receptors where the annual mean objective / limit value does not apply					
Pier Head Preparatory (Montessori) School / Shadwell Basin Outdoor Activity Centre playground (KEMR5)	**52.8**	**42.3**	**42.6**	0.3	Negligible
St Paul's Church (KEMR2)	**75.1**	**63.0**	**63.0**	0.0	Negligible
Prospect of Whitby Public House (KEMR3)	**48.4**	38.5	38.6	0.1	Negligible
Tennis Courts (KEMR7)	**55.8**	**45.0**	**45.3**	0.3	Negligible
Thames Path (KEMR8)	**58.7**	**47.6**	**48.2**	0.6	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		
King Edward Memorial Park (KEMR9)	**61.1**	**49.9**	**50.8**	0.8	Small
River Thames (KEMR13)	**50.8**	**40.6**	**42.6**	2.0	Small
The Shadwell Centre (KEMR11)	**79.1**	**68.0**	**68.1**	0.1	Negligible

*Notes: Emboldened figures indicate an exceedance of the criteria which is 40µg/m^3 for the annual mean. * Denotes receptor that is altered or constructed after the baseline year. Changes 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 at the King Edward Memorial Park Foreshore site is 2.0µg/m^3 which is predicted at the receptor on the River Thames (KEMR13). However, the annual mean objective / limit value (40µg/m^3) does not apply here. The largest increase at a receptor of relevant exposure to the annual mean concentration is 0.6µg/m^3 at Free Trade Wharf (KEMR10). This increase is described as small magnitude according to the criteria detailed in Vol 2 Section 4.

4.5.9 The significance of the effect at residential properties in Free Trade Wharf (KEMR10) and Pier Head Preparatory (Montessori) School / Shadwell Basin Outdoor Activity Centre building (KEMR6), which have a high sensitivity to local air quality, is **minor adverse** (according to the criteria detailed in Vol 2 Section 4). The significance of the effects at all other receptors would be **negligible**.

PM_{10} concentrations

4.5.10 Predicted annual mean PM_{10} concentrations for the modelled scenarios are shown in Vol 21 Table 4.5.2. This table details the forecast PM_{10} concentrations at specific sensitive receptors. Additionally, contour plots are provided (Vol 21 Figure 4.5.5 to Vol 21 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 21 Figure 4.5.8 (separate volume of figures).

4.5.11 The modelled concentrations in Vol 21 Table 4.5.2 show that annual mean concentrations of PM_{10} are predicted to achieve the annual mean criteria (40µg/m^3) and 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 predicted results for the development case show increases over the base case at six modelled receptors due to construction activities at the King Edward Memorial Park Foreshore site.

Vol 21 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					
Shadwell Pierhead residential (KEMR4)	25.1	22.8	22.9	0.0	Negligible
Free Trade Wharf residential (KEMR10)	26.5	23.9	24.0	0.1	Negligible
John Bell House residential (KEMR1)*	26.6	24.2	24.2	0.0	Negligible
Land off Schoolhouse Lane, Cable Street and Glasshouse Fields residential (KEMR12)*	26.1	23.6	23.6	0.0	Negligible
Pier Head Preparatory (Montessori) School / Shadwell Basin Outdoor Activity Centre building (KEMR6)	24.6	22.4	22.5	0.1	Negligible
Receptors where the annual mean objective / limit value does not apply					

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		
Pier Head Preparatory (Montessori) School / Shadwell Basin Outdoor Activity Centre playground (KEMR5)	24.7	22.5	22.5	0.1	Negligible
St Paul's Church (KEMR2)	29.5	26.6	26.6	0.0	Negligible
Prospect of Whitby Public House (KEMR3)	24.0	21.9	21.9	0.0	Negligible
Tennis Courts (KEMR7)	25.2	22.9	22.9	0.0	Negligible
Thames Path (KEMR8)	25.7	23.3	23.4	0.1	Negligible
King Edward Memorial Park (KEMR9)	26.2	23.6	23.8	0.1	Negligible
River Thames (KEMR13)	24.4	22.2	22.6	0.4	Small
The Shadwell Centre (KEMR11)	30.1	26.6	26.7	0.0	Negligible

** Denotes receptor that is altered or constructed after the baseline year. Changes at each receptor have been rounded to one decimal place.*

4.5.12 The largest predicted increase in the annual mean concentration as a result of construction at the King Edward Memorial Park Foreshore site is 0.4µg/m^3, predicted at a receptor on the River Thames (KEMR13). The largest increase at a receptor of relevant exposure to the annual mean concentration is 0.1µg/m^3 at Free Trade Wharf (KEMR10) and Pier Head Preparatory (Montessori) School / Shadwell Basin Outdoor Activity Centre building (KEMR6). These changes are described as negligible according to the criteria detailed in Vol 2 Section 4.

4.5.13 With no exceedances of the annual mean PM_{10} standard (40µg/m^3), the significance of the effects is **negligible** at all receptors.

4.5.14 With regard to the daily mean PM_{10} concentrations, Vol 21 Table 4.5.3 shows the predicted number exceedances of the daily PM_{10} standard (50µg/m^3) for each modelled scenario. The objective / limit value allows no more than 35 exceedances in a year.

4.5.15 The results in Vol 21 Table 4.5.3 show that the number of daily exceedances of PM_{10} is 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 predicted results for the development case show an increase in the number of days per year with concentrations above 50µg/m^3 at only one receptor compared with the base case due to construction works at the King Edward Memorial Park Foreshore site.

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

Vol 21 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 objective / limit value does apply					
Shadwell Pierhead residential (KEMR4)	13	8	8	0	Negligible
Free Trade Wharf residential (KEMR10)	16	10	10	0	Negligible
John Bell House residential (KEMR1)*	16	11	11	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		
Land off Schoolhouse Lane, Cable Street and Glasshouse Fields residential (KEMR12)*	15	9	9	0	Negligible
Pier Head Preparatory (Montessori) School / Shadwell Basin Outdoor Activity Centre building (KEMR6)	12	7	7	0	Negligible
St Paul's Church (KEMR2)	26	16	17	0	Negligible
Receptors where the objective / limit value does not apply					
Pier Head Preparatory (Montessori) School / Shadwell Basin Outdoor Activity Centre playground (KEMR5)	12	7	7	0	Negligible
Prospect of Whitby PH (KEMR3)	10	6	6	0	Negligible
Tennis Courts (KEMR7)	13	8	8	0	Negligible
Thames Path (KEMR8)	14	9	9	0	Negligible
King Edward Memorial Park (KEMR9)	15	9	10	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		
River Thames (KEMR13)	11	7	7	1	Small
The Shadwell Centre (KEMR11)	28	17	17	0	Negligible

** Denotes receptor that is altered or constructed after the baseline year. Changes at each receptor have been rounded to the nearest whole number.*

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 21 Appendix N), there would be no new receptors requiring assessment as a result of a one year delay.

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 King Edward Memorial Park Foreshore site in accordance with the criteria in Vol 2 Section 4, as described in Vol 21 Table 4.4.6. A summary of the approximate numbers of receptors in distance bands from the King Edward Memorial Park Foreshore site is detailed in Vol 21 Table 4.5.4.

Vol 21 Table 4.5.4 Air quality – numbers of dust sensitive receptors

Buffer distance (m)	Number of receptors*	Receptor type
<20	10-100	Residential, open space, playground, leisure centre
20-50	10-100	Residential, open space, playground
50-100	100-500	Residential, open space, playground
100-350	More than 500	Residential, open space, hotels, shops, restaurants

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

4.5.20 In line with the (Institute of Air Quality Management) 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 King Edward Memorial Park Foreshore site is classified as a 'small' dust emission class. This classification is based on the small size of the demolition volumes, which are estimated as less than 20,000m^3. The nearest receptor is within 20m from the construction site and applying the criteria, the receptor is at medium risk for demolition activities.

4.5.22 The earthworks have been assessed to be a 'large' dust emission class as the total material to be moved is more than 100,000 tonnes, although the size of the construction site is between 2,500m^2 and 10,000m^2. With the nearest receptor within 20m, the site is assessed to be high risk for earthworks.

4.5.23 The construction proposed for the King Edward Memorial Park Foreshore site has a 'medium' dust emission class. This classification is based on the use of concrete and the volume of materials moved. With the nearest receptor within 20m, the site is assessed to be high risk for construction.

4.5.24 There would be 50-100m of unpaved haul roads on site and the number of construction lorries per day would be between 25-100 and 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 21 Table 4.5.5. This summary of these risks does not take into account the measures outlined in the *CoCP* Parts A and B (Section 7).

Vol 21 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 measures.

4.5.26 On this basis, the development at the King Edward Memorial Park Foreshore 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 footpaths and the River Thames (as identified in Vol 21 Table 4.4.6), due to the duration of the works and the presence of more than ten dwellings 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* (Section 7) are applied, the significance of the effect would be reduced to **minor adverse** (in accordance with IAQM guidance[10]). This significance relates to receptors within 20m of the construction area. For receptors at distances greater than 20m from the construction area, the significance of the effect is **negligible**. The significance of the effect for each receptor is summarised in Vol 21 Table 4.5.6.

Vol 21 Table 4.5.6 Air quality – significance of construction dust effects

Receptor	Significance of effect
Shadwell Pierhead residential (KEMR4)	Minor adverse
Free Trade Wharf residential (KEMR10)	Minor adverse
John Bell House residential (KEMR1)*	Negligible
Land off Schoolhouse Lane, Cable Street and Glasshouse Fields residential (KEMR12)*	Negligible
Pier Head Preparatory (Montessori) School / Shadwell Basin Outdoor Activity Centre building (KEMR6)	Minor adverse
Pier Head Preparatory (Montessori) School / Shadwell Basin Outdoor Activity Centre playground (KEMR5)	Negligible
St Paul's Church (KEMR2)	Negligible
Prospect of Whitby PH (KEMR3)	Negligible
Tennis Courts (KEMR7)	Minor adverse
Thames Path (KEMR8)	Minor adverse
King Edward Memorial Park (KEMR9)	Minor adverse
River Thames (KEMR13)	Minor adverse
The Shadwell Centre (KEMR11)	Negligible

** Denotes receptor that is altered or constructed after the baseline year.*

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 Section 4. Vol 21 Table 4.6.1 shows the predicted maximum ground level odour concentrations at the King Edward Memorial Park Foreshore 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. In accordance with the odour benchmark set by the Environment Agency, results are presented for the 98^{th} percentile of hourly average concentrations in the year (or the 176^{th} highest hourly concentration in the year) and the number of hours in a year with concentrations above $1.5ou_E/m^3$. Achieving the 98^{th} 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 21 Table 4.6.1 Odour – impacts and magnitude – operation

Year	Maximum at ground level locations		Impact magnitude and justification
Typical	98^{th} percentile (ou_E/m^3)	0	Negligible 98^{th} percentile concentration is less than $1ou_E/m^3$
	No. of hours > $1.5ou_E/m^3$	8	

4.6.2 In Vol 21 Table 4.6.1 above, the 98^{th} percentile is shown as zero as air would be released from the ventilation columns for less than 2% of the year estimated at about 40 hours in the typical year with all air treated. This means that the odour benchmark would be achieved at all locations. This represents an impact of negligible magnitude.

4.6.3 The highest odour concentrations are predicted to occur in close proximity to the ventilation columns where odour concentrations are predicted to be above $1.5ou_E/m^3$ for eight hours in a typical year. The number of hours exceeding the threshold reduces rapidly with distance from the ventilation columns, such that beyond 15m from the ventilation columns, the number of hours exceeding is one or two per year and beyond 30m, no hours exceed. An odour may be detectable on the Thames Path and King Edward Memorial Park close to the ventilation columns for a few hours per year. Odour would not be detectable on an hourly basis at any buildings. With a frequent use year (ie, a more rainy year than average), there would be a slight increase in the number of hours with an odour close to the ventilation columns. Odour would not be detectable on an hourly basis at any buildings.

4.6.4 With regard to the significance of effects given that the predicted odour concentrations at all locations would not exceed the 98^{th} percentile benchmark of $1.5ou_E/m^3$, it is considered that overall significance 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, there would not be any cumulative construction effects. Therefore the effects on local air quality would remain as described in Section 4.5. This would also be the case if the programme for the Thames Tideway Tunnel project was delayed by approximately one year.

Operational effects

4.7.2 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.

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 further 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), no mitigation is required because effects are not significant.

Monitoring

4.8.3 It is envisaged that an appropriate particulate monitoring regime would be agreed with the LB of Tower Hamlets prior to commencement of construction at the King Edward Memorial Park Foreshore 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 21 Table 4.10.1 Air quality – summary of construction assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Residential - Shadwell Pierhead (KEMR4)	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
Residential - Free Trade Wharf (KEMR10)	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 - John Bell House (KEMR1)*	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
Residential - Land off Schoolhouse Lane, Cable Street and Glasshouse Fields (KEMR12)*	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
Educational - Pier Head Preparatory (Montessori) School / Shadwell Basin Outdoor Activity Centre building (KEMR6)	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

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Recreational - Pier Head Preparatory (Montessori) School / Shadwell Basin Outdoor Activity Centre playground (KEMR5)	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
Place of Worship - St Paul's Church (KEMR2)	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
Public House - Prospect of Whitby PH (KEMR3)	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 - Tennis Courts (KEMR7)	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 - Thames Path (KEMR8)	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 - King Edward Memorial Park (KEMR9)	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

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Recreational - River Thames (KEMR13)	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 – The Shadwell Centre (KEMR11)	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

** Denotes receptor that is altered or constructed after the baseline year.*

Vol 21 Table 4.10.2 Odour – summary of operational assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Residential - Free Trade Wharf (KEMR10)	Odour	Negligible	None	Negligible
Residential - Shadwell Pierhead (KEMR4)		Negligible	None	Negligible
Residential - John Bell House (KEMR1)*		Negligible	None	Negligible
Residential - Land off Schoolhouse Lane, Cable Street and Glasshouse Fields (KEMR12)*		Negligible	None	Negligible
Educational - Pier Head Preparatory (Montessori) School / Shadwell Basin Outdoor Activity Centre building (KEMR6)		Negligible	None	Negligible
Educational - Pier Head Preparatory (Montessori) School / Shadwell Basin Outdoor Activity Centre playground (KEMR5)		Negligible	None	Negligible
Place of Worship - St Paul's Church (KEMR2)		Negligible	None	Negligible
Public House - Prospect of Whitby PH (KEMR3)		Negligible	None	Negligible
Recreational - Shadwell Basin Outdoor Activity Centre (KEMR6)		Negligible	None	Negligible
Recreational - Tennis Courts (KEMR7)		Negligible	None	Negligible
Recreational - Thames Path (KEMR8)		Negligible	None	Negligible
Recreational - King Edward Memorial Park (KEMR9)		Negligible	None	Negligible
Recreational - River Thames (KEMR13)		Negligible	None	Negligible
Commercial – The Shadwell Centre (KEMR11)		Negligible	None	Negligible

** Denotes receptor that is altered or constructed after the baseline year.*

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, http://www.legislation.gov.uk/ukpga/1995/25/contents. Accessed January 2012.

[5] Defra, http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html. Accessed June 2012.

[6] LB of Tower Hamlets, Personal Communication. July 2012.

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

[8] Defra, 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: **6.2.21**

Volume 21: King Edward Memorial Park Foreshore site assessment

Section 5: Ecology - aquatic

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

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Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

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Thames Tideway Tunnel

Environmental Statement

Volume 21: King Edward Memorial Park Foreshore 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 of the proposed development on aquatic ecology at the King Edward Memorial Park Foreshore site.

5.1.2 The proposed development may lead to effects on aquatic ecology due to the physical works in-river during construction and the operation of the Thames Tideway Tunnel. During operation the interception of the combined sewer overflow (CSO) would result in substantially reduced discharges of untreated sewage into the Tidal Thames at this location. There would also be permanent in-river structures at this site. Significant construction and operational effects are therefore considered likely, and assessments of effects on aquatic ecology for both phases are assessed.

5.1.3 The presence of sewage in the aquatic environment has adverse effects on aquatic ecology receptors (habitats, mammals, fish, invertebrates and algae). In particular, discharges of untreated sewage effluent can result in low levels of dissolved oxygen (DO), which can cause mass fish mortalities known as 'hypoxia events'. There are CSOs discharging at locations throughout the tidal Thames, including the reach upstream and downstream of the North East Storm Relief CSO.

5.1.4 The tidal Thames comprises a dynamic environment, in which tidal action leads to dispersal of discharges. Therefore the effects of the operational Thames Tideway Tunnel, which is designed to intercept the most problematic CSOs, would be most evident at a project-wide level. These effects are therefore reported in Volume 3 Project-wide effects assessment. This section assesses the localised effects at a site-specific level for the King Edward Memorial Park Foreshore site.

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* (Defra, 2012)[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 included in the assessment for this site are contained in a separate volume (Volume 21 King Edward Memorial Park Foreshore 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 maximum extent of working at the King Edward Memorial Park Foreshore site would be partly located on the foreshore. Construction activities would occur over three and a half years, with structures in place for approximately three years. The elements of the construction of the proposed development of relevance to aquatic ecology would be as follows:

a. The installation of temporary and permanent sheet piling to create cofferdams on the foreshore for the CSO interception works as shown in the Construction Phases: Phase 1 Site Setup, Shaft Construction and Tunnelling drawing and Construction Phases: Phase 2 Construction of other Structures figures (see separate volume of figures – Section 1), and subsequent removal of the temporary cofferdam. The installation of cofferdams would be accomplished using a jack-up barge or similar equipment.

b. It is assumed for the assessment that the majority of foreshore material within the temporary cofferdams would remain *in-situ*. For structural reasons, soft material located adjacent to the perimeter of the temporary cofferdams and adjacent to the river wall would be removed. The soft material includes silt, peat and other materials. Removal of this material would ensure that any settlement of the cofferdam fill material does not adversely affect the ties between the walls of the twin walled temporary cofferdam leading to structural difficulties. All soft material within permanent cofferdams would be removed to ensure sound foundations for permanent construction.

c. The exact extent and depth of the foreshore deposits to be removed at each site would be informed by geotechnical investigations. Areas of removed material would be filled with gravel similar to the existing bed material. Cofferdam fill material would then be placed onto the foreshore on top of a geotextile layer. Suitable sized plant would be utilised to reduce potential load impacts on the foreshore. Upon removal of the temporary cofferdam, the fill and geotextile layer would be removed and the bed would be reinstated to match the existing river bed conditions. Material excavated would be disposed of in accordance with the project's Waste Management procedure.

d. Regular barge movements with a peak monthly average of four movements per day.

e. Evening (up until 22.00) and winter working, during which there would be lighting of in-river structures.

f. The placement and removal of a temporary campshed of approximately 1000m^2 on the foreshore outside the cofferdam for the CSO works, suitable for up to 1000 tonne barge.

g. The presence of a jack-up barge on the foreshore to install the cofferdam.

5.2.3 The construction of in-river structures, and in particular the temporary works cofferdam, would affect the river regime. There is potential for localised increases in flow velocity to cause scour of the river bed and foreshore, or deposition of sediments. The scour could occur around the face of the cofferdam (abutment scour) or across the channel width (contraction scour). Any potential scour development during construction would be monitored and if relevant trigger levels are reached, appropriate protection measures would be provided. Further details are provided in *Scour and Accretion Monitoring and Mitigation Plan for Temporary Works in the Foreshore* (Vol 3 Appendix L.4).

Code of Construction Practice

5.2.4 The *Code of Construction Practice* (*CoCP*) sets out the standards, procedures, and measures for managing and reducing construction effects. These measures would be implemented through a *Construction environment management plan* (*CEMP*) prepared by the contractor to control site operations and works.

5.2.5 The *CoCP* is provided in Vol 1 Appendix A. It contains general requirements (Part A), and site specific requirements for this site (Part B). 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 resting on the foreshore and river bed would be controlled to reduce extent of potential environmental impacts. The design of facilities such as campsheds would consider the need to minimise environmental impacts and should consider the use of lattice structure barge grids where appropriate. In-river structures, including campsheds, would be removed on completion of the works unless otherwise agreed. Where concrete is used, such as campsheds, a membrane is required to protect the underlying riverbed. The method for reinstatement of the temporary works area would be subject to a method statement that would consider requirements for impact on aquatic ecology (*CoCP Part A* Section 11).

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

c. Undertaking noise measurements at prescribed points and intervals to ensure compliance (*CoCP Part A* Section 6).

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

e. Where, technically feasible, utilising low noise/vibration cofferdam or pile/pier installation techniques such as pressing or vibro-piling rather than impact/percussive piling. In the event that in-river percussive piling is needed, prior approval from the EA would be required (*CoCP Part A* Section 6).

f. When 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).

g. The contractor shall make every reasonable effort to remove all piles completely from the bed of the river. With the prior written agreement of the PLA the contractor would ensure any piles which prove impossible to fully extract on application of the confirmed minimum crane pull of 40 tonnes, are driven down, cut off or removed to a depth of a least 1 metre below the adjacent riverbed level unless advised otherwise (*CoCP Part A* Section 4).

h. Dewatering operations for cofferdams and in river structures need to consider fish rescue arrangements. To the extent that it is not dealt with in the application for development consent, prior written consent from the EA is required under the Salmon and Freshwater Fisheries Act, 1975, to net or trap fish, or introduce fish into a water course (*CoCP Part A* Section 8).

i. Avoidance of pollution of the river through measures that accord with the principles set out in industry guidelines, including the Environment Agency (EA) note *PPG05: Works in, near or liable to affect water courses* (Environment Agency, undated)[2] and Construction Industry Research and Information Association (CIRIA) report *C532: Control of water pollution from construction sites* (CIRIA, 2001)[3] (*CoCP Part A* Section 8).

j. For works where materials are being loaded and unloaded on the river, the Contractor is required to establish suitable management arrangements and mitigation measures so as to prevent spillage of transferred materials. This includes design of conveyor systems, enclosures, conveyor belt scrapper locations and selection of other loading equipment. Monitoring methods and contingencies arrangements are to be included in the River Transport Management Plan and Emergency Preparedness Plan (*CoCP Part A* Section 8).

k. In constructing temporary cofferdams the contractor would avoid any mixing of fill material with the underlying substrate. This would be achieved by installing a membrane between the existing river bed and the back fill material (*CoCP Part A* Section 11).

l. Appropriate measures would be taken with regard to ‘in-river’ works to minimise the release of suspended sediment and solids into the water column (*CoCP Part A* Section 8).

m. The lighting, to be specified in a Lighting management plan, would be designed to comply with relevant standards. The lighting design needs to consider aquatic environment and avoid direct lighting of watercourses, where reasonably practical, to avoid inhibiting movements of photophobic species such as eel (*CoCP Part A* Section 4). (See para. 5.2.6 for *CoCP Part B* measures for site working hours relevant to lighting at King Edward Memorial Park Foreshore.)

5.2.6 The *CoCP Part B* at the King Edward Memorial Park Foreshore commits to the following measures of relevance to aquatic ecology:

a. A site specific lighting plan would be required. The lighting would address the impact on terrestrial and aquatic ecology and include the use of low level directional lighting where possible whilst meeting safe work requirements. The Lighting plan would be submitted and agreed with the LB of Tower Hamlets (*CoCP Part B* Section 4).

b. Membrane to be installed between existing river bed and temporary back fill material to prevent contamination of juvenile fish habitat. Areas of foreshore used for temporary works would be restored to similar condition and material prior to the works (*CoCP Part B* Section 11).

c. The site would adhere to standard and extended working hours. Extended working hours are required at this site to allow for major concrete pours for shaft construction including diaphragm wall panels, base slab, roof slab and other large elements. The exact timing of any extended hours working would be consulted and notified to the LB of Tower Hamlets in advance through S61 process (*CoCP Part B* Section 11).

d. The loading and unloading of barges would only be carried out during standard working hours (*CoCP Part B* Section 6).

Operation

5.2.7 The elements of the operation of the proposed development of relevance to aquatic ecology are set out below. Further information is provided in Section 3 of this volume.

5.2.8 Discharges from the North East Storm Relief CSO would be intercepted as part of the Thames Tideway Tunnel project. Based on the operational base case (which includes permitted Thames Tideway sewage treatment works upgrades, and the Lee Tunnel scheme, as well as projected population increases) discharges (which have been modelled for 2021) during the Typical Year[i] from the North East Storm Relief CSO are anticipated to be 848,000 m^3 per annum over a total of 32 discharge events (or spills) by 2021. The discharge is predicted to reduce to 85,000m^3 per annum over four discharge events once the Thames Tideway Tunnel is operational. This represents an approximately 90% decrease as a result of the Thames Tideway Tunnel.

5.2.9 A permanent foreshore interception structure would be in place in the river and would give rise to effects from the construction phase of the project onwards. However, as it is a permanent structure, its effects would be on-going for its full existence, and are therefore considered under the operational assessment.

5.2.10 Scour protection for the permanent foreshore structure and a discharge apron would consist of buried rip-rap which would be overlaid with an appropriate substrate material.

5.2.11 Improvements in water quality are anticipated both in the local area around the discharge point for the North East Storm Relief CSO and in the wider tidal Thames. The assessment of operational effects on the tidal Thames as a whole are contained within Volume 3.

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[i] The ‘Typical Year’ represents the most ‘typical’ 12 month period of rainfall observed between 1970 and 2011 and is represented by the period from October 1979 to September 1980

Environmental design measures

5.2.12 Generic design principles of relevance to aquatic ecology at King Edward Memorial Park Foreshore are as follows:

a. Where appropriate to context and practicable, fendering (horizontal or vertical) shall be included on the foreshore structure, preferably in timber, to promote aquatic ecology.

b. Scour protection shall be provided beneath any new outfall extending to below the low water line and along the line of the new river wall (to protect its foundation). The detailed design and extent of this shall seek to avoid or minimise adverse effects on aquatic ecology.

c. Where practicable, at the base of the foreshore structure, measures such as low level habitat features shall be provided to encourage retention of sediment to promote aquatic ecology.

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*. Specific comments relevant to this site for the assessment of aquatic ecology are presented in Vol 21 Table 5.3.1 Aquatic ecology – stakeholder engagement for King Edward Memorial Park Foreshore.

Vol 21 Table 5.3.1 Aquatic ecology – stakeholder engagement for King Edward Memorial Park Foreshore

Organisation	Comment	Response
Environment Agency (phase one consultation response – December 2010)	The foreshore at this location is mudflat and is identified as a UK priority biodiversity action plan habitat. Questioned why a foreshore site is needed at this location, and why all construction activity and permanent structures must be on the foreshore. Suggested the land to be used at this site rather than the foreshore. If the use of the foreshore can be justified then the space used should be minimal and only used for essential infrastructure. All associated works should be on land if possible.	The required scale of land take from the foreshore has been reduced through design development. Wherever possible, construction areas that are not required in the immediate vicinity of the shaft have been relocated to terrestrial areas.
Local Authorities – LB of Tower Hamlets	The site lies to the east of the Shadwell Basin SINC (Metropolitan Grade Importance) and within the River Thames and	These designated sites are described in this volume and effects assessed as

Organisation	Comment	Response
(scoping opinion –April 2011)	Tidal Tributaries SINC (Metropolitan Grade Importance).	appropriate.
Environment Agency (phase two Consultation response – February 2012)	We are pleased to see that some facilities, such as site support, have been moved from the foreshore site and is to be located on a site in the park. This has reduced the size of the land take into the foreshore. Encroachment onto the foreshore on this site is still large and as designs progress, opportunities to move more of the facilities into the park should be sought.	Wherever possible, construction areas that are not required in the immediate vicinity of the shaft have been relocated to terrestrial areas.
	The foreshore is identified as mudflat, which is a priority BAP habitat.	Noted and incorporated into this assessment
Local Authorities – LB of Tower Hamlets (phase two Consultation response – February 2012)	Adverse effects on aquatic ecology from King Edward Memorial Park Foreshore would be slightly more than for one of the alternative sites (King Edward Memorial Park/Heckford Street).	Noted. Whilst adverse effects on aquatic ecology are predicted as a result of the works on the foreshore at King Edward Memorial Park Foreshore, this site has been taken forward based on a wide range of considerations.
	An independent review of environmental information consulted on during Phase 2 Consultation was provided with the council's response. This included a review of the aquatic ecology assessment. The review requested that clarification of the scope of additional fish and invertebrate surveys should be provided.	Full details of the fish and invertebrate surveys undertaken for this ES are provided in Volume 2 Environmental Assessment Methodology
	Clarification of the fish population being assessed was sought – it is assumed to be the resident fish population. This should signpost to the project-	The fish population being assessed in this assessment is the local population ie, the assessment in this

Organisation	Comment	Response
	wide assessment of migratory fish	assessment considers the value of this particular site for fish. Fish (including migratory species) are assessed at the river-wide level in Volume 3.
	The impact summary conclusion for each receptor group should be highlighted in bold to stand out to the reader.	Effect levels are emboldened.
Environment Agency (October 2012) Section 48 consultation response	Several plans for this site show a proposed cantilever walkway on the foreshore structure. The foreshore is an important feature of the Thames Site of Metropolitan Importance. Cantilevered structures result in increased shading on this feature, resulting in a reduction and or inhibition of macrophyte and phytobenthos. This results in reduction in both diversity and production of macro-invertebrates. The inclusion of cantilevered structures should be avoided in order to prevent the negative impacts of overshadowing on the foreshore. In circumstances where it can be justified that there are no reasonable alternatives and cantilevered walkways are an essential part of the operational development, then the structures should be slatted or grilled to allow light through and reduce the impact of shading.	Noted. The walkway would only be present over the area of habitat that would be modified to provide essential rip-rap scour protection around the permanent works, and not over any other areas of foreshore habitat.

Baseline

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

5.3.3 The assessment is based on desk study and survey data. For habitats, fish, invertebrates and algae, and desk study data was 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 Tidal Thames. Locations as close to the King Edward Memorial Park Foreshore site as possible were selected. Details of the background and desk study data sets are provided in Vol 2.

5.3.4 Surveys for fish and invertebrates were undertaken during October 2010, 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 to the site was at Bermondsey Wall East approximately 1.7km upstream, to the west.

5.3.5 Surveys for algae were undertaken at eight sampling locations in May 2012, comprising each of the foreshore sites, including the King Edward Memorial Park Foreshore site. 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. 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 King Edward Memorial Park Foreshore 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 listed in the site development schedule (see Vol 21 Appendix N) are considered relevant to the aquatic ecology base case and none to cumulative impact assessment for the construction phase as none would comprise in-river development, development adjacent to the river or development discharging into the river. Therefore no cumulative impact assessment has been undertaken.

5.3.9 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

5.3.10 The assessment methodology for the operational phase follows that described in Vol 2. The assessment area is as stated in para. 5.3.6 There are two assessment years for operational effects; Year 1 and Year 6. Year 1 is the year that the Thames Tideway Tunnel would be brought into operation. Year 6 provides sufficient time after operation commences to allow the longer term effects on aquatic ecology to be assessed. There are no site-specific variations for undertaking the operational assessment of this site.

5.3.11 Section 5.6 details the likely significant effects arising from the operation of the proposed development at the King Edward Memorial Park Foreshore site. The effects of the interception of all of the CSOs within the Thames Tideway Tunnel project on aquatic ecology receptors at a river wide level are considered in Vol 3 Project-wide assessment.

5.3.12 No developments listed in the site development schedule (see Vol 21 Appendix N) are considered relevant to the aquatic ecology base case and none to cumulative impact assessment for the operational phase as none would comprise in-river development, development adjacent to the river or development discharging into the river. Therefore no cumulative impact assessment has been undertaken.

5.3.13 As with construction (see para. 5.3.9), 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

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

Assumptions

5.3.15 It has been assumed that:

a. The campsheds would be concrete structures.

b. Vibro piling techniques would be used.

c. It would be necessary to remove all alluvial and other deposits above the natural gravel within the temporary cofferdam and campshed in order to establish a stable construction platform, as detailed in Section 5.2.

d. The area between the outer edge of the temporary cofferdam and the maximum extent of working area would be subject to disturbance and consolidation during construction from jack-up barges and similar equipment particularly during cofferdam installation.

e. There would be no dredging to enable barging at this site.

f. 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 more coarse 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.

g. The trigger level for implementing scour protection measures (para. 5.2.3) would be set to ensure that scour would not penetrate below the depth of the existing substrate (ie, there would be no change in broad habitat type as a result of scour).

h. That there would be illumination at this facility and campshed given the need for evening and winter working.

Limitations

5.3.16 There are no site-specific limitations.

5.4 Baseline conditions

5.4.1 The following section sets out the baseline conditions for aquatic ecology within the assessment area. 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 (ie, with a basis in law) and non-statutory (ie, 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 marine 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.

5.4.4 The tidal Thames is part of the proposed Thames Estuary South East Marine Conservation Zone (MCZ no. 5) that was 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)[4]. The tidal 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 (SSSI) or Local Nature Reserves (LNR)) designated for aquatic ecology within the assessment area.

5.4.6 The King Edward Memorial Park Foreshore site falls within the non-statutory River Thames and Tidal Tributaries Site of Importance for Nature Conservation (SINC Grade III of Metropolitan importance)[ii]. The SINC is designated by the Greater London Authority and adopted by all boroughs which border the 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 tidal Thames, though many of these are only occasional visitors.

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

The more common species include dace (*Leuciscus leuciscus*), bream (*Abramis brama*) and roach (*Rutilus rutilus*) in the freshwater reaches (described in para. 5.4.10), and sand-smelt (*Atherina presbyter*), flounder (*Platichtyhys 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 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 King Edward Memorial Park Foreshore site is also situated immediately adjacent to Shadwell Basin Site of Importance for Nature Conservation. Shadwell Basin is the most significant body of water surviving from the historical London Docks. The site is of particular local importance for its waterfowl and fish populations. The Basin is hydrologically linked to the tidal Thames.

5.4.8 The tidal Thames is the subject of a Habitat Action Plan (HAP) within the London Biodiversity Action Plan (BAP) (Thames Estuary Partnership Biodiversity Action Group, undated)[5]. The intertidal habitat represents the 'Rivers and Standing Water' habitat which forms part of the London Borough (LB) of Tower Hamlets local Biodiversity Action Plan (LB of Tower Hamlets, undated)[6].

5.4.9 The tidal 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. The tidal 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.

5.4.10 The river is divided into three zones within the tidal Thames HAP; freshwater, brackish and marine (Vol 3 Figure 5.4.1, see separate volume of figures). The brackish zone is equivalent to the category known as 'transitional water' or estuaries under the Water Framework Directive (WFD). Further details of the WFD river zone classifications can be found in Volume 3.

5.4.11 The King Edward Memorial Park Foreshore site lies within the brackish zone of the river, which means that the fish and invertebrate communities which occur within the river at this location consist of both freshwater tolerant marine species and salt-water tolerant freshwater species. Invertebrate diversity is generally lower than in the freshwater zone as species must be able to withstand some variations in salinity and a stressful environment. The fluctuating tidal conditions mean that flora and fauna have to be able to tolerate wide variations in their physical environment.

5.4.12 The river in this location is confined by a vertical river wall. There is no marginal or high tide vegetation, although the vertical river wall supports communities of macro and micro algae.

5.4.13 The intertidal habitat within and immediately adjacent to the proposed foreshore construction site is a narrow strip of foreshore dominated by cobbles and pebbles, with some sand. The site is located within an area of UK BAP priority habitat 'mudflats' (Natural England, undated)[7], as noted by the EA in their response to the phase two consultation for the project.

5.4.14 A summary of habitat types present, and other features of interest recorded during October 2010 surveys are presented in Vol 21 Table 5.4.1 and Vol 21 Fig 5.4.1 (see separate volume of figures).

Vol 21 Table 5.4.1 Aquatic ecology – Principal habitat, substrate and other features of interest at King Edward Memorial Park Foreshore

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%) Sand (20%)	Pebble Gravel Sand

Evaluation of habitats for King Edward Memorial Park Foreshore

5.4.15 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) and due to close linkages to Shadwell Basin site of local importance. Although limited in width due to encroachment by development on either bank, the intertidal habitat on both banks also constitutes UKBAP habitat 'mudflats'.

Marine mammals

5.4.16 Records compiled by the Zoological Society of London (ZSL) for 2003-2011 indicate that harbour porpoise (*Phocoena phocoena*), bottlenose dolphin (*Tursiops truncatus*) and two seal species (grey (*Halichoerus grypus*) and common (*Phoca vitulina*)) migrate through the tidal Thames. Three records of seal (one common in 2010 and two unidentified in 2004 and 2005) and one dolphin (species unidentified in 2006) have been observed near the King Edward Memorial Park Foreshore area of the tidal Thames. The tidal Thames upstream of the site is used by grey and common seal.

Evaluation of marine mammals for King Edward Memorial Park Foreshore

5.4.17 The site is considered to be of low-medium (local) value for marine mammals given the small number of records of both seal species and two cetacean species, and the limited extent of suitable habitat for seals to use as 'haul-out' sites.

Fish

5.4.18 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.

Baseline surveys

5.4.19 A single day survey was undertaken at the King Edward Memorial Park Foreshore site during October 2010. Full details of the methodology and rationale for timing of surveys are presented in Vol 2. The area covered by the survey is illustrated in Vol 21 Figure 5.4.1 (see separate volume of figures).

5.4.20 Fish are routinely categorised into 'guilds' according to their tolerance to salinity and habitat preference(Elliott and Taylor, 1989[8]; Elliott and Hemingway, 2002[9]) 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.

5.4.21 The survey recorded relatively low fish abundance in the area of King Edward Memorial Park Foreshore, with only 64 individuals captured in total. This was a relatively 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 lowest catch (at Albert Embankment) was of 19 individuals. Although the absolute abundance of individual species based on a single survey visit is not a reliable basis for evaluation of the site, the presence of 50 smelt is notable in the context of the survey, making the King Edward Memorial Park Foreshore area one of the best Thames Tideway Tunnel project survey sites for this species. The range of species recorded and the number of individuals is presented in Vol 21 Table 5.4.2.

5.4.22 The low abundance of freshwater species relative to estuarine resident and diadromous species at the King Edward Memorial Park Foreshore site, such as roach and bream is explained by the site location, which is towards the upstream end of the brackish zone (Vol 3 Figure 3.4.1 (see separate volume of figures)), where salinity is relatively close to the tolerance threshold of freshwater species.

Vol 21 Table 5.4.2 Aquatic ecology – results of fish surveys at King Edward Memorial Park Foreshore

Common name	Scientific name	Number of individuals	Guild
Flounder	*Platichthys flesus*	4	Estuarine resident
Common goby	*Pomatoschistus microps*	3	Estuarine resident
Smelt	*Osmerus eperlanus*	50	Diadromous
Common bream	*Abramis brama*	4	Freshwater
Roach	*Rutilus rutilus*	2	Freshwater

5.4.23 Smelt is a species listed under Section 41 of the Natural Environment and Rural Communities Act 2006 and is a priority UK BAP species. Smelt migrate into freshwater to spawn on gravel banks. Colclough *et al* (2002)[10] have identified smelt spawning sites on gravel shores in the upper Tidal Thames around Wandsworth and Battersea but not as far downstream as the King Edward Memorial Park site. The spawning period is March-April and thereafter smelt drift progressively downstream from spawning sites towards Greenwich. Catches may be expected anywhere along the tidal Thames over the summer months.

Juvenile fish data

5.4.24 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. Young fish also feed predominantly amongst the intertidal habitat. Adult migrants of larger fish tend to use faster mid-channel routes.

5.4.25 Surveys for juvenile fish were undertaken at five sites sampled six times between May and September 2011, as part of the project-wide assessment. The data from the juvenile fish surveys at Bermondsey Wall East are presented in Vol 21 Table 5.4.3. The findings are relevant to this site because it gives context to the assemblage of fish that may be expected to be found in this reach of the river. The site locations are presented in Vol 2 Figure 5.4.4 (see separate volume of figures). The aim of the surveys was to record juvenile fish migrations through the tidal Thames to inform a 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.

Vol 21 Table 5.4.3 Aquatic ecology – results of 2011 juvenile fish surveys at Bermondsey Wall East

Common name	Scientific name	Number of individuals					
		Survey					
		1 May	2 late May	3 June	4 July	5 Aug	6 Sept
Flounder	*Platichthys flesus*	1	7	102	16	1	10
Smelt	*Osmerus eperlanus*	1	2	0	0	0	0
Eel	*Anguilla anguilla*	0	3	2	4	1	3
Common bream	*Abramis brama*	0	0	0	7	0	5
Dace	*Leuciscus leuciscus*	0	2	0	0	0	0
Roach	*Rutilus rutilus*	0	0	25	1	0	1
Perch	*Perca fluviatilis*	0	0	0	7	0	0
Goby	*Pomatoschistus* spp.	0	0	2	262	457	330
Sea bass	*Dicentrarchus labrax*	0	0	0	247	14	4
3-spined stickleback	*Gasterosteus aculeatus*	0	0	1	0	0	0
Zander	*Stizostedion lucioperca*	0	0	0	2	2	1
Sand smelt	*Atherina presbyter*	0	0	0	2	1	0

5.4.26 Post-larval flounders dominated the catch during survey three. Flounder were caught in the shallow littoral zone, indicating early springtime colonisation from marine spawning sites. In survey four, sea bass (*Dicentrarchus labrax*) and gobies (*Pomatoschistus* sp.) were numerous, with numbers of gobies remaining high in surveys five and six. This indicates that the vicinity of Bermondsey Wall East is of importance for juvenile fish and that this broad stretch of the river is of value for juveniles, if not for adults.

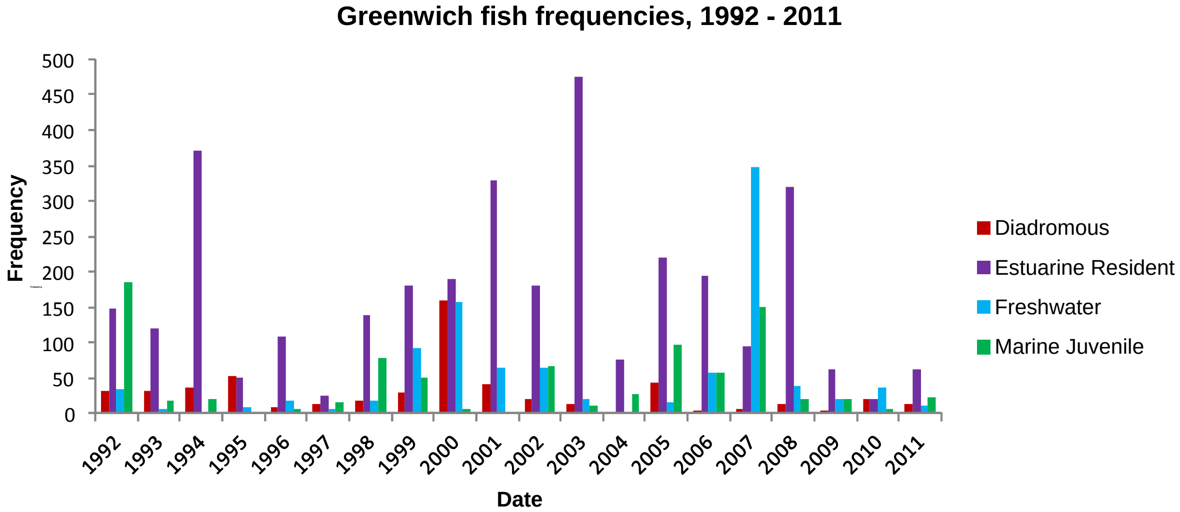
Environment Agency (EA) background data

5.4.27 EA records have 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 surveys are provided in Vol 2. There is an EA sampling site at Greenwich, located approximately 4.5km downstream. These show fairly steady catches in trawls but some indication of increasing seine-net catches in recent years (Vol 21 Plate 5.4.1).

5.4.28 Catches during these surveys have been dominated by estuarine resident fish such as common goby (*Pomatoschistus microps*), flounder and sand smelt, freshwater species including dace, common bream, perch (*Perca fluviatilis*) and roach, and migratory species including eel and smelt. This includes all the species recorded in the 2011 surveys undertaken for this project at the King Edward Memorial Park Foreshore site. Other migratory species such as salmon and sea trout must pass through the area but are too infrequent 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 in to the Tidal Thames and lower salinity conditions which allowed them to survive.

5.4.29 The survey results from Bermondsey Wall East presented above match the EA data fairly well, except for the relatively small number of smelt. The EA data is, however, from a site several kilometres away, and such differences may be anticipated.

Vol 21 Plate 5.4.1 Aquatic ecology – long-term EA total fish catches from Greenwich site



Water quality and current fish baseline

5.4.30 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)[11] the progressive improvement of fish populations from the 1960s onwards. The ecology of the tidal Thames has undergone further improvement in recent decades, with some 125 fish species now recorded by the EA.

5.4.31 However, hypoxia events (see para. 5.1.3) arising from regular CSO spills and occasional discharges of untreated waste from STWs still occur. Discharges have the effect of depleting DO (measure 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).

5.4.32 The Tideway Fish Risk Model (TFRM) was developed to evaluate DO standards for the tidal Thames (Turnpenny *et al*, 2004)[12] 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 over 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 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.

5.4.33 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 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 'life stage cases'), since juveniles generally have a lower tolerance to hypoxia.

5.4.34 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/life stage 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 King Edward Memorial Park Foreshore

5.4.35 The assessment area at the King Edward Memorial Park Foreshore site is considered to be of medium-high (metropolitan) importance for fish, since although relatively low numbers of fish were recorded during the survey, this included relatively large numbers of smelt and the site forms part of the migratory habitat of a wide assemblage of estuarine fish species.

Invertebrates

5.4.36 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 may indicate poor quality.

5.4.37 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

5.4.38 A single day survey was undertaken at the King Edward Memorial Park Foreshore site during October 2010. The survey area was the same as that described for the fish survey above (paras. 5.4.19 to 5.4.23) and illustrated in Vol 21 Figure 5.4.1 (see separate volume of figures). Details of the sampling methods used can be found in Vol 2. Three intertidal and three subtidal samples were taken on each occasion.

5.4.39 The data for the invertebrates collected during the October 2010 field surveys are presented in Vol 21 Table 5.4.4 below. The Community Conservation Index (CCI) score (Chadd and Extence, 2004)[13] has 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[14], Shirt, 1987[15]) 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 21 Table 5.4.4 Aquatic ecology – invertebrate fauna sampled at King Edward Memorial Park October 2010

Taxa	CCI Score	No. of individuals - subtidal samples			No. of individuals - intertidal samples		
Sample numbers		Air lift 1	Air lift 2	Air lift 2	Kick sample	Sweep net 1	Sweep net 2
Radix balthica	1	0	18	0	0	0	0
Oligochaeta	-	12	30	80	0	8	150
Erpobdella sp.	-	0	1	0	0	0	0
Crangon crangon	-	0	0	16	0	0	1

Taxa	CCI Score	No. of individuals - subtidal samples			No. of individuals - intertidal samples		
Eriocheir sinensis	-	0	0	0	2	0	0
Apocorophium lacustre	8	11	0	0	0	0	1
Corophium volutator	3	0	0	1	0	0	0
Gammarus zaddachi	1	0	50	8	0	0	1
Diptera pupae	-	0	0	0	0	1	0
Number of taxa	-	2	4	4	1	2	4

5.4.40 Invertebrate diversity and abundance at the King Edward Memorial Park Foreshore site were amongst the lowest within the tidal Thames in both intertidal and subtidal samples.

5.4.41 There was little difference in diversity between subtidal and intertidal samples. The most pollution sensitive animals present were *Gammarus zaddachi,* brackish water amphipod shrimps. However, these were present in relatively low numbers and limited to the subtidal samples. As at other sites, despite the apparent low quality, pollution tolerant taxa such as Oligochaeta were only present in low numbers, and the taxa present are brackish species, with varying tolerance of different levels of salinity from estuarine to near freshwater.

5.4.42 The presence of three CSO discharges from the North East Storm Relief, Bell Wharf and Cole Stairs sewers, and in particular the former, within close proximity of the samples, is likely to be a significant contributing factor to the low biological quality of the site. The low invertebrate diversity and abundance in the intertidal area is however also likely to reflect the physical conditions at the site. There is a very narrow intertidal zone due to encroachment by the river defences and neighbouring development. Wave washing from the tide and passing river craft is therefore intense and affects the entire width of the intertidal habitat. The site also lies within the brackish zone of the river which means that invertebrates are subject to considerable variations in salinity.

5.4.43 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, and therefore the relative value of the invertebrate community is not considered to be of higher value in this instance.

Environment Agency background data

5.4.44 The King Edwards Memorial Park Foreshore site is located approximately 4.5 km upstream of the EA sampling site at Greenwich, which is the nearest sampling location with recent data (2006 -2007). The EA samples were taken using a number of techniques, including cores and kick sampling in the intertidal and day grab and core samples in the subtidal.

Sampling at Greenwich was undertaken on an approximately monthly basis over the period 1989 and 1993 and 2006-2007.

5.4.45 A total of 35 taxa were recorded at Greenwich over the seven year period in which samples were collected. The taxa Oligochaeta, which thrives in organically polluted conditions, was most abundant, together with other pollution tolerant species such as the snail *Potamopyrgus antipodarum,* Polychaeta worms (mostly *Boccardiella ligerica*), gastropod snails (*P.antipodarum* and Cochliopidae) and *G. zaddachi*.

5.4.46 In addition to the native *G. zaddachi*, the amphipod *Gammarus tigrinus*, of North American origin, was also relatively abundant in samples taken at Greenwich. It is believed that this species 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.

5.4.47 The majority of taxa present at Greenwich are brackish species, with varying tolerance of different levels of salinity from estuarine to near freshwater. However, the increasing saline influence compared to upstream sites is demonstrated by the abundance of *Lekanesphaera hookeri* (a water louse) and various Polychaete worms (notably *Boccardiella ligerica* and *Marenzelleria viridis*), which are exclusively associated with estuarine or marine conditions.

Water quality and current invertebrate baseline

5.4.48 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.5. 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 in the vicinity of the North East Storm Relief CSO at King Edward Memorial Park are indicative of polluted conditions because they are able to tolerate the low DO conditions and multiply rapidly in the enriched sediments.

5.4.49 The analysis is described in further detail in Vol 3 Section 5.4. The following summary is relevant to the brackish zone of the tidal Thames in which the North East Storm Relief CSO site is located.

5.4.50 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)[16]. 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.

5.4.51 Redundancy analysis[iii] (RDA) 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 King Edward Memorial Park Foreshore

5.4.52 The King Edward Memorial Park Foreshore site is considered to be of medium (borough) importance due to the limited diversity and dominance of the invertebrate community by pollution tolerant species. Only a single species of conservation importance (*A. lacustre*) was recorded although this is common within the tidal Thames.

Algae

5.4.53 Algae occurs in the tidal Thames both in the water column and growing on the river wall and associated structures. The range of species which occur in the tidal Thames reflect both 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

5.4.54 A single day survey was undertaken in May 2012 at the King Edward Memorial Park Foreshore site. During the 2012 algal survey of King Edward Memorial Park only six species of algae were recorded, of which *Blidingia minima* was overwhelmingly dominant. These were all on the river wall and are shown in Vol 21 Table 5.4.5. All species are widespread and abundant in 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 invertebrates assemblages.

Vol 21 Table 5.4.5 Aquatic ecology – marine algae sampled at King Edward Memorial Park during 2012

Species	Survey observations	Species presences in the tidal Thames
Blidingia marginata	Occasionally present on the river wall.	Widespread and abundant.
Blidingia minima	This species is dominant at all but the lowest level of the river wall.	Widespread and abundant.
Cladophora glomerata	Frequently present at the lowest level of the river wall.	Widespread and abundant.
Rhizoclonium riparium	Occasionally present on the lowest level of the river wall only.	Common in the tidal Thames.
Ulva compressa	Occasionally on the river wall.	Widespread and abundant.
Rhodochorton purpureum	Occasionally present on the river wall.	Not uncommon in the tidal Thames.
Vaucheria sp.	Occasionally present on 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

5.4.55 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 Wapping, located approximately 0.9km upstream of the King Edward Memorial Park Foreshore site with the records all shown in Vol 21 Table 5.4.6.

Vol 21 Table 5.4.6 Aquatic ecology – marine algae sampled at Wapping between early 1970s and 1999

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

Rhodochorton purpureum	Mid to upper littoral levels in shaded situations on sea walls and other structures. Not uncommon in the Tidal Thames.

Water quality and algal communities

5.4.56 Algae depend on nutrients, nitrate and phosphate for growth. Although these nutrients occur naturally in water bodies, they are also present in sewage. 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 (see para. 5.1.3). This process is known as eutrophication. Excessive levels of algae can disrupt other elements of the ecosystem by smothering them.

5.4.57 Studies of the pelagic algae (para. 5.4.53) 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)[17]. 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)[18], although pollution tolerant species such as the green algal species still dominate the community.

Evaluation of algal community for King Edward Memorial Park Foreshore

5.4.58 None of the species recorded have protected or otherwise notable status (eg, 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

5.4.59 Using the baseline set out in paras. 5.4.1 to 5.4.58 the value accorded to each receptor considered in this assessment is set out in Vol 21 Table 5.4.7. The definitions of the receptor values and sensitivities used in this evaluation are set out in Vol 2.

Vol 21 Table 5.4.7 Aquatic ecology – summary of receptors and their values/sensitivities at King Edward Memorial Park Foreshore

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

5.4.60 The base case in Site Year 1 of construction would include the improvements at the five main sewage treatment works that discharge into the Thames Tideway (Mogden, Beckton, Crossness, Long Reach and Riverside), and the Lee Tunnel project. TFRM modelling (see Vol 3 Appendix C.3) has shown that at a river-wide level there would 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. 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 King Edward Memorial Park Foreshore 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 would, however, be at an early stage.

5.4.61 The invertebrate analysis demonstrates that more pollution sensitive groups such as shrimps (Gammaridae) are subject to significant 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. While there may be minor changes, abundance and diversity would however be limited by the fact that even with the Lee Tunnel and sewage treatment works improvements in place there are still predicted to be a large number of failures of DO standards. Colonisation by DO sensitive taxa such as Corophiidae, Crangonidae and Gammaridae which would otherwise occur within the brackish zone, including the King Edward Memorial Park Foreshore site 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 There is unlikely to be major encroachment onto the tidal Thames foreshore for non-river dependent uses as this is restricted through *London Plan* (Greater London Authority, 2012)[19] 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* (Environment Agency, 2005)[20] 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, no change to the current baseline from other developments is considered likely.

Operational base case

5.4.63 The river-wide recovery of fish and invertebrate communities that would occur as a result of the Lee Tunnel project and sewage treatment works upgrades would have advanced by Year 1 and Year 6 due to the reduced number of hypoxia events. However, as noted in para. 5.4.60 there would still be unsustainable mortalities of salmon, and possibly other sensitive taxa. Further catchment modelling shows that the frequency, duration and volume of spills from the North East Storm Relief CSO would continue to rise due to population growth, which would limit improvements for aquatic ecology receptors (spill frequency and volume as stated in para. 5.2.8: further details of projected spills are provided in Vol 21 Section 14 [Water resources – surface water]). Therefore, recovery due to water quality improvements would be suppressed at the King Edward Memorial Park Foreshore site. As a result there are unlikely to be significant changes in habitat quality at the site level and pollution sensitive fish species, such as salmon would continue to be suppressed. Indeed, conditions in the immediate vicinity of the CSO may be less favourable for fish than the current baseline given the increase in frequency, volume and duration of CSO spills.

5.4.64 At a river-wide scale invertebrate communities would be likely to include more pollution sensitive components as noted in para. 5.4.61, which would also be reflected to some degree at a site level. However, increased CSO spill frequency, durations and volumes would suppress recovery and may also be less favourable than current baseline conditions given the increase in frequency, volume and duration of CSO spills.

5.4.65 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.

5.4.66 As stated in para. 5.4.62 there is unlikely to be major encroachment onto the tidal Thames foreshore for non-river dependent uses. Therefore no change to the current baseline from other developments is considered likely.

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 There would be a total of approximately 250m^2 of temporary landtake from intertidal habitats and approximately 2,175m^2 from subtidal habitats associated with the temporary cofferdam and the campshed. This represents 0.01% of the River Thames and Tidal Tributaries SINC (Grade M). Soft materials from within the temporary cofferdam would be removed and a geotextile membrane used to separate the underlying substrate from the imported granular fill material. The cofferdam would be in place for approximately three years, which is therefore the duration of this temporary impact.

5.5.3 For those areas around the permanent structure where scour protection is not required (see para. 5.2.10), reinstatement would involve the removal of imported granular fill and the geotextile membrane. Where soft material had been removed in order provide stable conditions within the cofferdam (see para. 5.2.2b) this would be replaced with an appropriate substrate material. The approach to reinstatement at each of the foreshore sites is presented in Vol 3 Appendix C.4. The objective would be to restore the area to a profile similar to the surrounding foreshore.

5.5.4 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

5.5.5 It has been assumed that the area between the outer edge of the cofferdams and the maximum extent of working area would be subject to disturbance and consolidation due to the jack-up barge operation. At the King Edward Memorial Park Foreshore site this represents a total area of approximately 3,240m^2 outside the cofferdams which would be affected by construction activities during the site establishment phase. Furthermore, the area in the vicinity of the campshed is likely to be affected by consolidation and disturbance due to barge movements. At the King Edward Memorial Park Foreshore site there would be a peak monthly average of approximately four barge movements per day.

5.5.6 Impacts on the intertidal and subtidal habitats 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.

Change to scour and accretion patterns

5.5.7 The approach to addressing scour associated with the temporary structures is summarised in 5.2.3. It consists of monitoring the structures and implementing mitigation only if trigger levels of scour are reached. Further details are provided in the *Scour and Accretion Monitoring and Mitigation Plan for Temporary Works in the Foreshore* (Vol 3 Appendix L.4). No deposition currently occurs within the vicinity. With the temporary structure there would be sediment accumulation immediately upstream and over a greater distance immediately downstream of the temporary works. There would also be some occasional accumulation of sediment upstream and over a greater distance downstream of the site.

5.5.8 These predicted areas of sediment and accumulation are illustrated in Vol 21 Section 14 (Water resources – surface water). Based on the assumption that scour associated with the temporary structures would not be permitted to penetrate beyond the existing substrate layer (para.

5.3.15g) impacts associated with temporary scour and accretion are considered to be low negative, probable and temporary.

Change to flow velocity

5.5.9 The presence of the temporary cofferdam would result in alterations to the hydraulic regime. Hydraulic modelling shows that there would be areas of low velocity water created in the lee of the structure and faster flowing water around the riverward faces. The impact on flow velocity is considered to be negligible.

Waterborne noise and vibration

5.5.10 There would be approximately 200m of sheet piling installed for the temporary cofferdam and 120m of bored piling for the permanent cofferdam. It has been assumed that piles would be driven using vibro-piling, 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 *CoCP*. These are described in Section 5.2 of this volume.

5.5.11 There would be additional sources of noise and vibration, including activities associated with construction of the shaft 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 underwater noise and vibration levels are likely to be elevated locally during construction. Noise and vibration have the potential to cause physical damage to fish, and disrupt behaviour and movement. 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.

Increase in suspended sediment loads

5.5.12 Construction of the campshed, piling operations, and barge movements are likely to lead to localised increases in suspended sediment and potentially contaminants with the possibility for effects on local and downstream habitats.

5.5.13 Chemical analysis of sediment within the foreshore at this site has identified that levels of heavy metals, poly aromatic hydrocarbons (PAH) and other contaminants are below the Probable Effects Level (the concentration above which adverse effects are most likely to occur if sufficient exposure takes place). As such impacts related to mobilisation of contamination can be discounted.

5.5.14 It is predicted that the cofferdams and campshed would impact on scour patterns while in place, which could cause the mobilisation of increased levels of suspended solids into the river. However, the Thames is a high sediment environment and 40,000t (or 20,000m^3 assuming an *in-situ* density of 2t per m^3) of sediment are estimated to be carried on a spring tide (HR Wallingford, 2006)[21]. In this context, the volumes produced by the construction works from piling or scour are unlikely to be detectable against natural fluctuations in sediments and would not have an impact on surface water resources (HR Wallingford, 2012)[22]. Impacts resulting from releases of suspended sediment are considered to be low negative, probable and temporary.

5.5.15 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*. These are described in Section 5.2. No impacts from polluted discharges are anticipated with these control measures and safeguards in place.

Construction effects

5.5.16 This 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.

Designations and habitats

Loss of intertidal and subtidal habitat due to temporary landtake

5.5.17 There would be a temporary loss of approximately 2,425 m^2 of intertidal habitat and subtidal habitat, coupled with localised losses due to scour. The habitats affected by temporary landtake are presented in Vol 21 Table 5.4.1 and include gravel foreshore, sublittoral sand and gravels, river wall and mudflats. 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.

5.5.18 Subsequent excavation and removal of the granular fill material followed by reinstatement of substrate of comparable particulate material to the original substrate would facilitate recovery. This is expected to lead to re-establishment in the medium (one-five years) or long term (+5 years). Habitats within the area occupied by the campshed would be expected to recover more rapidly since the level of disturbance is likely to be lower. However, this does not affect the overall effect level, which is considered to be **minor adverse**, due to the low negative magnitude of impact on a medium-high (metropolitan) value receptor.

Change in intertidal and subtidal habitat due to scour and accretion

5.5.19 The intertidal habitats at the King Edward Memorial Park Foreshore site are dominated by cobbles and pebbles with some sand with subtidal habitat comprising cobbles, gravel and sand (Vol 21 Table 5.4.1). There may be some removal of the finer material in the areas subject to abutment and contraction scour, although based on the assumption that scour would not be permitted to develop beyond the depth of the existing broad habitat type, which is river gravel deposits. Changes are thus anticipated to be limited to minor and localised changes in the relative composition of the substrate types.

5.5.20 There would be an increase in the proportion of fine sediments in the vicinity of the site due to accretion. This may result in localised changes in the composition of the habitat as sediments accumulate on top of the coarser material. There is a risk that anoxic (ie, low DO) conditions) can develop within accreted sediment with potentially adverse effects on sediment dwelling organisms.

5.5.21 Overall, the effect of scour and accretion is considered to be **minor adverse** given the medium-high (metropolitan) importance of the receptor and the low negative impact.

Disturbance and consolidation of intertidal and subtidal habitat

5.5.22 There is likely to be disturbance and consolidation of up to approximately 3,240m^2 outside the cofferdam during the site establishment phase due to the presence of a jack-up barge to install the temporary cofferdams. The jack-up barge may also be used to remove the piles once construction is complete. Habitats within this zone are expected to recover within the short term (less than 12 months) following site establishment. Coupled with the medium-high (metropolitan) 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.

Marine mammals

Interference with the migrations of marine mammals within the Tideway

5.5.23 Noise, vibration and other construction activity has the potential to disturb marine mammals and deter them from passing the site. However, given the low-medium (local) value of the receptor, the low negative magnitude of noise and vibration impacts, the vibro 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*, (see Section 5.2 of this volume) this is considered to be a **negligible** effect.

Fish

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

5.5.24 The site is not considered to offer suitable spawning habitat for smelt, or any other fish species, although surveys in 2011 indicate relatively high numbers of non-spawning smelt. Loss of foreshore habitat is considered to be a low negative impact on a medium-high (metropolitan) receptor, which would result in a **minor adverse** effect.

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

5.5.25 The area which would be subject to disturbance and consolidation outside the cofferdam lies primarily in the subtidal zone. It is unlikely to offer feeding, resting or nursery habitat for juvenile fish. 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 thus considered to be **minor adverse**.

Change in feeding, resting and nursery habitat for fish due to scour and accretion

5.5.26 The limited depths of scour predicted at this site are not predicted to result in a change in the extent or nature of feeding, resting and nursery habitats. Increase levels of accretion may cause minor localised changes in the invertebrate community. However, this is not anticipated to limit the feeding opportunities for fish. The site does not lie within the zone in which smelt and dace are known to spawn and therefore there is no risk of smothering of spawning habitats due to sediment accretion. Effects are thus considered to be **minor adverse** due to the medium-high (metropolitan) value of the receptor and the low negative magnitude of the impact.

Interference with the migratory movements of fish

5.5.27 Ideally, the river channel should provide an uninterrupted route for juvenile fish migrations for species such as eel as glass eels or elvers, dace, goby and flounder as they move through the estuary.

5.5.28 In general, encroachment of structures such as cofferdams into the river channel may affect the river hydraulics, particularly at high discharges associated with heavy fluvial inputs or spring tides. Changes in water velocity caused by constriction of the hydraulic channel may hinder movements of fish against the tide, including their ability to withstand, or hold station in the flow. Constriction of the hydraulic channel, reduction of the intertidal zone and increased water velocities might cause some fish to be lost, for example by forcing them into deeper water with increased predation risk. Formation of eddy currents in the wake of structures may temporarily entrap fish and delay progress of migrations. Persistently delaying the successful migrations of fish past individual sites may also interfere with key life stage events such as spawning through preventing fish from reaching spawning sites at appropriate times.

5.5.29 The Individual Based Modelling (IBM) used to simulate the effects of the temporary and permanent structures on juvenile fish migration demonstrates that the square sides of the temporary structure provide opportunities for fish to shelter from adverse currents. Although the structure would cause juvenile fish to move into deeper water where predation risk is higher, the period of time in which they are exposed to this risk is sufficiently short that the study found it would have no effect on overall mortality rates when compared to the base case. Detail of the study, including the modelling methods, are presented in Vol 3.

5.5.30 Given the temporary nature of the works, and the fact that the minor adverse effects of fish being forced into deeper water would be offset by the minor beneficial effect anticipated through increased opportunities for shelter, the effects of the temporary structures on juvenile fish migrations are considered to be **negligible**.

Effects of waterborne noise and vibration on fish

5.5.31 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 cofferdams would be undertaken using techniques that minimise the level of noise and vibration. However, the period of piling would be sufficiently brief (assumed for the purposes of this assessment to be approximately 7 weeks). Removal of the piles would take a similar length of time at the end of the construction period. Furthermore, a series of control measures relating to the timing and duration of piling operations have been included in the *CoCP* (see Section 5.2 of this volume).

5.5.32 Waterborne noise and vibration 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**.

Blanketing of feeding areas for fish and reduction in water column visibility due to suspended sediment

5.5.33 Although the tidal Thames is a sedimentary environment with high levels of suspended solids, construction activities such as dredging, piling and barge movements could generate levels of suspended sediment locally which may cause disorientation of fish.

5.5.34 No dredging would be undertaken at this site as part of the temporary works. Given the extent of cofferdam (approximately 200m of temporary cofferdam), there is the potential for re-suspended sediments from piling and barge movements to affect juvenile fish migrations, particularly when considered along with the hydraulic effects described in paras. 5.5.27 to 5.5.30. Adult fish are considered to be less likely to be affected as they are able to move away from the turbid water. Effects on juvenile fish are considered to be **minor adverse,** with natural recovery of sediments anticipated, considering the medium-high (metropolitan) value of the receptor and low negative magnitude impact.

Invertebrates

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

5.5.35 There would be direct mortality of invertebrates within sediments removed or covered by the cofferdams and due to consolidation and disturbance of sediment during the site establishment phase. The effect is considered to be **negligible** due to the low negative magnitude of impact and medium (borough) value of the receptor.

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

5.5.36 The area beneath the temporary cofferdams would also be lost as burrowing and feeding habitat for invertebrates during the entire construction period. Subsequent excavation and removal of the granular fill material followed by reinstatement of substrate of comparable particulate material to the original substrate would facilitate recovery.

5.5.37 Given the medium (borough) value of the receptor and the low negative impact of habitat loss, the overall effect is considered to be **negligible**, particularly given the relatively limited loss of a burrowing and feeding resource.

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

5.5.38 The area beneath the temporary cofferdam would be subject to heavy consolidation, and hence would be unavailable to burrowing invertebrates in the medium term (one to five years) following removal of the cofferdam. The temporary consolidation and disturbance to the habitat for burrowing invertebrates is considered to be a **negligible** effect. This is because the receptor is of medium (borough) value, the impact of sediment disturbance and consolidation is considered to be low negative, and the effects are considered likely to be reversed upon recovery of the habitat, which would occur in the short term (less than 12 months).

Change to burrowing and feeding habitat due to scour and accretion

5.5.39 Whilst there may be some losses of fine material in the localised areas where scour is predicted, this is not anticipated to result in a change in the invertebrate community. The increase in the proportion of fine material associated with accretion may favour certain benthic invertebrates including the sediment dwelling Oligochaeta and Polychaeta. Oligochaeta are already the dominant benthic invertebrate group at the site and the change in the proportion of fine sediments is unlikely to change the overall community composition.

5.5.40 Overall, the effects are considered to be **negligible** due to the low negative magnitude of the impact and the medium (borough) importance of the receptor.

Reduction in water quality due to suspended sediment

5.5.41 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. However, high levels of suspended sediment which may occur as a result of a sudden scour event could give rise to localised reductions in DO and potentially, increases in the concentrations of contaminants.

5.5.42 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 (eg, 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.

5.5.43 The effects are considered to be **negligible**, when considering the low negative magnitude impact and medium (borough) value of the receptor.

Algae

Loss of habitat due to temporary landtake

5.5.44 The construction of a temporary cofferdam would mean that any algae would be lost from the area of wall within the structures, as the algae require regular tidal inundation in order to survive. However, given the low-medium (local) value of the receptor and the fact that algae are likely to re-colonise rapidly following removal of the cofferdams, the effect is considered **negligible**.

Blanketing of areas and increase in water column turbidity due to suspended sediment

5.5.45 As stated in para. 5.5.33, the tidal Thames is already a sedimentary environment with high levels of suspended solids. The generation of increased levels of suspended sediment from construction activities may cause smothering of marine algae.

5.5.46 Given the length and extent of cofferdam in contact with the tidal flow as described in para. 5.5.34, there is the possibility that re-suspended sediments may affect marine algae located on river walls immediately downstream. The value of the receptor is low-medium (local) and the impact considered low negative and therefore the effect is considered to be **negligible**.

Sensitivity test for programme delay

5.5.47 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 (paras. 5.5.1 to 5.5.46). 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.5.4.60 to 5.4.62.

5.6 Operational effects assessment

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

Operational impacts

Permanent landtake

5.6.2 There would be approximately 1,885m^2 of landtake from intertidal and 1,270m^2 from subtidal habitats (of which approximately 880m^2 would be from subtidal and 150m^2 from intertidal habitat associated with a permanent apron that would consist of buried rip-rap which would be overload with an appropriate substrate material). Permanent landtake would be associated with the cofferdam for the permanent CSO structures and permanent advancement of the river wall. The permanent foreshore structure would extend between approximately 20m and 30m into the channel and the majority of it would be located on the existing intertidal foreshore but would also encroach into the subtidal zone to a small extent.

Permanent landtake is certain and is considered to be a medium negative impact since the King Edward Memorial Park Foreshore site falls within the non-statutory River Thames and Tidal Tributaries SINC (Grade M) and includes areas of the London and UKBAP habitat mudflats.

Modification of habitat as a result of scour protection measures

5.6.3 The permanent in-river structures at the King Edward Memorial Park Foreshore site would include an apron to prevent residual discharges scouring the surrounding bed. Scour protection would also be provided around the perimeter of the permanent foreshore structure. Scour protection (including aprons) would comprise buried rip-rap. A total area of up to 1,030m^2 (of which 150m^2 would be from intertidal habitat and 880m^2 from subtidal habitat) is likely to be affected by scour protection at the King Edward Memorial Park Foreshore site. This is regarded as a low negative impact as habitat modification, rather than habitat loss, would result.

Change to scour and accretion patterns

5.6.4 The permanent foreshore structure would extend into the channel. Hydraulic modelling has shown that the structure would impact on scour patterns.

5.6.5 Scour protection would be provided beneath the new outfall where it extends below the mean low water line, in the form of an outfall apron, and along the line of the new river wall (to protect its foundation). The detailed design and extent of this shall seek to avoid or minimise adverse effects on aquatic ecology.

5.6.6 With the permanent structure in place, some sediment accumulation is predicted to occur immediately upstream of the permanent foreshore structure within the intertidal zone, with some occasional deposition predicted both immediately upstream and downstream of the permanent foreshore structure within the intertidal and subtidal zones. These predicted areas of sediment and accumulation are illustrated in Vol 13 Section 14 (Water resources – surface water).

5.6.7 Impacts on the intertidal and subtidal habitats and associated flora and fauna are considered to be low negative, probable and permanent, due to the reduced area likely to be subject to scour following incorporation of scour protection. Impacts due to accretion are considered to be negligible, probable and permanent.

Change to flow velocity

5.6.8 The presence of a permanent foreshore structure would result in alterations to the hydraulic regime, but these are considered to be very small (none greater than 0.1 m/s). This is considered a negligible impact.

Increases in dissolved oxygen concentrations in the vicinity of the CSO

5.6.9 The project Typical Year 90% decrease in the volume of discharges compared against the base case (see para. 5.2.8 would result in improvements in DO concentrations at a local level and throughout the tidal Thames. The Thames Tideway Tunnel improvements would ensure compliance with the DO standards described in para. 5.4.32. These improvements are assessed at a river wide level in Vol 3. The local impact in the vicinity of the King Edward Memorial Park Foreshore site is considered to be medium positive due to the relative large magnitude of the North East Storm Relief CSO, and impacts would be near certain and permanent.

Reduction in sediment nutrient levels

5.6.10 Elevated concentrations of nutrients (phosphate and nitrate) are likely to have accumulated in the sediments in proximity to the existing CSO discharge point as a result of the faecal material and sewage derived litter discharged from the CSO. In addition to the directly toxic effects of elevated ammonia (particularly in low oxygen situations) increased nutrients in the sediment can reduce the natural limits on algal growth and enable more nitrogen/phosphate responsive species to outcompete other species reducing diversity. Interception of the CSO would lead to a gradual reduction in sediment nutrient levels. The impact is considered to be low positive, probable and permanent.

Reduced levels of sewage derived litter

5.6.11 Sewage derived litter from the CSO can be expected to reduce by 90% from approximately 216t to approximately 21t, in the Typical Year with beneficial effects on aquatic ecology receptors. This is considered to be a low positive impact and would be near certain and permanent.

Operational effects

5.6.12 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.

5.6.13 Unless stated the effects described below apply to both Year 1 of operation and Year 6 of operation.

Designations and habitats

Permanent loss of intertidal habitats

5.6.14 There would be a permanent loss of approximately 1,735m^2 of intertidal and 393m^2 of subtidal habitat due to the permanent structure. A further 1,034m^2 (880m^2 would be from subtidal and 150m^2 from intertidal habitat) would be modified as a result of the scour protection measures and permanent apron. This would consist of buried rip-rap which would be overlaid with an appropriate substrate material.

5.6.15 The intrinsic value of the habitats in this area is considered to be relatively high, and the habitats are designated as having medium-high (metropolitan) importance as part of the River Thames and Tidal Tributaries SINC (Grade M). The effect is considered to be **moderate adverse** due to the magnitude of the impact (medium negative) and the medium-high (metropolitan) value of the receptor.

Change in intertidal and subtidal habitat due to accretion

5.6.16 The modelling results have predicted some changes in sediment accumulation and occasional deposition as a result of the permanent foreshore structure. Therefore overall the effect of accretion is considered to be **minor adverse**, given the medium-high (metropolitan) value of the receptor and low negative impact.

Improvements in habitat quality through changes in water quality

5.6.17 The predicted increases in DO concentrations and reductions in BOD would result in localised improvements in habitat quality. This may be characterised by increased levels of photosynthesis by microscopic algae at the interface with the sediment and within the water column, termed primary production. These algae form the basis of the estuarine food chain, providing a food source for fish and invertebrates. The gradual breakdown and removal of sewage derived litter associated with the sewage discharge would contribute to the recovery. However, habitats per se are relatively insensitive to alterations in DO concentrations, with reductions in sediment nutrient levels and sewage derived litter more important factors with regards to habitat quality improvements. Therefore the impact in this instance is considered to be of low positive magnitude, rather than medium positive. The effects are considered to **negligible** at Year 1 increasing to **minor beneficial** by Year 6, considering the medium-high (metropolitan) value of the receptor and low positive magnitude of impact.

Marine mammals

Increase in the number and/or change in the distribution of marine mammals

5.6.18 No changes are anticipated on marine mammals as a result of the water quality improvements associated with interception of a single CSO discharge. This is because they are relatively insensitive to point source sewage discharges. Improvements in habitat quality due to the reduction in sewage derived litter may make the habitat more favourable, although the factor determining its use by seals relates predominantly to the lack of disturbance rather than water quality. Effects are considered **negligible**, considering the low-medium (local) value of the receptor and the low positive impact magnitude.

Fish

Permanent loss of intertidal feeding and resting habitat for fish due to landtake

5.6.19 The site is not considered to offer suitable spawning habitat for smelt although surveys undertaken in 2011 indicate relatively high numbers of non-spawning smelt. Loss of 1,735m^2 of intertidal foreshore and 390m^2 of subtidal habitat is considered to be a medium negative impact. Given that the value of the receptor is medium-high (metropolitan) and the magnitude of impact medium negative, the effect on fish is considered to be **moderate adverse**.

Modification of intertidal feeding and subtidal habitat for fish

5.6.20 At the King Edward Memorial Park Foreshore site, scour protection would occupy an area of 1,030m^2.(of which 150m^2 would be intertidal habitat and 880m^2 of subtidal habitat). The rip-rap scour protection areas may offer some benefits to juvenile fish by providing refuges from the current and from predators. In this respect it is analogous to artificial reef structures created in the marine environment to provide shelter for fish and increase the heterogeneity of otherwise uniform habitats (Grove *et al*. 1991)[23].

5.6.21 Similarly, the rip-rap scour protection may offer shelter for pelagic invertebrates such as *Gammarus* which represent a food source for some fish species. It is unlikely to have potential as feeding habitat for benthic feeding fish except where accretion allows colonisation by invertebrates.

5.6.22 The effects on fish are considered to be negligible. This is because although the overall impact is low negative, the balance of positive and adverse effects for fish gives rise to a **negligible** effect.

Change in feeding, resting and nursery habitat for fish due to accretion

5.6.23 The modelling results have predicted some changes in sediment accumulation and occasional deposition as a result of the permanent foreshore structure. Increase levels of accretion may cause minor localised changes in the invertebrate community. However, this is not anticipated to limit the feeding opportunities for fish. The site does not lie within the zone in which smelt and dace are known to spawn and therefore there is no risk of smothering of spawning habitats due to sediment accretion. Therefore overall the effect of accretion is considered to be **minor adverse**, given the medium-high (metropolitan) value of the receptor and low negative impact.

Interference with migratory movements of fish

5.6.24 The Individual Based Modelling study shows that although the permanent works would provide less of a refuge than the temporary works no increased mortality risk due to juvenile fish being forced into deeper water is expected at this site. Although the permanent foreshore structure may force bass briefly into deeper water the increased mortality risk is considered negligible. The effect is therefore considered **negligible**, considering the medium-high (metropolitan) value of the receptor and negligible impact magnitude.

Reduction in the occurrence of dissolved oxygen related fish mortalities

5.6.25 Interception of the CSOs throughout the tidal Thames would result in far fewer hypoxia events. The TFRM has been used to predict the change in the number of hypoxia events, and the results are reported in Vol 3. In summary, all tidal Thames fish populations would become sustainable (i.e. less than 10% mortality as a result of hypoxia (Turnpenny *et al*, 2004)[24]), compared with the current baseline in which there is a greater than 10% mortality due to hypoxia for four key species (smelt, dace, flounder and common goby).

5.6.26 Interception of the North East Storm Relief CSO would contribute to tidal Thames improvement, but would also result in improvements in the local area (medium positive impact magnitude). Given the potential value of this site as an area for non-spawning smelt the effect is considered to be **moderate beneficial** on a medium-high (metropolitan) value receptor. Improvements across the tidal Thames as a whole are assessed in Vol3.

Increase in the distribution of pollution sensitive fish species

5.6.27 The Tidal Thames currently supports a small number of rare fish species such as salmon, sea trout, twaite shad and river lamprey (*Lampetra fluviatilis*). A number of factors limit the colonisation of habitats by these species, including salinity, substrate type and current, but pollution is known to be a significant factor in determining colonisation (Maitland and Hatton-Ellis, 2003)[25]. Improving water and sediment quality would facilitate the spread of those pollution sensitive species which are currently being impeded by poor water and sediment quality.

5.6.28 Project surveys have indicated that the area around the King Edward Memorial Park Foreshore site may be important for smelt (although not for spawning). However, no other rare fish species have been identified in the vicinity. Given that the impact is considered to be medium positive, and the value of the receptors is medium-high (metropolitan) the effect is thus considered to be **negligible** in the short term (Year 1), and **moderate beneficial** in the medium term (Year 6), since it would take time for recovery to occur.

Improvement in the quality of foraging habitat

5.6.29 Intertidal habitat in the upper and middle tidal Thames is used by juvenile fish for foraging. For example, juvenile flounder, bass and smelt migrate to the tidal limit in spring and early summer and then migrate downstream in search of suitable foraging habitat. As habitat quality improves as described in para. 5.6.17, and the invertebrate community becomes more diverse (para. 5.6.35 to 5.6.38) foraging opportunities for fish may increase. Given that the impact is considered to be medium positive, and the value of the receptors is medium-high (metropolitan), the effect is considered to be **negligible** in the short term (Year 1), increasing to **moderate beneficial** in Year 6 of operation as it would take time for communities to develop.

Invertebrates

Permanent loss of intertidal feeding and burrowing habitat for invertebrates due to landtake

5.6.30 The area beneath the permanent works would be lost as burrowing and feeding habitat for invertebrates. Given that the impact is considered to be medium negative and the value of the receptor is medium (borough), the effect is considered to be **minor adverse**.

Modification of intertidal and subtidal habitats for invertebrates by scour protection

5.6.31 As for fish, the degree to which the scour protection would change conditions for invertebrates depends on the nature of the existing substrate. Fine substrates are unlikely to accumulate extensively within the rip rap scour protection given the high flow velocities which are likely to occur in the vicinity of them. Benthic invertebrates may thus be excluded from these areas, except in sheltered pockets where accretion can occur.

5.6.32 Pelagic invertebrates such as *G. zaddachi* may be attracted to these areas in order to shelter from the current.

5.6.33 The overall effect on invertebrates is considered to be **minor adverse**, considering the medium (borough) value of the receptor and medium impact magnitude**.**

Change to burrowing and feeding habitat due to accretion

5.6.34 The modelling results have predicted no changes in sediment accumulation as a result of the permanent foreshore structure. The increase in the proportion of fine material associated with accretion may favour certain benthic invertebrates including the sediment dwelling Oligochaeta and Polychaeta. Oligochaeta are already the dominant benthic invertebrate group at the site and the change in the proportion of fine sediments is unlikely to change the overall community composition. Therefore overall the effect of accretion is considered to be **negligible**, given the medium (borough) value of the receptor and low negative impact.

Localised improvements in invertebrate diversity and abundance

5.6.35 Improvements in DO concentrations are likely to lead to an increase in the distribution of a range of species that are currently being suppressed by poor water quality conditions. Some of these improvements would occur under the base case due to the Lee Tunnel project and sewage treatment works upgrades. However, even with these improvements in place there are still predicted to be a number of occasions during an average year when DO standards would be breached. Colonisation by DO sensitive taxa such as Corophiidae, Crangonidae and Gammaridae which would otherwise occur within the brackish zone would continue to be suppressed.

5.6.36 Full compliance with the standards as a result of the Thames Tideway Tunnel is expected to enable colonisation by these DO sensitive taxa. In the localised areas around CSO discharges gradual reductions organic material associated with sewage would also allow for a transition from invertebrate communities dominated by small numbers of species to a more diverse and balanced community.

5.6.37 Improvements in water quality could theoretically selectively enhance colonisation by invasive, non-native species. However, studies on mitten crabs, for example, have determined that the species is able to tolerate poor water quality, but that improvement of water quality does not necessarily lead to an increased distribution (Veilleux and de Lafontaine, 2007)[26].

5.6.38 Given that the impact is considered to be medium positive, and the value of the receptors is medium (borough), the effect is considered to be

negligible at Year 1 and **minor beneficial** at Year 6, as it would take time for communities to establish.

Increase in the distribution of pollution sensitive invertebrate species

5.6.39 The tidal Thames currently supports a small number of rare invertebrate species, such as swollen spire snail and tentacled lagoon worm. A number of factors limit the colonisation of habitats by these species, including salinity, substrate type and current, but pollution is known to be an important factor in determining colonisation. Improving water and sediment quality would facilitate the spread of those pollution sensitive species which are currently being impeded by poor water and sediment quality.

5.6.40 EA data and bespoke project surveys have indicated one species of nationally rare (RDB) invertebrate, the mudshrimp (*A. lacustre*), present in the vicinity of the King Edward Memorial Park Foreshore site but this is locally very common, and habitat quality at this site is limited by a number of factors including the confinement of the river channel between vertical river walls. Given that the impact is considered to be medium positive, and the value of the receptors is medium (borough), the effect is thus considered to be **negligible** in Year 1, and **minor beneficial** in Year 6, as it would take time for species to colonise.

Algae

Permanent loss of original river wall

5.6.41 The algae that have previously been found on the river wall at the King Edward Memorial Park Foreshore site can be expected to recolonise the new river wall (ie, the outer wall of the permanent structure) relatively quickly following the completion of construction (within five years). As none of these species are uncommon (low-medium (local) value receptor) and the medium negative magnitude of impact, the effect is considered to be **negligible**.

Changes in algal communities

5.6.42 The reduction in nutrient levels, both in the water column and the sediments in the vicinity of the discharge may cause local changes to the algal communities of the river wall. Whilst it is not possible to predict these changes precisely it is likely that the reduction in nutrients would contribute to the recovery of algal flora, with pollution sensitive species becoming a more common component of the community at the expense of more pollution tolerant species.

5.6.43 However, habitat availability would remain a key factor determining the diversity and abundance of algal communities and so the effects associated with the Thames Tideway Tunnel project are considered to be **negligible**, due to the low-medium (local) value of the receptor and low positive magnitude of impact.

Sensitivity test for programme delay

5.6.44 For the assessment of effects on aquatic ecology 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 (paras. 5.6.1 to 5.6.43). 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. 5.4.63 to 5.4.66.

5.7 Cumulative effects assessment

5.7.1 As described in para. 5.3.12, during the construction phase there are no schemes within the site development schedule (Vol 21 Appendix N) that would have an impact on aquatic ecology receptors and so no cumulative impacts with the proposed development would arise.

5.7.2 During the operational phase there are similarly no schemes that could lead to a cumulative impact at the King Edward Memorial Park Foreshore site.

5.7.3 Therefore the effects on aquatic ecology would remain as described in Sections 5.5 and 5.6 above.

Sensitivity test for programme delay

5.7.4 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 paras. 5.7.1 to 5.7.3, 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 and compensation

Mitigation

5.8.1 The approach to mitigation has been informed by the ‘Mitigation and Compensation Hierarchy’ consulted on with the Thames Tideway Tunnel Biodiversity Working Group and EA Technical Working Group as a systematic and transparent decision-making process. The hierarchy is appended to Vol 2.

5.8.2 The hierarchy is sequential and seeks to avoid adverse environmental effects. The hierarchy of ‘avoid effect’, ‘minimise’, ‘control’ ‘compensate’, and ‘enhance’ has been strictly applied in this sequence.

5.8.3 All *CoCP* and embedded design measures of relevance to aquatic ecology are summarised in Section 5.2. The permanent loss of intertidal habitat in itself and as a feeding and resting habitat for fish is considered to be a moderate adverse effect. The footprint of the permanent structure has been minimised as far as possible to accommodate the necessary works. Therefore, further mitigation on-site is not possible.

5.8.4 During operation, the permanent loss of habitat at the King Edward Memorial Park Foreshore site contributes to an overall loss of habitat arising from all of the foreshore sites. Compensation for this project-wide permanent loss of foreshore habitat is described in Vol 3.

5.8.5 A monitoring programme to measure the recovery of aquatic ecology receptors throughout the tidal Thames following interception of the CSO network would be implemented.

Compensation

5.8.6 Significant adverse effects would occur due to the permanent loss of intertidal and subtidal habitats, and intertidal feeding and resting habitat for fish. On site habitat compensation is not considered possible due to the limited availability of land to create new habitat within the boundary of the site. A package of off site measures which would compensate for significant adverse effects on habitats and fish has been developed and is reported in full in Vol 3 Section 5.8. It includes measures such as the creation of an intertidal terrace on the Bell Lane Creek, and the installation of fish passes on several structures which are currently inhibiting the migration of fish from the tidal Thames into freshwater tributaries.

5.9 Residual effects assessment

Construction effects

5.9.1 As no further mitigation measures are proposed in addition to the *CoCP* requirements, the residual construction effects remain as described in Section 5.5. All residual effects are presented in Section 5.10.

Operational effects

5.9.2 Compensation for the overall permanent habitat loss across the Thames Tideway Tunnel project is considered in the project-wide assessment (Vol 3). At a project wide level the total habitat losses have been addressed through creation/ enhancement of sites along the route of the Thames Tideway Tunnel to compensate for adverse effects on aquatic ecology. The loss of habitat at the King Edward Memorial Park Foreshore site has been reported here without taking account of any compensation sites. This is to ensure that the local effects are presented. However, it is recognised that aquatic ecological resources are highly mobile and river-wide. Reference should therefore be made to the project wide assessment which includes the compensation sites to understand the total effects anticipated to result from the Thames Tideway Tunnel project.

5.9.3 As no other mitigation is required all other effects remain as reported in section 5.6.

5.10 Assessment summary

Vol 21 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 habitat due to temporary landtake	Minor adverse	None	Minor adverse
	Disturbance and consolidation of intertidal and subtidal habitat	Minor adverse	None	Minor adverse
	Change in intertidal and subtidal habitat due to scour and accretion	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 temporary landtake	Minor adverse	None	Minor adverse
	Loss of feeding, resting and nursery habitat for fish due to sediment consolidation	Minor adverse	None	Minor adverse

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
	and disturbance			
	Change in feeding, resting and nursery habitat for fish due to scour and accretion	Minor adverse	None	Minor adverse
	Interference with migratory movements of fish	Negligible	None	Negligible
	Effects of waterborne noise and vibration on fish	Minor adverse	None	Minor adverse
	Reduction in water quality due to suspended sediment.	Minor adverse	None	Minor adverse
Invertebrates	Direct mortality of invertebrates due to temporary landtake, sediment disturbance and consolidation	Negligible	None	Negligible
	Loss of feeding/burrowing habitat for invertebrates due to landtake	Negligible	None	Negligible
	Loss of feeding/burrowing habitat for	Negligible	None	Negligible

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
	invertebrates due to sediment consolidation and disturbance.			
	Change to burrowing and feeding habitat due to scour and accretion	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
	Blanketing of areas and increase in water column turbidity due to suspended sediment.	Negligible	None	Negligible

Vol 21 Table 5.10.2 Aquatic ecology – summary of operational assessment

Receptor	Effect	Significance of effect		Mitigation	Significance of residual effect	Compensation
		Year 1	Year 6			
Designated sites and Habitats	Permanent loss of designated intertidal habitat	Moderate adverse	Moderate adverse	None	Moderate adverse	Compensation would be provided through a suite of off-site habitat creation schemes which are described in the project-wide volume (Vol 3)
	Improvements in habitat quality through changes in water quality	Negligible	Minor beneficial	None	Minor beneficial	None
	Change in intertidal and subtidal habitat due to accretion	Minor adverse	Minor adverse	None	Minor adverse	None
Marine mammals	Increase in the number and/or change in the distribution of marine mammals.	Negligible	Negligible	None	Negligible	None
Fish	Permanent loss of	Moderate adverse	Moderate adverse	None	Moderate adverse	Compensation

Receptor	Effect	Significance of effect		Mitigation	Significance of residual effect	Compensation
		Year 1	Year 6			
	intertidal feeding and resting habitat for fish.					would be provided through a suite of off site habitat creation schemes which are described in the project-wide volume (Vol 3)
	Modification of intertidal feeding and subtidal habitat for fish	Negligible	Minor beneficial	None	Minor beneficial	None
	Change in feeding, resting and nursery habitat for fish due to accretion	Minor adverse	Minor adverse	None	Minor adverse	None
	Interference with migratory movements of fish	Negligible	Negligible	None	Negligible	None
	Reduction in the occurrence of dissolved oxygen related fish mortalities.	Moderate beneficial	Moderate beneficial	None	Moderate beneficial.	None
	Increase in the	Negligible	Moderate	None	Moderate	None

Receptor	Effect	Significance of effect		Mitigation	Significance of residual effect	Compensation
		Year 1	Year 6			
	distribution of pollution sensitive fish species.		beneficial		beneficial.	
	Improvement in the quality of foraging habitat	Negligible	Moderate beneficial	None	Moderate beneficial	None
Invertebrates	Permanent loss of intertidal feeding and burrowing habitat for invertebrates.	Minor adverse	Minor adverse	None	Minor adverse	None
	Modification of intertidal feeding and subtidal habitat for invertebrates	Minor adverse	Minor adverse	None	Minor adverse	None
	Change to burrowing and feeding habitat due to accretion	Negligible	Negligible	None	Negligible	None
	Localised improvements in invertebrate diversity and abundance.	Negligible	Minor beneficial.	None	Minor beneficial	None
	Increase in the distribution of pollution sensitive	Negligible	Minor beneficial	None	Minor beneficial	None

Receptor	Effect	Significance of effect		Mitigation	Significance of residual effect	Compensation
		Year 1	Year 6			
	invertebrate species.					
Algae	Permanent loss of original river wall	Negligible	Negligible	None	Negligible	None
	Changes in algal communities	Negligible	Negligible	None	Negligible	None

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

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Section 6: Ecology - terrestrial

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Thames Tideway Tunnel

Environmental Statement

Volume 21: King Edward Memorial Park Foreshore 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 King Edward Memorial Park Foreshore site.

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 in the foreshore

d. 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 is minimal (the park is closed at night so lighting is not required other than for maintenance) and complies with the lighting design principles to minimise light spill, and also that 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 by the pattern of existing development. 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. 6.4.27).

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*

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[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).

(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 (Volume 21 King Edward Memorial Park Foreshore 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 29 trees, introduced shrub and amenity grassland, and the pruning of 15 others adjacent to the proposed development site boundary

b. construction works that would create noise and vibration, such as the use of construction machinery and vehicles

c. artificial lighting of the site in evenings during winter

d. construction of permanent and temporary structures, including a temporary cofferdam, within the foreshore

e. use of barges and the associated temporary campshed on the foreshore

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

Code of construction practice

6.2.3 The *Code of Construction Practice* (*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 terrestrial ecology impacts:

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. a minimum clearance of 4.5m from the trunk of the leylandii trees along the access route, to protect the roots of the trees. This exclusion zone would also avoid a notable fungus.

a. protection of the river bed during works and 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 project design:

a. where practicable, trees removed would be replaced as close as possible to the current position or within close proximity to the site

b. large tree species would be planted along the river frontage

c. bird and bat boxes would be attached to trees on site at the end of construction to attract a range of nesting bird species, and common pipistrelle and noctule bats.

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*. Specific comments relevant to this site for the assessment of terrestrial ecology are presented here in Vol 21 Table 6.3.1.

Vol 21 Table 6.3.1 Terrestrial ecology – stakeholder engagement

Organisation	Comment	Response
London Borough of Tower Hamlets (Response to position paper – February 2011)	The Biodiversity Officer was happy with the methodology proposed for terrestrial ecology. A suggestion was made that protected species be referred to as notable species to ensure that those species that are not protected are considered within the assessment. The Biodiversity Officer also drew attention to the need to consider lighting impacts on bats during construction.	Both legally protected species and those that are of conservation interest are referred to as notable species within the *Environmental Statement*. The impacts of lighting on bats are considered as appropriate, including within this volume section 6.5.

Baseline

6.3.2 The baseline methodology follows the methodology described in Vol 2. In summary, the following baseline data has been reported in this assessment:

a. desk study

b. a Phase 1 Habitat Survey was undertaken on 26 October 2010

c. bat triggering surveys (remote recording surveys) were undertaken over three nights between 3 and 5 May 2011

d. bat activity (dawn) surveys were undertaken on 1 July 2011

e. wintering bird surveys were undertaken on 17 December 2010 and 26 January, 25 February, 16 March, 13 October and 14 November 2011

f. an invasive plant survey (species listed on Schedule 9 of the Wildlife and Countryside Act 1981) was undertaken on 16 August 2011.

Construction

6.3.3 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.

6.3.4 The term significance is used within this volume to refer to project 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 significant and therefore do not require mitigation. These significance criteria and their relationship with levels of significance based on the Institute for Ecology and Environmental Management guidelines (IEEM, 2006)[2] is given in Vol 2 Section 6.

6.3.5 No effects on habitats are predicted beyond 10m of the site boundary. Therefore, the assessment area for habitats 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 King Edward Memorial Park Foreshore 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 proposed developments in Vol 21 Appendix N that would be complete and operational during construction, due to the isolated location of these developments from the proposed development site, within the urban context.

6.3.9 There are no proposed development projects in the vicinity of the proposed development site that would be under construction during the construction phase of the Thames Tideway Tunnel project. Therefore, no cumulative effects of construction activities are considered for King Edward Memorial Park Foreshore site (Section 6.7).

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.

Assumptions

6.3.12 It is assumed for the purposes of this assessment that the current use of King Edward Memorial Park will continue between the time of ecological surveys and the first construction year.

Limitations

6.3.13 No site-specific limitations have been identified.

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 21 King Edward Memorial Park Foreshore 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 21 Figure 6.4.1 (see separate volume of figures):

a. King Edward Memorial Park lies adjacent to the River Thames Tidal Tributaries Site of Importance for Nature Conservation (SINC) (Grade M[ii]) comprising 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.

b. Shadwell Basin SINC (Grade L[iii]) is located approximately 20m to the southwest of the site. It comprises an area of open water supporting breeding and wintering birds.

c. St Paul's Churchyard SINC (Grade L[iii]) is located approximately 50m to the west of the site.

d. Cable Street Community Garden SINC (Grade B[iv]) is located approximately 200m north of the site. It comprises a community garden used to grow organic flowers and vegetables and to create a haven for wildlife in the city, including fruit trees, berry bushes and numerous mini-ponds.

Habitats

6.4.3 Habitats recorded within the survey area during the Phase 1 Habitat Survey are described in Vol 21 Table 6.4.1 below and shown on Vol 21 Figure 6.4.2 (see separate volume of figures). Target notes (TN#) are indicated on this map and are referred to within the text below.

Vol 21 Table 6.4.1 Terrestrial ecology – Phase 1 Habitat Survey

Habitat type / feature of note	Habitat description
Hardstanding	Hardstanding is present around the park in the form of pathways. The Thames Path runs along the top of the foreshore.

[ii] SINC (Grade M) = Site of Nature Conservation Importance (Grade M of Metropolitan importance)
[iii] SINC (Grade L) = Site of Nature Conservation Importance (Grade L of Local importance)
[iv] SINC (Grade B) = Site of Nature Conservation Importance (Grade B of Borough importance)

Habitat type / feature of note	Habitat description
	Tennis courts and asphalt recreational areas are present on and adjacent to the site.
Buildings	Buildings within the survey area comprise single storey units associated with the Bowling Club to the northwest of the site. There are also a small number of portacabins in this area, which are associated with grounds maintenance. Adjacent to the foreshore in the south of the survey area, a building to house air management plant and equipment is present associated with the Rotherhithe tunnel (TN1).
Amenity grassland	Located in the centre of the park and partially within the site are two large areas of mown amenity grassland bisected by hardstanding pathways. An area of amenity grassland is present in the southeast of the survey area, adjacent to the Thames Path. A bowling green is located in the northwest of the park, to the north of the site.
Semi-improved grassland	Grassland to the northeast of the site has been planted with wild flowers. A native species border is also located along the eastern boundary of the park to the northeast of the site. Signage indicates that species include Welsh poppy (*Meconopsis cambric)* and common chicory (*Cichorium intybus)*.
Scattered trees	A continuous tree line comprising Leyland spruce (TN2) is present on site along the southern boundary. Native and ornamental non-native trees are scattered throughout the park. Remnants of avenues of trees are present along the footpaths through the park. Of note is the line of trees around the children's play area in the southwest of the site
Introduced shrub	Mature, species diverse areas of introduced shrubs are located around the park adjacent to the site. Raised areas along the northern boundary of the park comprise dense areas of planting with a mixture of native and non-native species. The introduced shrub includes several invasive plant species including a number of *Cotoneaster* sp., montbretia (*Crocosmia x crocosmiifliora)* and a further horticultural variety of montbretia *Crocosmia x crocosmiiflora* var. 'lucifer'. A further area of mature introduced shrub is located in the south of the park.

Habitat type / feature of note	Habitat description
Standing water – pond	A small ornamental pond is located adjacent to tennis courts in the west of the park, to the north of the site.
Running water and intertidal habitat	Intertidal mudflats are present in the southeast of the site and are exposed at low tide. This habitat type is part of the aquatic ecology assessment (see Section 5 of this volume).
Other	A green wall (TN3) is present in the north of the survey area (off-site). Climbing plants create a relatively dense and continuous vegetated feature along this section.
	Bird boxes were noted on a number of the trees around the park.
	A dead wood pile was located in the south of the wildflower meadow, to the northeast of the site. Individual logs were also present under the line of trees here (TN4).

6.4.4 Buildings and hardstanding are not considered to have biodiversity value as habitat and therefore are of negligible value.

6.4.5 The site includes the London BAP habitat ‘Parks, Squares and Amenity Grassland’. Semi-natural habitats such as these are valuable in the otherwise urban landscape of London, attracting wildlife from a wide area for foraging and breeding. The value of any one area of semi-natural habitat is dependent on the overall availability of this habitat within the town, borough and wider London metropolitan area.

6.4.6 The amenity grassland on site is species-poor, common in most park areas and can easily be recreated. It provides some limited value as a semi-natural habitat within an otherwise urban area. This habitat is of low (site) value.

6.4.7 Scattered trees are present on site. The Leyland spruce trees in the south of the site are non-native and are of limited biodiversity value. Therefore, these trees are considered to be of low (site) value.

6.4.8 The remaining scattered trees within King Edward Memorial Park mainly comprise native species as well as non-native species that are considered to provide biodiversity value. The tree species present are common in the UK and the southeast of England but less common in London due to the urban hard landscaping that dominates the city. Trees are generally limited to the many parks and squares scattered throughout London. However, native mature trees are uncommon within the local area, with few street trees and only limited similar semi-natural areas. Therefore, the scattered trees on site are considered to be of low-medium (local) value.

6.4.9 The introduced shrubs on site mainly comprise non-native invasive species and are considered to provide limited value as a habitat type. Therefore, the introduced shrub habitat is considered to be of negligible value.

6.4.10 The other features of note recorded in Vol 21 Table 6.4.1 are not relevant to the assessment of effects on habitats and are therefore not valued in their own right, however they form part of habitat available within the survey areas for notable species.

Notable species

6.4.11 Survey results are set out in a notable species report, which is included in Vol 21 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

6.4.12 During the Phase 1 Habitat Survey, the potential for roosting bats was identified within the Rotherhithe Tunnel Air Shaft adjacent to the south of the site. Mature lines of trees (primarily around the children's play area, adjacent to the air shaft building) could be used by bats as commuting corridors through the area and as foraging habitat. The potential for bats to forage and commute along the River Thames was also identified during the Phase 1 Habitat Survey. Therefore, remote recording surveys and an activity survey at dawn were undertaken for bats.

6.4.13 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 in addition to a mouse-eared species *(Myotis* sp.*)* or other unidentified bat species were recorded on site. Detailed survey results are provided in Vol 21 Appendix D.1 and on Vol 21 Figure 6.4.3 (see separate volume of figures).

6.4.14 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, 1995)[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.

6.4.15 During the remote recording surveys, the maximum number of common pipistrelle bat passes was 31 at location one and 59 at location two. The activity (dawn) survey also identified common pipistrelle activity with bats commuting along the River Thames and foraging along tree lines within King Edward Memorial Park. Of the ten common pipistrelle passes recorded in the activity (dawn) survey, three were within an hour of dawn indicating that there are likely to be common pipistrelle roosts in the wider area. However, no common pipistrelle roosts were identified within the survey area.

6.4.16 Given the conservation status of common pipistrelle, that it is common relative to other UK bat species, it was recorded in moderate numbers and the population is likely to be associated with at least one nearby roost, the common pipistrelle population associated with the site is considered to be of low-medium (local) value.

6.4.17 Soprano pipistrelle was only recorded during the remote recording survey in one location with a maximum number of three bat passes recorded in any one night. This species was not recorded during the dawn survey. The survey results indicate that soprano pipistrelle bats occasionally use the River Thames corridor for commuting and the vegetation on site for foraging purposes. With consideration to the conservation status of soprano pipistrelle and that only one individual was recorded, the soprano pipistrelle population associated with the site is considered to be of low (site) value.

6.4.18 Noctule was recorded using the site only on one occasion during the remote recording surveys when two bat passes were recorded. This species was not recorded during the dawn survey. 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.

6.4.19 Small numbers of an unidentified bat species (a mouse-eared bat or noctule) were recorded during the remote recording surveys. As very small numbers of bat passes were recorded, it is considered likely that this species is an occasional visitor to the site. It is considered unlikely that this species is particular rare and therefore this resource is considered to be of low (site) value.

Breeding birds

6.4.20 The Phase 1 Habitat Survey identified the scattered trees on site to have some potential to support nesting birds. There are nesting opportunities along the southern boundary of the site and in patches of scrub vegetation on site This habitat is limited in extent and it was therefore not considered necessary to undertake breeding bird surveys of the site.

6.4.21 Limited nesting or foraging opportunities for birds are present on the site itself. Birds may use the scattered trees for nesting purposes and are likely to comprise species common to the area. However, the number of nests that the site could support is considered to be relatively small. There are further opportunities for nesting birds in the wider King Edward Memorial Park within shrubs and scattered trees. In view of the low abundance of these habitats within the highly urbanised wider area, the bird resource is likely to be of low-medium (local) value.

Wintering birds

6.4.22 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 21 Appendix D.1 and shown on Vol 21 Figure 6.4.4 (see separate volume of figures).

6.4.23 A total of ten waterbird[v] species were recorded within the survey area. Of these, six are of conservation concern and are included on the Birds of Conservation Concern 3 (RSPB, 2009)[5] Red or Amber List and/or UK and London BAP as priority species:

a. Mallard (*Anas platyrhynchos),* 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 on the foreshore on site and on adjacent foreshore habitat.

b. Unexpected numbers of gulls were recorded during the December 2010, and January and February 2011 survey visits at this location as birds were fed by the public from the park. This attracted gulls to the site.

c. Moored barges at the pier to the northeast of the site were regularly used by resting gulls and cormorants.

6.4.24 The records of waterbirds of nature conservation importance recorded on the foreshore on and adjacent to the site were compared to counts at other sites published in the London Bird Report 2007 (London Natural History Society, 2011)[6].

6.4.25 Notable waterbird species associated with the foreshore habitat were recorded in low and moderate numbers relative to their London populations. Taking into account the influence of bird feeding by the public on gull numbers, any population of one individual species of conservation concern is considered to be of low-medium (local) value. The remaining four waterbird species that are not considered to be notable would each be of no more than low (site) value.

[v] 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.

Vol 21 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
Mallard	*Anas platyrhynchos*	Amber List	Recorded on four survey visits, with a maximum count of six in November 2011 and numbers varying between one and five in other months	Low-medium (local)
Black-headed gull	*Larus ridibundus*	Amber List	Recorded on each survey visit, with a maximum count of 86 in December 2010 and numbers varying between four and 64 in other months	Low-medium (local)
Common gull	*Larus canus*	Amber List	Recorded on two survey visits, with joint maximum counts of three in January and November 2011	Low-medium (local)
Lesser black-backed gull	*Larus fuscus*	Amber List	Recorded on each survey visit, with joint maximum counts of 6 in March and October 2011 and numbers varying between two and five in other months	Low-medium (local)
Herring gull	*Larus argentatus*	Red List and UK and London BAP Priority List	Recorded on each survey visit, with joint maximum counts of eight in December 2010 and March 2011 and numbers varying between two and three in other months	Low-medium (local)
Great black-backed gull	*Larus marinus*	Amber List	Recorded on four survey visits, with a maximum count of two in October 2011 and singles in other months	Low-medium (local)

[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].

Fungi

6.4.26 The daisy earthstar (*Geastrum floriforme*) has been identified on site beneath the row of Leylandii in the south of the site, as shown on Vol 21 Figure 6.4.5 (see separate volume of figures) and detailed in Vol 21 Appendix D.1. This species is scarce in the UK although it is not listed in any red data book. It is considered rare in London having been identified in a small number of sites. However, it may be rare due to under-recording. This species is listed on the London BAP as a priority species. Given the conservation status and rare occurrence of this species in London, the daisy earthstar at King Edward Memorial Park is considered to be of moderate-high (metropolitan) value.

Invasive plants

6.4.27 The invasive plant species montbretia was recorded on site along the proposed access road between the site compound and the foreshore works area as shown on Vol 21 Figure 6.4.6 (see separate volume of figures). This species is assumed to have been planted in the park and is an invasive species listed on Schedule 9 Part II of the Wildlife and Countryside Act 1981 (as amended). It is illegal to cause this species to spread or grow in the wild. Invasive plants are not considered further within this assessment as the eradication and control of such invasive species would be managed in advance of site clearance and by the measures set out in the *CoCP* Part A (Section 11), as discussed in para. 6.1.4c.

Noise, vibration and lighting

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

6.4.29 Current sources of noise and vibration are mainly derived from vehicle movement along adjacent roads most notably The Highway and noise associated with general public use of the park.

6.4.30 At night the site is unlit but subject to low levels of light spill from adjacent streetlights and properties.

Construction base case

6.4.31 Assuming use of the site continues as at present, conditions at the first year of construction would be the same as the current baseline conditions.

6.4.32 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 of low-medium (local) value, amenity grassland of low (site) value, and introduced shrubs, buildings and hardstanding of negligible value would be removed as part of site clearance. This reduces the availability of nest sites for breeding birds. Tree protection measures would be in place to prevent impacts on trees adjacent to the site, as detailed in the *CoCP* Part A (Section 11).

6.5.2 Replacement tree planting would be provided. Bird and bat boxes would also be provided on site, increasing the availability of nesting and roosting opportunities in the area. The daisy earthstar fungus would be protected during works by exclusion fencing. Dust that could also affect this fungus would be controlled through measures in the *CoCP* Part A. Site supervision would ensure that the fecundity and distribution of this species is maintained.

6.5.3 There would be temporary loss of foreshore habitat for wintering birds during construction from the temporary in-river structures. The majority of the foreshore would be reinstated. The use of a campshed would also result in the temporary loss of habitat for wintering birds and bats on the foreshore of the River Thames. The foreshore would be reinstated following removal of the campshed and temporary structures at the end of construction. However, a small area of foreshore would be permanently lost to the structure proposed within the foreshore. This is likely to affect wintering birds that use the foreshore for foraging and resting.

Movement, noise, vibration and lighting

6.5.4 Noise and vibration impacts are based upon the data and assessment in Section 9 of this volume. Noise and vibration would be likely to increase during construction over current baseline levels with the greatest increases in noise levels experienced during shaft sinking. These activities could cause disturbance to wintering birds on the foreshore adjacent to the site, and breeding birds adjacent to the site. Noise and vibration from construction activities are unlikely to affect bats as the majority of the works would be undertaken during the day and bats fly through the site at night.

6.5.5 Construction would require there to be some lighting in the early morning and evening during the winter months to facilitate standard working hours. Whilst current background levels are low, 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). Construction lighting would be directed away from dark vegetated areas around the park, used by bats for commuting and foraging. Therefore, the change in light levels is likely to be small.

6.5.6 As no bat roosts have been identified immediately adjacent to the site, bats are only likely to be present within habitat adjacent to the site whilst foraging and commuting at night. Noise and vibration from construction activities are unlikely to affect bats as the majority of the works would be undertaken during the day and bats fly through the site at night.

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

Barging and associated facilities

6.5.8 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. Therefore, some disturbance from lighting is anticipated on wintering birds and commuting bats.

6.5.9 The movement of barges in and out of the site 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

6.5.10 Habitat to be lost during construction comprises low-medium (local), low (site), and negligible value habitat. Replacement planting would be provided for trees would be provided, resulting in no overall loss in habitats of low or low-medium value in the long-term. Therefore, the effect is probable, **negligible** and not significant.

Species

Bats

6.5.11 There would be temporary loss of foraging habitat for bats on site. However, the majority of habitat in the wider King Edward Memorial Park such as trees and wildflower planting would be retained. Foraging habitat would be reinstated following completion of the works. Therefore, bats that forage on site are likely to continue foraging with the wider park and other areas of similar habitat. This is unlikely to result in a change to local bat populations. Therefore, the effect is considered to be probable, **negligible** and not significant.

6.5.12 The presence of lighting of the barge facilities and small changes in light levels during evening construction works are unlikely to create a barrier to the movement of commuting bats. Common and soprano pipistrelle bats can tolerate relatively high light levels, up to 14 lux, while noctule bat can tolerate much lower light levels (c. 3 lux) but tend to fly at a greater height. There may be some slight changes in bat behaviour as bats would need to commute over or around the barge facilities. The River Thames is a wide corridor at this point, and the function of this habitat is likely to be maintained. As there are currently no roosts on or adjacent to the site, there would be no disturbance to roosting bats. It is considered unlikely that changes in light levels and subsequent changes in 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**.**

6.5.13 The provision of bat boxes would be beneficial for bats although the significance of the effect on bats cannot be predicted with any level of certainty as the number, location and type of bat box is to be agreed with the local authority. Therefore, the significance of the effect on bats is considered to be probable, **negligible** and not significant.

Breeding birds

6.5.14 There would be temporary loss of nesting opportunities along the southern boundary of the site and in tree and patches of scrub vegetation on site. As the number of breeding territories is likely to be small relative to their existing populations, it is considered unlikely that the loss of nesting habitat for a small number of birds would result in perceptible changes to their populations. Therefore, this effect is considered to be probable, **negligible** and not significant.

6.5.15 Birds on and adjacent to the site are likely to habituate to changes in noise and vibration levels, and disturbance from lighting would be minimised through measures set out in the *CoCP* Part A (Section 11). Suitable breeding bird habitat is available within the wider area and any birds displaced could move to these areas. Also, the breeding bird resource associated with the site is small. Any change in populations would not be perceptible against background population fluctuations. The displacement effect would be reversed following the completion of construction works. Therefore, the effect of disturbance on breeding birds is considered to be probable, **negligible** and not significant.

6.5.16 The provision of bird boxes would be beneficial for birds although the significance of the effect on birds cannot be predicted with any level of certainty as the number, location and type of bird box is to be agreed with the local authority. Therefore, the significance of the effect on birds is considered to be probable, **negligible** and not significant.

Wintering birds

6.5.17 There would be temporary loss foraging and resting habitat on the foreshore for wintering birds due to construction activities within the foreshore and the presence of the temporary cofferdam and campshed. This is likely to result in the displacement of wintering birds to elsewhere along the foreshore of the River Thames. Following reinstatement of the foreshore, wintering birds are considered likely to return to the site. The permanent loss of an area of foreshore is small relative to the total area of foreshore available along the River Thames for foraging and resting wintering birds. 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 probable, **negligible** and not significant.

6.5.18 Birds may be displaced from adjacent foreshore habitat due to small changes in disturbance from noise, vibration and the movement and wash of barges. Occasional displacement of birds is expected where sudden noises occur and when barges pass close by, with small numbers of wintering birds 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 probable, **negligible** and not significant.

6.5.19 Changes in light levels with control measures in place are considered to be small and are unlikely to affect wintering birds adjacent to the site. Therefore, the effect of disturbance on wintering bird populations is probable, **negligible** and not significant.

Fungi

6.5.20 The daisy earthstar fungus would be protected and monitored during works to ensure that the fecundity and distribution of this species is maintained. A significant effect on the population and distribution of this species is considered unlikely. Therefore, the effect is considered to be probable, **negligible** and not 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 - 6.5.9). This is because there are no developments in the site development schedule (see Vol 21 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 Section 6.4.

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 As stated in para. 6.3.9, there are no proposed developments in the vicinity of the site that would be under construction during the construction phase of the Thames Tideway Tunnel project. Therefore, no cumulative effects on terrestrial ecology are anticipated.

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. 0, 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.

6.8.2 The townscape and visual assessment (Section 11) has also identified the opportunity for advance tree planting to help reduce townscape and visual effects during construction. If implemented, this would result in a moderate beneficial effect on habitats. However, agreement to undertake advanced planting at this location has not been gained with the local authority and land owner.

6.9 Residual effects assessment

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 21 Table 6.10.1 Terrestrial ecology – construction assessment summary

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Habitats				
Hardstanding, amenity grassland, scattered trees and intertidal mudflats.	Temporary loss of habitats of low-medium (local) and low (site) value with reinstatement on completion of works.	Negligible	None	Negligible
Species				
Bats	No change in bat populations as a result of temporary displacement of foraging bats from the site to the surrounding area due to habitat loss on site.	Negligible	None	Negligible
	No significant changes to bat populations as a result of disturbance from lighting.	Negligible	None	Negligible
	No significant changes to bat populations as a result of the provision of bat boxes.	Negligible	None	Negligible
Breeding birds	No significant change in breeding bird populations as a result of habitat loss, with habitat reinstated on	Negligible	None	Negligible

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
	completion of works.			
	No change in bird populations as result of low levels of disturbance from noise, vibration and lighting.	Negligible	None	Negligible
	No predicted change in bird populations as a result of the provision of bird boxes	Negligible	None	Negligible
Wintering birds	No significant change in bird populations as a result of temporary habitat and permanent habitat loss on site.	Negligible	None	Negligible
	No significant change in wintering bird populations as a result of disturbance from noise, vibration and wash from passing barges.	Negligible	None	Negligible
	No significant changes in populations of wintering birds due to increases in light levels during construction activities.	Negligible	None	Negligible
Fungi (daisy earthstar)	No significant change in the fecundity or distribution of this species as they will be protected during works.	Negligible	None	Negligible

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.21**

Volume 21: King Edward Memorial Park Foreshore site assessment

Section 7: Historic environment

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Thames Tideway Tunnel
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Thames Tideway Tunnel

Environmental Statement

Volume 21: King Edward Memorial Park Foreshore 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 of the proposed development on the historic environment at the King Edward Memorial Park Foreshore site. The historic environment is defined in para 4.10.2 of the National Policy Statement for Waste Water (NPS)[1] 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 buried and above-ground archaeological remains, buildings, structures, monuments and heritage landscapes within and around the site. Effects during construction and operation are assessed with effects on buried assets presented first, followed by above-ground assets.

7.1.2 The construction assessment includes an assessment of the effects of ground movement generated by tunnelling and deep excavations (in this case ground settlement). As the ground movement would be generated by construction activity and any damage would be greatest for the period of construction, an assessment has not been undertaken of operational effects on above ground heritage assets from ground movement. An assessment of effects from ground movement resulting from the whole Thames Tideway Tunnel project is covered in Vol 3 Project wide effects.

7.1.3 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.

7.1.4 Once the proposed development is operational, scour protection around foreshore structures would prevent scour affecting heritage assets. In the deeper mid-channel of the river, where contraction scour may occur, it is unlikely that archaeological remains would be present. 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 The assessment of the historic environment effects of the project has considered the requirements of the NPS. 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.

7.1.7 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Volume 21 King Edward Memorial Park Foreshore Figures).

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. Those deep excavations and demolitions in the vicinity of the listed Rotherhithe Tunnel Air Shaft would cause ground movement that could potentially induce damage to the listed building. These works are described below.

7.2.3 Demolition works would involve the removal of several structures on the landward side of the river wall, including fencing, a park maintenance compound, and a playground in the southwestern part of the site. A bandstand and benches in the eastern part of the site would be removed and either stored offsite or relocated within the park. The handrails and plinth of the existing river wall within the site would also be removed, along with a foreshore protection apron (part of the North East Storm Relief sewer) in the eastern part of the site. A number of existing trees along the southern edge of the park would be removed (see Demolition and site clearance plan, separate volume of figures - Section 1).

7.2.4 The setting up of the construction compound on the landward side of the existing river wall would be likely to entail preliminary site stripping, assumed for the purposes of this assessment to reach a depth of approximately 0.5m below-ground level (bgl). Site fencing would be erected, supported by timber posts in concrete foundations. Office, storage and welfare facilities on the landward side of the existing river wall would be constructed on pad foundations with a depth of approximately 1.0m bgl, as assumed for the purposes of this assessment. Site setup would also entail the diversion of an existing electricity cable running along Glamis Road and the construction of a new surface water drainage trench up to an assumed maximum depth of 1.0m bgl (see see separate volume of figures - Section 1).

7.2.5 A temporary cofferdam would be constructed on the foreshore adjacent to the river wall in the southeastern part of the site. For structural reasons, soft material located adjacent to the perimeter of the temporary cofferdam and adjacent to the river wall would be removed. The soft material includes silt, peat and other materials. It is assumed for the assessment that the majority of foreshore material within the temporary cofferdam would remain *in-situ*. Removal of the soft material would ensure that any settlement of the cofferdam fill material does not adversely affect the ties between the walls of the twin walled temporary cofferdam leading to structural difficulties, and to ensure sound foundations for permanent construction. The exact extent and depth of the foreshore deposits to be removed at each site would be informed by geotechnical investigations. Areas of removed material would be filled with gravel similar to the existing bed material. Cofferdam fill material would then be placed onto the foreshore on top of a geotextile layer, to a total average depth of 7.8m as assumed for the purposes of this assessment. Suitable sized plant would be utilised to reduce potential load impacts on the foreshore. A piling rig, located on a jack up barge positioned on the foreshore, would be used to construct the cofferdam. The cofferdam would be tied into the existing river wall using slots prepared in the river wall (see separate volume of figures - Section 1).

7.2.6 Upon removal of the temporary cofferdam, the fill and geotextile layer would be removed by suitably sized plant and the locally excavated areas on the foreshore bed would be reinstated with suitable material to match the pre-existing river bed conditions.

7.2.7 A campshed would be constructed within the channel on the southern side of the temporary cofferdam for the removal of excavated material by barge from the site (see separate volume of figures - Section 1). It is assumed for the purposes of this assessment that foreshore material would be removed from the footprint of the campshed to an approximate depth of 0.3m.The area of the foreshore where permanent scour protection is required would be excavated to a depth of approximately 1.5m by an excavator. A new outfall apron would be constructed, in the form of 1.0m depth of stone placed up to 0.5m below the existing foreshore level, as assumed for the purposes of this assessment.

7.2.8 Within the temporary cofferdam, a permanent cofferdam would be constructed adjacent to the embankment, and would form part of the new river wall and enclose the underground operational structures. It is assumed for the purposes of this assessment that all alluvial and foreshore material within the footprint of the permanent cofferdam would be removed down to natural gravels. Permanent below-ground works within the permanent cofferdam would include excavations for the construction of the Combined Sewage Overflow (CSO) drop shaft; an interception chamber; a valve chamber; an air treatment chamber and connection culverts. These works would take place within the zone defined in the Site works parameter plan (see separate volume of figures - Section 1).

7.2.9 Permanent above-ground ventilation structures, including a local control pillar and ventilation columns, would be constructed within the footprint of the permanent foreshore structure within the zones defined on the Site works parameter plan (see separate volume of figures – Section 1). An electrical and control kiosk would be constructed landward of the river wall, at the southeastern corner of King Edward Memorial Park within a defined zone.

7.2.10 Ground intrusion from tree planting and root action, and paving as part of landscaping works is assumed for the purposes of this assessment to reach a depth of approximately 1.5m bgl. This would take place within the zone defined in the Site works parameter plan (see separate volume of figures - Section 1).

7.2.11 The existing Cole Stairs CSO outfall, which extends across the foreshore to the west of the permanent cofferdam, would be retained (see separate volume of figures - Section 1).

7.2.12 The specific construction activities which may give rise to effects on the historic character, appearance and setting of heritage assets are:

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

b. use of cranes and other tall plant during shaft construction

c. provision of welfare facilities

d. lighting of the site when required.

Code of Construction Practice

7.2.13 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. It would also address any effects from third-party impacts, vibration, ground movement and dewatering.

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 would 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. Condition surveys to define ground movement and vibration limits for heritage assets potentially affected by the works - to include monitoring regimes and provision for cessation of works where feasible, should levels exceed the specified limits.

f. Procedures under the Emergency Preparedness Plan for the emergency repair of damage to listed buildings. Where there is damage that does not require emergency repair, repair would be affected as making good as part of the construction process. Final repairs to significant finishes would be 'like for like'.

g. 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.

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

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

7.2.14 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).

7.2.15 Section 13 of the *CoCP* details the approach to third party impact and the asset protection process in relation to ground movement. This includes measures for the contractor to undertake a condition survey of the relevant infrastructure and buildings prior to commencing works that could impact them. The contractor would put in place protection measures during construction to minimise the impact to third-party infrastructure and buildings as a result of ground movement. Monitoring would be carried out prior to commencement of construction work to enable baseline values to be established and would continue until significant ground movement due to the works, as shown by the monitoring, has effectively ceased. Post condition surveys would be carried out, as well as installation of instrumentation and monitoring to confirm that ground movements is as predicted and acceptable. An Emergency Planning and Response Plan would be developed in conjunction with the asset owner to include relevant contingency plans and trigger levels for action.

7.2.16 Site-specific measures in the *CoCP* Part B (Section 12) comprise the removal and storage of memorial benches currently located on the riverfront. These would be reinstated at the end of construction.

7.2.17 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 para 7.8.5.

Operation

7.2.18 The operation of the proposed development at the King Edward Memorial Park Foreshore site is described in Section 3 of this volume. The particular components of the operational development of importance to the historic environment include the design of the public realm and the design and siting of the proposed ventilation structures and electrical and control kiosk.

Historic environment design measures

7.2.19 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 of the principles relating to the integration of functional components that apply to the site. These relate to matters including materials, signature designs and detailing, and would inform the appearance of the completed operational infrastructure.

b. Heritage design principles that address matters including; the design of monitoring equipment; the legibility of key historic functions; interpretation materials, and trees.

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

d. All the landscape principles that apply at the site. These relate to matters including soft and hard landscapes and public accessibility.

7.2.20 The following site-specific design principles are also relevant:

a. The design would reinforce the character of the park, specifically by maximising the planting of large tree species close to the river frontage where technically possible. Furthermore, the layout of existing paths and landscaped areas would be extended onto the foreshore structure where possible to integrate it into the surroundings.

b. The main electrical and control kiosk would be placed to avoid interrupting views from the park to the river.

c. The permanent access route would be integrated into the park.

d. Memorial benches and bandstand would be reinstated unless otherwise agreed.

7.3 Assessment methodology

Engagement

7.3.1 Vol 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. Throughout the environmental impact assessment (EIA) there has been regular liaison with English Heritage and other stakeholders. Vol 21 Table 7.3.1 below summarises the comments raised by consultees and how each comment has been addressed.

Vol 21 Table 7.3.1 Historic environment – consultation response

Organisation and date	Comment	Response
English Heritage phase two consultation response (February 2012)	EH concurred with the mitigation approach set out for archaeology in relation to the landward part of the site but in relation to the foreshore, considered that the results of hydrological modelling would need to be considered before detailed comment on mitigation.	Monitoring of the foreshore during construction would be undertaken to ensure that any effects from scour around structures are appropriately mitigated. Foreshore protection is embedded in the operational design, to ensure that scour around operational structures is avoided.
London Borough (LB) of Tower Hamlets Section 48 publicity comments (October 2012)	The construction and operation of the proposed development would affect the Wapping Wall Conservation Area and setting of the Rotherhithe Tunnel Air Shaft.	The *Environmental Statement* assesses the likely significant effects upon these heritage assets in Sections 7.5 and 7.6.
	The Council noted that the King Edward Memorial Park site lies within a locally designated area of archaeological importance.	The baseline presented in Section 7.4 describes the area of archaeological importance. A full assessment of effects on buried heritage has been undertaken, and appropriate mitigation is identified.

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, ie, asset significance, and the significance of the environmental effect throughout the following assessment.

7.3.3 Baseline conditions for above-ground and buried heritage assets are described within a 400m radius area around the centre point of the site, which is considered through professional judgement to be most appropriate to characterise the potential of the site to contain heritage assets. There are occasional references to assets beyond the baseline area, for example, a Roman burial ground adjacent to The Highway, which lies approximately 750m northwest of the site, which contribute 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 Vol 10 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 400m baseline area described above. 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 the Wapping Wall conservation area appraisal and from professional judgement based on observation and understanding of historic context and architectural purpose and design.

7.3.5 Site visits were carried out in March and April 2011 to identify assets on or adjacent to the site and a further site visit was carried out in January 2012 to identify assets for inclusion within the assessment of effects on 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 or buried 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 defined by the site boundary, except in the case of ground movement, where the assessment area extends to where the predicted degree of ground movement is 1mm or less.

7.3.8 In terms of effects on the character and setting of above-ground heritage assets, the peak construction phase is Site Year 2, when the shaft would be under construction and cranes would be present at the site. This year has therefore been used as the construction assessment year for effects on the character and setting of heritage assets. It should be noted that in some instances, the townscape and visual assessment (Section 11) may differ to the historic environment assessment 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 receptor as relevant). The construction assessment area is as described in para. 7.3.4 above.

7.3.9 Section 7.5 details the likely significant effects arising from construction at the King Edward Memorial Park Foreshore 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 (Chambers Wharf to the west and Bekesbourne Street to the east) are too distant from the 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 (ie, decay or grow) unless their environment changes as a result of human or natural intervention. At King Edward Memorial Park ongoing fluvial erosion is likely to be changing the archaeological baseline within the foreshore. However, the rate of erosion is not known so the base case is assumed to be the same as the current baseline. Neither of the two developments included in the site development schedule (Vol 21 Appendix N) would lead to physical changes in above or buried heritage assets within the King Edward Memorial Park Foreshore 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 programme 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. The construction base case would be as per the baseline.

7.3.11 Neither of the two developments included in the site development schedule (Vol 21 Appendix N) would change the existing baseline in terms of character and setting of above-ground assets due to the distance of these developments from the site and the presence of intervening structures. Therefore the construction base case remains the same as the existing baseline detailed in Section 7.4.

7.3.12 All of the developments detailed in the development schedule (Vol 21 Appendix N) would be complete and operational by the construction phase assessment year. Therefore no assessment of cumulative effects on above-ground or buried heritage assets has been undertaken.

7.3.13 The assessment of construction effects on the character, setting and appearance 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

7.3.14 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 assessment (Section 11) 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 receptor as appropriate). The operational assessment area is as described in para. 7.3.4 above.

7.3.15 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.

7.3.16 None of the developments included in the site development schedule (Vol 21 Appendix N) would change the existing baseline in terms of the character and setting of above-ground heritage assets given the distance of these developments from the site and the presence of intervening structures and buildings. Therefore the operational base case remains the same as the baseline detailed in Section 7.4.

7.3.17 As all of the developments detailed in the development schedule (Vol 21 Appendix N) would be complete and operational by the operational phase assessment year, no assessment has been undertaken of cumulative effects on the historic character and setting of above-ground heritage assets.

7.3.18 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

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

Assumptions

7.3.20 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 in the

Site works parameter plan (see 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 particularly significant heritage assets within the site, which would warrant preservation *in-situ*.

7.3.21 A number of assumptions have been made regarding the likely depth of temporary construction works (eg, 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.

7.3.22 Vol 2 details assumptions made regarding the predicted impact of compression of potential archaeological assets within the foreshore from temporary cofferdam fill material. For the purposes of this assessment it has been assumed that where archaeological remains within the foreshore could contain voids, and/or are made of porous/organic material (timber structures/objects such as wattle, fishtraps, and peat), the compression predicted to occur is likely to cause some damage. Where such remains could be solid, non-porous or inorganic without voids, such as metal, stone, flint or brick, the compression is generally unlikely to lead to damage.

7.3.23 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 defined zones for these structures. For this site the assessment is not sensitive to variations in location within these zones of deviation because of the open character of the surrounding parkland and the river frontage.

7.3.24 Assumptions relating to the assessment of effects arising from ground movement are detailed in the project wide assessment in Vol 3 Section 7.

Limitations

7.3.25 A limitation of the assessment 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 around the site. Nevertheless the assessment is considered to be robust and in accordance with best practice.

7.3.26 There has also been little research into the effects of compression of buried heritage assets within foreshore alluvium from fill material placed on top of such deposits. Professional judgement has been used to estimate the likely impacts on different archaeological remains within the foreshore, and the assessment is considered to be robust.

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 400m radius 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, 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 (Vol 21 Figure 7.4.1, see separate volume of figures) shows the location of known above-ground and buried historic environment features within the 400m radius 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 21 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 at paras. 7.4.38 - 7.4.53.

Designated assets

International and national designations

7.4.3 The site does not contain any nationally designated (statutorily protected) heritage assets, such as scheduled monuments, listed buildings, or registered parks and gardens. The Thames (Rotherhithe) Tunnel (HEA 8), designed by Marc Isambard Brunel and constructed in 1825–1843 lies approximately 40m to the west of the site. The associated air shaft (HEA 31) constructed in 1904–1908, is Grade II listed and lies adjacent to the south-west of the site. There is a Grade II listed slipway approximately 40m to the south of the site (HEA 30) which is used by the Shadwell Basin Outdoor Activities Centre to access the river and foreshore. There are no internationally designated heritage assets within the baseline area.

Local authority designations

7.4.4 The site lies within an Archaeological Priority Area defining an area of potential for palaeoenvironmental remains preserved in the deep alluvial deposits associated with the River Thames and for remains associated with historical riverfront activity.

7.4.5 Almost the entire site lies within Wapping Wall Conservation Area. This is characterised by historic riverside settlement, shipbuilding and maritime activity in the medieval and post-medieval periods and 19th century industry and warehousing.

Known burial grounds

7.4.6 There are no known burial grounds within the site or adjacent to it. The burial ground of the Society of Friends (now disused), dated to the later 17th century, lies approximately 245m to the northeast of the site (HEA 21). The churchyard and burial ground of the Church of St. Paul's Shadwell lies approximately 75m to the west of the site (HEA 87).

Site location, topography and geology

7.4.7 Within the park in the northern half of the site the ground slopes down gently southwards towards the Thames, from approximately 107.0m ATD (Above Tunnel Datum) to approximately 105.5m ATD at the riverfront embankment. There is a drop of 3m down into the park from The Highway to the north of the site, at 110.0m ATD, reflecting the edge of the higher terrace gravels and the Thames floodplain on which the site is located. There is a drop of approximately 4.5m from the top of the river wall down to the foreshore in the southern half of the site. The top of the foreshore lies at 100.5m ATD. The lower part of the foreshore lies at approximately 97.0–98.0m ATD. The riverbed dips from 95.5m ATD to 64.0m ATD in the southwest limit of the site.

7.4.8 The site is situated entirely on alluvium of the River Thames floodplain, an area of alluvial silts and peats overlying sand and gravel deposits associated with a wide meander of the River Thames. The gravel terrace lies approximately 40m to the north of the site, and the gravel surface lies at 99.0m ATD.

7.4.9 Borehole data just to the northwest of the site indicates an eroded gravel surface where gravels survive to 98.0m ATD. These gravels are probably Shepperton Gravels, which underlie the present floodplain, banked up against the older river terrace. The Shepperton Gravels were deposited around 18,000–15,000 years ago, in a braided river environment, following the down-cutting by the Thames to its present floodplain at the end of the last cold stage. This left the Taplow Gravel as a river terrace, above the modern floodplain to the north. On the site the gravel has been eroded out by the river, and sands and peats deposited during the Holocene (from 10,000 BP). This is indicative of the infilling of former channels, which became abandoned through channel migration. Bathymetric data shows the basal channel deposits slope down toward the deepest part of the Thames approximately 75m to the southeast of the site. The Shepperton gravels exist here as a thin layer at approximately 93.0m ATD.

7.4.10 According to borehole records for the site, 4.0m thick peats of probably Early Mesolithic date (c. 9000–7500 BP) exist over ‘loamy sands’ dating from the Late Glacial or Early Holocene periods (10,000 BP), at about 93.0m ATD. Only the deepest of these deposits are likely to survive towards the southern boundary of the site, due to river scour and possibly dredging. Further up the foreshore/riverbed, beneath reclamation dumps that make up the existing riverfront, a thicker sequence of archaeological deposits, perhaps as much as 4.0m, is likely to survive, beneath modern foreshore gravels. The site topography and geology is described in more detail in Vol 21 Appendix E.2.

Past archaeological investigations

7.4.11 A number of archaeological investigations have been carried out within the baseline area in the past, although none lie within the site.

7.4.12 The closest investigation to the site is an evaluation at Free Trade Wharf (HEA 41), which revealed traces of an 18th century dock, 19th century and later river walls, and buildings with basements.

7.4.13 In the 1990s, the Thames Archaeological Survey (TAS) surveyed the foreshore at Shadwell to the southwest of the site, and at Ratcliffe to the northeast, and noted post-medieval structural remains and finds (HEA 44–47, 52–54).

7.4.14 Three other archaeological investigations have been carried out approximately 215–280m to the north and northeast (HEA 38–40); two approximately 210–300m to the south, on the opposite bank of the Thames in Rotherhithe (HEA 42 and 43); and one approximately 225m to the southwest (HEA 55). These have revealed remains dating to the later medieval and post-medieval periods associated with the development of the waterfront. One investigation, approximately 225m to the north of the site (HEA 38), revealed earlier remains in the form of a large ditch dated to the Roman period. Current understanding of the nature and extent of early human activity pre-dating the later medieval period is therefore limited.

7.4.15 Further details of past archaeological investigations carried out within the site and baseline area are included in Vol 21 Appendix E.3.

Archaeological and historical background of the site

7.4.16 The following section presents a chronological summary of the archaeological and historical background of the site. Further detail is included in Vol 21 Appendix E.4.

7.4.17 During the prehistoric period (700,000 BC–AD 43) the site lay within intertidal marshes to the south of an area of high ground. The presence of peat (the rotted vegetation of a former land surface) noted in a borehole within the site, and the remains of a prehistoric forest (HEA 85), recorded approximately 170m to the west of the site, indicate that some areas of higher, drier, land existed on the floodplain. Such areas were subsequently buried beneath flood alluvium following a rise in water levels from the later prehistoric onwards. The marshland would have provided a range of predictable resources such as food (fish/game), reeds for basketry, and water. Despite this there are few known prehistoric finds within the baseline area.

7.4.18 During the Roman period (AD 43–410) the site lay approximately 1.8km to the east of the Roman city and approximately 650m to the southeast of an area of settlement in Shadwell. It lay within low-lying intertidal marshland which was probably frequently flooded. The gravel terrace close to the northern edge of the site may have been used for farming. The line of an east-west Roman road (HEA 15) is thought to have followed the present line of The Highway. Several cemeteries have been excavated on the south side of the road, approximately 750m to the northwest of the site (outside the baseline area). A coffin burial was discovered in 1858 (HEA 86) beside St. Paul's Shadwell, approximately 115m to the west of the site, which may indicate an isolated roadside burial or possibly a roadside cemetery. An evaluation (HEA 38), approximately 145m to the north of the site revealed a large east-west Roman ditch, the significance of which is not known.

7.4.19 During the early medieval (AD 410–1066) period the site was located within the intertidal marshland of Wapping marsh and would have been prone to flooding and unsuitable for occupation. The resources of the marshland may have been exploited for a range of activities including animal grazing and fishing. The site visit for the present assessment noted a line of vertical timber posts aligned northeast to southwest (HEA 2) on the foreshore at low tide, approximately 20m to the west of the site. These might conceivably be the remains of a fish trap dated to this period. A Saxon spearhead (HEA 18) was discovered approximately 70m to the west of the site.

7.4.20 During the later medieval period (AD 1066–1485) the site lay to the east of a small settlement and shipyards at Shadwell (HEA 17). The marshland along the riverfront within which the site lies began to be drained and reclaimed and river walls constructed. A line of timber posts noted on the foreshore at low tide, approximately 20m to the west of the site (HEA 2; see para. 7.4.19), possibly dates to this period.

7.4.21 It is likely that the construction of river walls and flood defences, as well as land reclamation, consolidation and the extension of any earlier (medieval) walls, continued throughout the post-medieval period (AD 1485–present). Buildings were constructed along the riverfront between Wapping Marsh and Ratcliffe, and by the very beginning of the 17th century Stow[2] described the area, including the riverfront adjacent to the site, as 'a continual street… with alleys of small tenements.'

7.4.22 A number of remains dated to the post-medieval period have been found both within the site and the baseline area, reflecting rapid commercial development from the 16th century onwards. Much of the riverfront developed into an industrial area that included roperies, tanneries, breweries, wharves, smiths and taverns. Further inland much of the area remained extensive open fields.

7.4.23 Maps from the 18th and 19th centuries show the eastern part of the site occupied by wharves, timber and coal yards, and warehouses, whilst the western and northwestern part of the site was occupied by housing and industrial buildings. Shadwell Market (HEA 1A) lay within the northwestern part of the site from the 17th to the mid-19th century. By the mid–late 19th century two major developments had taken place within the vicinity of the site. The Thames (Rotherhithe) Tunnel (HEA 8) was constructed as well as Shadwell Old Basin as part of the London Docks. During the 1920s the North East Storm Relief sewer outlet (HEA 1I) was incorporated into the embankment wall. The site visit carried out as part of the present assessment noted several remains on the foreshore that are probably associated with 18th–20th century riverfront activity. These include a post-medieval structure of unknown nature (HEA 1E), a drain (HEA 1F), a river wall/ flood defence (HEA 1D) and dump deposits (HEA 1G and 1H).

Statement of significance: buried heritage assets on the site

Introduction

7.4.24 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, for example, building foundations), identified from historic maps, the site walkover survey, and information on the likely depth of deposits.

7.4.25 In accordance with the National Policy Statement for Waste Water (Defra, 2012)[3], National Planning Policy Framework (DCLG, 2012)[4] and PPS5 Planning Practice Guide (DCLG, 2010)[5], (which remains extant), 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

7.4.26 Archaeological survival potential is likely to be varied. Along the line of the existing 20th century river wall, remains are likely to have been heavily disturbed during the construction of the wall. Elsewhere, the survival potential for remains is generally likely to be high.

7.4.27 Any remains of late 19th century riverside industrial buildings are likely to have been completely removed from within the construction footprint of the early 20th century river wall and North East Storm Relief sewer.

7.4.28 There is no evidence of substantial ground disturbance, such as dredging, within the foreshore in the LLAU, including the area of the temporary cofferdam. This is based on historic maps, bathymetry data, and the site walkover inspection carried out as part of this assessment, which noted no evidence of substantial fluvial erosion of the foreshore since a walkover survey carried out by the Thames Discovery Programme in 2010. Archaeological survival potential of any remains within and beneath the alluvium is likely to be high. Archaeological remains are predicted to lie within deep alluvial deposits of peat and sand at depths of up to 4.0–5.0m bgl (93.0–94.0m ATD).

7.4.29 The landward side of the river wall lies in an area formerly occupied by late 19th century riverside industrial buildings, the construction and subsequent demolition of which is likely to have partially or completely removed earlier archaeological remains to a probable depth of approximately 1.0–1.5m bgl. There is also likely to have been some disturbance associated with the subsequent landscaping of the park, although it is unlikely to have significantly affected any alluvium beneath the made ground or any archaeological remains within it.

7.4.30 The proposed access route, running along the landward side of the river wall from Glamis Road, is located along a paved and planted area immediately to the west of the Rotherhithe Tunnel air shaft. Levelling of the ground and the construction and subsequent clearance of former industrial buildings, yards and cottages, which began in the late 19th century, is likely to have truncated remains of earlier post-medieval structures to a depth of approximately 0.5–1.5m. Although the remains of 19th century structures themselves would also potentially be of archaeological interest. Earlier, deeper, archaeological remains within the alluvium underlying the made ground are likely to survive intact.

Asset potential and significance

7.4.31 The following statement of asset significance takes into account the levels of natural geology and the level and nature of later disturbance and truncation.

Palaeoenvironmental

7.4.32 The site has a high potential to contain palaeoenvironmental remains. The site is situated on the Thames floodplain on alluvium overlying river gravels. The results of a single borehole taken within the site revealed thick peat overlying loamy sands, which have the potential for high preservation of organic remains such as wood and vegetation, which can be used to reconstruct former environments. Such remains would be of low or medium significance depending on their nature and degree of preservation. This would be derived from the evidential value of such remains.

Prehistoric

7.4.33 The site has an uncertain, possibly moderate, potential overall to contain prehistoric remains. Although scattered remains dating to the prehistoric period have been discovered within the baseline area, there is no evidence of extensive activity. The site lay on higher ground/within the channel/marshland in this period and may have been the focus for activity and settlement. Previous investigations within the baseline area have uncovered organic layers preserving remains such as prehistoric timbers. Due to the localised nature of the investigations, and the likely depth of archaeological remains, it is possible that residual or *in-situ* early prehistoric material may be contained within deep alluvial deposits. The remains of timber trackways, used to traverse the marshes and boats, may potentially be preserved within the site. Redeposited finds would be of low significance. Localised settlement evidence would be of medium significance, *in-situ* timber structures, if present, would potentially be of high significance. This would be derived from the evidential value of such remains.

Roman

7.4.34 The site has an uncertain, probably low, potential to contain Roman remains. Although scattered Roman remains have been discovered within the baseline area, there is no evidence of settlement within the vicinity of the site and it is likely that it remained wet marshland in this period and prone to flooding. Isolated artefacts and features would be of low or medium significance, depending on the nature and extent, eg, it would be medium if extensive or well-preserved remains indicating landing areas were discovered. This would be derived from the evidential value of such remains.

Early medieval

7.4.35 The site has a moderate potential to contain early medieval remains. A line of posts, possibly a fish trap dating to this period (HEA 2), has been identified on the foreshore just west of the site, which lay in an area of low-lying marshes which is unlikely to have been settled. Any such remains, if confirmed, would potentially be of medium or high significance derived from the evidential and historical value.

Later medieval

7.4.36 The site has a moderate potential to contain later medieval remains. A possible fish trap (HEA 2) on the foreshore, approximately 20m to the west of the site might date to this period (although see above). Other remains may be present within the area of the site, which was, in part, in an area of intertidal foreshore that was later reclaimed, possibly from the 13th or 14th century. A later medieval shipyard and wharf are known to have existed in the vicinity of the site. Evidence of reclamation dumping and drainage ditches would be of low significance. Evidence of shipbuilding such as timbers and other materials, barge beds or jetties, or fish traps would be of high significance. This would be derived from the evidential and historical value of such remains.

Post-medieval

7.4.37 The site has a high potential to contain post-medieval remains. Post-medieval remains dating from the 18th and 19th centuries have been recovered along the foreshore within the site and immediately adjacent to it. Other remains that might be present include those associated with the construction of river walls and drainage from riverside factory buildings, as well as evidence of activity associated with the landing, repair and building of ships, such as barge beds, and scatters of ship timbers and nails. The site also has a high potential to contain the remains of post-medieval industrial buildings, wharves and warehouses landward of the river wall. Such remains would generally be of low or medium significance, with the exception of re-used nautical timbers. If such timbers were present, the relative lack of knowledge in this area would give them a high significance. This would be derived from the evidential and historical value of such remains.

Statement of significance: above-ground heritage assets

Introduction

7.4.38 In accordance with the National Policy Statement for Waste Water[6] 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.

7.4.39 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 21 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 assessment area whose settings would be significantly adversely affected by the proposed development.

Within the site

Wapping Wall Conservation Area

7.4.40 The site lies within the Wapping Wall Conservation Area, an asset of high significance. The conservation area is characterised by a river-face of substantial 19th century warehouses on brick faced wharves, interrupted by passages to stairs which provided access to the river, with 20th century jetties formerly used for berthing and discharging of ships. The extension to the Wapping Wall Conservation Area (2008) includes the King Edward Memorial Park and the river frontage as far as Narrow Street to the east. Although the area to the east contains few historic structures, the designation is intended to conserve the line of the river frontage at this point. The Narrow Street Conservation Area lies adjacent to the Wapping Wall Conservation Area to the east.

7.4.41 Whereas the western part of the conservation area is characterised by large historic industrial buildings along the river frontage with limited outwards views from the public realm, the eastern part in which the site lies is characterised by the open green space of the King Edward Memorial Park and modern residential buildings set back from the river. The break in the buildings along the river frontage offers far reaching views across and along the River Thames. As the only element of green space along this part of the river frontage, the King Edward Memorial Park is a visual focal point in views towards the Wapping Wall Conservation Area from the opposite bank of the river (see View of Heritage Value 5 in Vol 21 Figure 7.4.2 (see separate volume of figures) and Viewpoints 1.1 and 2.1 detailed in Section 11 Townscape and visual). The Rotherhithe tunnel shaft (HEA 31) and surrounding low scale buildings provide a visual break or ‘relief’ from the corridor of buildings that extend either side of Wapping High Street (LB of Tower Hamlets, 2009)[7], whose character is still defined by substantial warehouse developments.

7.4.42 There are a considerable number of statutorily designated assets in the vicinity of the site, in the conservation area, including the following, each of high significance:

a. the Grade II listed Rotherhithe Tunnel Air Shaft (HEA 31), adjacent to the site

b. the Grade II listed Shadwell Dock Stairs (HEA 30), approximately 40m to the south-west of the site

c. the Grade II listed St. Paul's Terrace (HEA 36), approximately 75m to the west of the site.

7.4.43 Of these, the Rotherhithe Tunnel Air Shaft is within the area of assessment for ground movement effects. The building is a single storey circular red brick building with Portland stone dressings, with a slate covered roof with a central brick and stone cupola. The entrance is to the south, and incorporates two openings within one bay, with stone surrounds. Each other bay has a double opening, again with stone surrounds; these openings contain wrought iron tracery incorporating the letters 'LCC'. The shaft itself contains stairs and hoists associated with the use of the Rotherhithe Tunnel. The building is considered to have a high significance related to its aesthetic and historical associations, and its Grade II listing.

7.4.44 The three listed buildings mentioned all contribute to the riverside wharf and industrial character of the area and contribute to the interest of the Thames shoreline. The King Edward Memorial Park therefore makes a positive contribution to the character and significance of the Wapping Wall Conservation Area, although its contribution is that it contrasts rather than harmonises with the rest of the conservation area.

King Edward Memorial Park

7.4.45 King Edward Memorial Park, which is not subject to any designations in relation to its historic value, occupies the site of the former Shadwell Fish Market Estate and an area previously occupied by riverside industry and small scale housing. Planning of the park began in 1910 but due to disruption caused by the First World War, it was not opened to the public until 1922. At that time it was the only public park in Stepney. King Edward Memorial Park is of medium significance for its evidential, historical and communal value.

7.4.46 The landscape was restored and altered by Cooper Partnership for the London Docklands Development Corporation (LDDC), probably during the 1980s. It consists of a formal and compact layout with paths formed of hard standing, around areas of lawn, mature trees and wildflower meadows and a bandstand dating to the original park construction. On the western side, there is a children's playground, tennis courts and a bowling green. Access is via gateways to the north, west and east. Retained in this redevelopment is a fountain designed by the sculptor Sir (Edgar) Bertram Mackennal in 1922, located to the north of the site. The fountain once bore a medallion, stolen in 2007, with the inscription 'In grateful memory of King Edward the seventh this park is dedicated to the use and enjoyment of the people of East London for ever–opened by King George the fifth 1922', as well as a depiction of the late king (LB of Tower Hamlets, 2008)[8]. There are views from the fountain aligned on the Rotherhithe Tunnel Air Shaft (HEA 31). See View of Heritage Value 1.

7.4.47 Surrounded on the landward side by a high brick wall, views out of the park on three sides are constrained by this and vegetation and the presence of intervening buildings. The park is self-contained and separated from its surrounding environs.

7.4.48 The river frontage to the park is characterised by modern hard standings and railings, and offers extensive and far-reaching views across the River Thames to the east, south and southwest, which are largely characterised by modern buildings of no heritage value (see Views of Heritage Value 3 and 4). Views along the river frontage towards the historic buildings along Wapping Wall are curtailed by the presence of modern development at Shadwell Pierhead to the southwest (see View of Heritage Value 2). Viewed from across the river, the park offers a visual relief in the otherwise continuous frontage of historic and modern buildings along the frontage (see Views of Heritage Value 5 and 6; and Viewpoint 1.2 detailed in Section 11 Townscape and visual). The river frontage of the park and the residential area to the east is characterised by the largely uninterrupted sweep of the river.

7.4.49 The immediate setting of the park, which includes views out from the park, is characterised largely by modern residential development of little or no heritage or architectural significance. Although the historic context of the park provided by the Wapping Wall Conservation Area is of value, modern development within the conservation area has degraded the park's setting. The curved sweep of the river frontage at this point contributes to the character and setting of King Edward Memorial Park (see Viewpoints 1.1 and 2.1 detailed in Section 11 Townscape and visual).

Vol 21 Plate 7.4.1 Historic environment – view north from river front showing character of King Edward Memorial Park

Vol 21 Plate 7.4.2 Historic environment – view east along river frontage of King Edward Memorial Park

River frontage

7.4.50 The riverwall within the site is consolidated with reinforced poured concrete of 20th century date, and yellow stock brick in English bond. There is evidence of repair along this length as the top 8 courses are of blue engineering brick capped with poured concrete. Further eastwards, is the NESR outfall formed of 3 rectangular tunnels with brick piers between. This section is formed of reinforced poured concrete with horizontal timbers inset, likely to have held supports to prevent vessels damaging the riverwall, and probably dates to the early 20th century. Given the 19th and 20th century date and piecemeal nature of the river wall it is considered to be an asset of low significance.

Within the assessment area

Setting of Rotherhithe Tunnel Air Shaft

7.4.51 Directly adjacent to the site, to the south, is the Grade II listed Rotherhithe Tunnel air shaft (HEA 31), constructed 1904–1908. This comprises a circular red brick single storey 'drum' with Portland stone dressings, containing a staircase down to the Rotherhithe tunnel and pedestrian passageways. A memorial stone in front of the air shaft, in the western part of the site, reads “Sir Hugh Willoughby…and other navigators who in the latter half of the sixteenth century set sail from this reach of the river Thames near Ratcliffe Cross to explore the Northern Seas”. This memorial stone and porcelain plaque painted with galleons were erected by the LCC in 1922 (Cherry, O’Brien and Pevsner, 2005)[9]. This is a reminder of the historical importance of this area and its strong links with its nautical past. The Rotherhithe Tunnel air shaft structure is considered an asset of high significance, due to its historical, evidential and communal value.

7.4.52 The Rotherhithe Tunnel Air Shaft building can be viewed from within the park, notably along the axis from the memorial to the north, and on the approach to the park along the river from the east. Its distinctive form and architectural detailing makes it a focal point within the park and along the river frontage. The river frontage and surrounding park make a positive contribution to the setting of the Rotherhithe Tunnel Air Shaft (see View of Heritage Value 2 and Vol 21 Plate 7.4.3). Although its historic, industrial context has been lost, its relationship with the river remains strong. Its location in a designed green space leads to better appreciation of the building. The contribution of setting to the significance of the structure is therefore high, albeit as a remnant of an industrial landscape in a contrasting park.

Vol 21 Plate 7.4.3 Historic environment – view west towards Rotherhithe Tunnel Air Shaft from river frontage to King Edward Memorial Park

Setting of adjacent slipway

7.4.53 The setting of the Grade II Listed slipway (HEA 30) that lies between the mouth of Shadwell Basin and the King Edward Memorial Park is defined by its relationship with the line of the river frontage at this point. Although it is of high significance, there are limited views to it from within the park. The slipway does not contribute to the character of the park, but forms part of the character of the line of the river frontage, which includes the river wall. The contribution of setting to its significance is therefore negligible.

Construction base case

7.4.54 As explained in para. 7.3.10 whilst ongoing fluvial erosion is likely to be changing the archaeological baseline within the foreshore, since the rate of erosion is not known, the base case is assumed to be the same as the current baseline for the purposes of the assessment. Similarly, as explained in paras. 7.3.10, no other non-Thames Tideway Tunnel developments would change the base case.

7.4.55 Other non-Thames Tideway Tunnel developments would not cause damage to the Rotherhithe Tunnel Air Shaft building from ground movement. These schemes would therefore not change the base case for the assessment of the effects of ground movement.

7.4.56 For the reasons outlined in para. 7.3.11, the base case in Site Year 2 of construction would remain the same as the baseline for the assessment of effects on historic character, appearance and setting.

Operational base case

7.4.57 For the reasons outlined in para. 7.3.16 the base case in Year 1 of operation would remain the same as the current baseline for the assessment of effects on historic character, appearance and setting

7.5 Construction effects assessment

Buried heritage assets

7.5.1 Effects of construction works are described in the following sections 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.

Demolition, site setup, landscaping and electrical and control kiosk landward of the river wall

7.5.2 Demolition of fencing and park features, the set up of the construction compound, the diversion of services, landscaping (including tree planting and paving), and the later construction of the electrical and control kiosk, would have a localised impact on any 19th century or possibly earlier post-medieval features, comprising remains of industrial buildings, docks and warehouses adjacent to the river wall, and the footings of houses within the southwestern corner of King Edward Memorial Park, of low asset significance.

7.5.3 The removal of such remains would locally reduce the significance of the asset to negligible and would constitute a low magnitude of impact, considering the location, localised nature and depth of excavation required. Considering the low significance of these assets, this would result in a **minor adverse effect**.

Construction of cofferdam, campshed, outfall apron and scour protection

7.5.4 Within the area of the temporary cofferdam, soft material (ie, alluvium) would be excavated down to the gravels adjacent to the perimeter of the temporary cofferdam and existing river wall (see assumptions in para. 7.3.22). Within the area of the campshed, foreshore deposits would be removed to an approximate depth of 0.3m, as assumed for the purposes of this assessment. These works would entirely remove any archaeological remains present within the excavated areas, and constitute a high magnitude of impact.

7.5.5 The movement of small plant machinery used to lay the geotextile layer across the cofferdam footprint prior to infilling, and used to remove the geotextile layer subsequently, would have an impact upon any archaeological remains on the surface of the foreshore and within the upper part of the alluvium, within the cofferdam footprint, through rutting and compaction, resulting in a localised high magnitude of impact.

7.5.6 The placement of temporary cofferdam fill material is predicted to have a high magnitude of impact due to compression of any remaining buried heritage assets within the foreshore alluvium and gravels which are not removed from within the cofferdam, where these are hollow (e.g. pottery vessels, hulked boats), and/or are made of porous/organic material (timber structures/objects such as wattle, fishtraps, and peat). Where remains are solid, non-porous or inorganic without voids, such as metal, stone, flint or brick, there is unlikely to be an impact.

7.5.7 Within the area of the permanent cofferdam, all alluvium and other soft foreshore deposits would be removed down to natural gravels. This would entirely remove any archaeological remains present from within its footprint and would constitute a high magnitude of impact.

7.5.8 A jack-up barge would be used to insert the sheet pile walls of the temporary cofferdam and campshed. The jack-up barge supports would have a localised impact on any archaeological remains within the footprint of the supports. Excavation to a depth of 1.5m within the footprint of permanent scour protection and proposed outfall apron would remove any surviving buried heritage assets within the foreshore alluvium to this depth.

7.5.9 These activities would constitute a high magnitude of impact, reducing the significance of any affected assets present to negligible. The environmental effect would vary depending upon the significance of the assets removed:

a. There is a high potential for palaeoenvironmental remains of low or medium asset significance. The removal of these remains would comprise a **minor adverse** effect.

b. The site has an uncertain, possibly moderate, potential for redeposited prehistoric artefacts, of low asset significance. Their removal would constitute a **minor adverse** effect.

c. The site has an uncertain, possibly moderate, potential for evidence of prehistoric riverfront activity (timber structures) and settlement remains of medium to high significance. If present, their removal would constitute a **major adverse** effect.

d. There is an uncertain, possibly low, potential for Roman remains associated with marshland activity, of low or medium asset significance. The removal of such remains would constitute a **minor or moderate adverse** effect.

e. There is a moderate potential for early medieval remains of medium or high asset significance revealing evidence of marshland exploitation, such as fish traps. The removal of such remains would constitute a **major adverse** effect.

f. There is a moderate potential for later medieval riverfront activity, such as fish traps, of medium or high asset significance, and for evidence of shipbuilding. The removal of such remains would constitute a **major adverse** effect. The removal of reclamation dumps, of low asset significance, would result in a **minor adverse** effect.

g. The site has a high potential for remains of post-medieval ship building, jetties and other waterfront features, including possible barge beds on the foreshore. Such remains would be of low or medium asset significance and their removal would comprise a **minor or**

moderate adverse effect. Evidence for post-medieval features incorporating re-used nautical timbers, some of which have been identified on the foreshore, would be of high asset significance. Their removal would comprise a **major adverse** effect.

h. The site has a high potential for post-medieval industrial buildings, including wharves and warehouses landward of the river wall, of low asset significance. Such remains would be of low asset significance and their removal would comprise a **minor adverse effect**.

Scour around temporary structures

7.5.10 It is possible that scour could occur around the temporary cofferdam, which would impact upon any archaeological remains in the area of scour. The significance of any assets affected would be reduced, which would constitute a high magnitude of impact. The significance of effect on heritage assets would be the same as that for the cofferdams described in para. 7.5.9, above.

Construction of the CSO drop shaft, chambers and culverts

7.5.11 Permanent works comprising the CSO drop shaft, interception chamber, valve chamber, air treatment chamber and connection culverts would all be located within the footprint of the permanent cofferdam. The construction of these permanent works would entirely remove any archaeological remains within the footprint of each structure, which had not previously been removed as part of the cofferdam construction (i.e. through the removal or localised disturbance of soft material and through the movement of plant). This would potentially include features within the alluvium and cut into the underlying gravel. The significance of any affected assets (if present), would be reduced to negligible, constituting a high magnitude of impact. The significance of effect on heritage assets would be the same as that for the cofferdams described in para.7.5.9 above.

Above-ground heritage assets

Physical effects on above-ground heritage assets

Rotherhithe Tunnel Air Shaft

7.5.12 There would be ground movement effects on the Grade II listed Rotherhithe Tunnel Air Shaft. The maximum settlement predicted is 12mm at the eastern edge of the building, decreasing to 0mm on the western side. The damage risk associated with this movement is assessed to be negligible, typically causing cracking up to 0.1mm in the area of greatest movement, and at points of existing damage. Because of the form of the air shaft there may be a risk of differential heave to the building. The magnitude of change to this asset of high significance would be negligible, and would result in a **minor adverse** effect.

River frontage

7.5.13 The handrails and plinth of the existing river wall would be removed to facilitate access between the terrestrial parts of the site and the cofferdam. The permanent cofferdam and newly aligned river wall would permanently change the alignment of the river wall in this area. These changes would constitute a localised change to the river wall, comprising a low magnitude of impact. This would reduce the significance of the asset in this area from low to negligible and would constitute a **minor adverse** effect.

Effects on the historic character and setting of above-ground heritage assets

7.5.14 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.

King Edward Memorial Park

7.5.15 Within the King Edward Memorial Park a number of trees would be removed from the area closest to the river as part of the construction works. Benches and the bandstand in the eastern part of the site would either be relocated within the park or stored and relocated after construction. The construction site would also restrict views to and from the King Edward Memorial Park. Given the medium significance of the asset combined with the high magnitude of change, the construction works would have a **moderate adverse** effect on the character and setting of the King Edward Memorial Park.

7.5.16 The separate townscape and visual assessment (Section 11) concludes that the works would have a major adverse effect upon the park. The difference between the two assessments derives from their different methodologies: one considers the effect of the change upon the heritage value of the park; whereas the other considers the effect upon the park in townscape terms, which includes non-heritage factors.

Wapping Wall Conservation Area

7.5.17 The construction works would be visible in views to the Wapping Wall Conservation Area from the opposite bank of the River Thames. However, they would not significantly detract from the historic character or appearance of the western, more historic river frontage of the Wapping Wall Conservation Area (including the settings of the listed buildings within it). Given the high significance of the asset, combined with the medium magnitude of change, the construction works would have a **moderate adverse** effect on the character of the Wapping Wall Conservation Area.

Rotherhithe Tunnel Air Shaft

7.5.18 The construction works would be undertaken within the setting of the Rotherhithe Tunnel Air Shaft, restricting views to the structure from the east along the river frontage. However, views to the structure along the path and avenue aligned on the monument to the north would be retained in part by the use of mesh fencing along the access route. The Air Shaft building would remain prominent in views to the King Edward Memorial Park from the opposite bank of the river. Given the high significance of the asset, combined with the medium magnitude of change, the construction works would have a **moderate adverse** effect on the setting of the Rotherhithe Tunnel Air Shaft building.

Slipway

7.5.19 The construction works would detract from the setting of the adjacent listed slipway when viewed from the river or opposite bank. Given the high significance of the asset, combined with the medium magnitude of change, the construction works would have a **minor adverse** effect on the setting of the adjacent Grade II Listed slipway.

Sensitivity test for programme delay

7.5.20 A delay to the Thames Tideway Tunnel project of approximately one year would not change the construction effects assessment findings reported above. This is because even if other developments as identified in the site development schedule (Vol 21 Appendix N) were to become operational and form part of the base case, due to the distance of these developments from the site and the presence of intervening structures, there would be no material change in the base case against which effects are assessed.

7.6 Operational effects assessment

Effects on the historic character and setting of above-ground heritage assets

King Edward Memorial Park

7.6.1 The proposed development would result in change to the character of the King Edward Memorial Park. The development of the foreshore structure would extend the extent of the park outwards into the river corridor, altering the existing arrangement of paths and tree planting along the river frontage. However, the overall form of the planting scheme across the park is of little heritage value and would also not be affected. The proposed operational development would enhance the quality of public realm by introducing a larger area of green space and net increase in the number of trees within the park. There would be no adverse effect on significant views from the park across the river, and projecting the line of the river frontage would enhance views towards the historic frontage along Wapping Wall. The quality of the river wall would also be improved. Given the medium significance of the asset, the medium magnitude of change of the proposed development would have a **moderate beneficial** effect on the character of the King Edward Memorial Park.

Wapping Wall Conservation Area

7.6.2 The overall character of the Wapping Wall Conservation Area would not be affected by the proposed operational development. Although the new foreshore structure and vent columns would introduce new elements within the area, they would be of such a scale as to be negligible within broader views to the Wapping Wall Conservation Area. The park is, in character, quite unlike the core of the conservation area to the west and the new elements would enhance the park and its significance within the conservation area. Given the high significance of the asset, the negligible magnitude of change of the proposed development would have a **minor beneficial** effect on the character of the Wapping Wall Conservation Area.

Rotherhithe Tunnel Air Shaft

7.6.3 The overall parkland setting of the Rotherhithe Tunnel Air Shaft would be enhanced through landscaping associated with the operational development, and alignment with the memorial to the north would not be affected. Views from the structure across the river would not be affected. Given the high significance of the asset, the negligible magnitude of change of the proposed development would have a **minor beneficial** effect on the setting of the Rotherhithe Tunnel Air Shaft.

Slipway

7.6.4 The permanent foreshore structure would alter the relationship between the slipway (HEA 31) and the adjacent later river frontage. However, it would not detract from the riverside setting of the slipway or association with Shadwell Basin. Given the high significance of the asset, the low magnitude of change of the proposed development would have a **minor adverse** effect on the setting of the slipway.

Sensitivity test for programme delay

7.6.5 A delay to the Thames Tideway Tunnel project of approximately one year would not change the construction effects assessment findings reported above. This is because even if other developments as identified in the site development schedule (Vol 21 Appendix N) were to become operational and form part of the base case, due to the distance of these developments from the site and the presence of intervening structures, there would be no material change in the base case against which effects are assessed.

7.7 Cumulative effects assessment

7.7.1 All of the developments detailed in the development schedule (Vol 21 Appendix N) would be complete and operational by the construction phase assessment year and Year 1 of operation. Therefore no assessment of cumulative effects on above-ground or buried heritage assets has been undertaken.

Sensitivity test for programme delay

7.7.2 A delay to the Thames Tideway Tunnel project of approximately one year would not change the assessment of cumulative effects assessment.

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 on buried heritage assets within the site during the construction phase 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 (*SSAWSI)*, as detailed in para 7.8.5 below.

7.8.4 Subject to the findings of any subsequent field evaluation and the detailed construction methodology employed by the contractor, mitigation of the adverse effects upon archaeological remains within the site would include the following as appropriate:

a. An archaeological watching brief during site preparation and construction to mitigate impacts arising from service diversions and foundations for offices and welfare on the landward side of the existing river wall.

b. Targeted archaeological excavation within the temporary and permanent cofferdams and the temporary campshed following the insertion of the pile walls and prior to infilling.

c. For works taking place below low water on the outside of the cofferdams (such as construction of the campshed) conventional archaeological investigation may not be feasible. In such an eventuality other techniques would be employed, such as monitoring and scanning the excavated material resulting from groundworks on the foreshore.

7.8.5 Both evaluation and mitigation would be carried out in accordance with a scope of works (*SSAWSI)*, based on the principles in the *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 requirement.

7.8.6 Construction phase scour around the temporary cofferdam 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 temporary moderate adverse effect on the King Edward Memorial Park (medium asset significance) due to the temporary removal of the bandstand and park benches would be mitigated by a photographic survey of the park to Level 1 standard by English Heritage guidelines. This would provide a record of the existing location of the bandstand and benches and ensure that the subsequent relocation of these features within the park is undertaken sensitively.

7.8.8 The minor adverse effect arising from the localised demolition of the 19th/20th century river wall, an asset of low significance would be mitigated by a standing building survey of Level 2 standard (English Heritage, 2006)[10], comprising a descriptive record, with additional archival and documentary research, and a brief written record and photographs, to achieve preservation by record.

7.8.9 The minor adverse effect on the Rotherhithe Tunnel Air Shaft caused by ground movement would be mitigated by a programme of repair to significant cracks caused by the construction works, following the conclusion of the works.

7.8.10 All measures embedded in the proposed development and *CoCP* of relevance to the assessment of effects on the character and setting of above-ground heritage assets during construction are summarised in Section 7.2 above. No further mitigation during construction is possible for significant adverse effects due to the highly visible nature of the construction activities.

7.8.11 No mitigation would be 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 buried heritage assets would be **negligible**. All residual effects are presented in Section 7.10.

7.9.2 The residual effects on the character and setting of King Edward Memorial Park, Wapping Wall Conservation Area and the character and setting of the Rotherhithe Air Shaft would be **moderate adverse.** Residual effects on the slipway and the river wall would be **negligible**. Residual effects on the Rothehithe Air shaft from ground movement would be **negligible**. All residual effects area presented in Section 7.10.

7.9.3 As no mitigation measures are required for effects on the historic character, appearance and setting of above-ground heritage assets beyond those embedded in the proposed development and *CoCP*, 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

7.9.4 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 21 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				
High potential for palaeoenvironmental remains (Low or medium asset significance)	Assets affected by the construction of the cofferdams, campshed, outfall apron and scour protection. Assets removed by scour around temporary structures. Assets removed by construction of the CSO drop shaft, chambers and culverts. Asset significance reduced to negligible.	Minor adverse	Targeted archaeological investigation and recording, including environmental sampling, within the area of the temporary cofferdam and foreshore ground works. Monitoring of foreshore and provision of scour protection if required and agreed with statutory consultees.	Negligible
Uncertain, possibly moderate, potential for isolated redeposited prehistoric artefacts (Low asset significance)	Assets affected by the construction of the cofferdams, campshed, outfall apron and scour protection. Assets removed by scour around temporary structures. Assets removed by construction of the CSO drop shaft, chambers and culverts. Asset significance reduced to negligible.	Minor adverse	Targeted archaeological investigation and recording, including environmental sampling, within the area of the temporary cofferdam and foreshore ground works. Monitoring of foreshore and provision of scour protection if required and agreed with statutory	Negligible

Receptor (heritage asset)	Effect	Significance of effect	Mitigation	Significance of residual effect
			consultees.	
Uncertain, possibly moderate, potential for prehistoric settlement and riverfront activity (Medium to high asset significance)	Assets affected by the construction of the cofferdams, campshed, outfall apron and scour protection. Assets removed by scour around temporary structures. Assets removed by construction of the CSO drop shaft, chambers and culverts. Asset significance reduced to negligible.	Major adverse	Targeted archaeological investigation and recording, including environmental sampling, within the area of the temporary cofferdam and foreshore ground works. Monitoring of foreshore and provision of scour protection if required and agreed with statutory consultees.	Negligible
Uncertain, possibly low potential for Roman remains associated with marshland activity. (Low or medium asset significance)	Assets affected by the construction of the cofferdams, campshed, outfall apron and scour protection. Assets removed by scour around temporary structures. Assets removed by construction of the CSO drop shaft, chambers and culverts. Asset significance reduced to negligible.	Minor or moderate adverse	Targeted archaeological investigation and recording, including environmental sampling, within the area of the temporary cofferdam and foreshore ground works. Monitoring of foreshore and provision of scour protection if required and agreed with statutory consultees.	Negligible
Moderate potential for early medieval remains,	Assets affected by the construction of the cofferdams, campshed,	Major adverse	Targeted archaeological investigation and	Negligible

Receptor (heritage asset)	Effect	Significance of effect	Mitigation	Significance of residual effect
including fish traps (Medium or high asset significance)	outfall apron and scour protection. Assets removed by scour around temporary structures. Assets removed by construction of the CSO drop shaft, chambers and culverts. Asset significance reduced to negligible.		recording, including environmental sampling, within the area of the temporary cofferdam and foreshore ground works. Monitoring of foreshore and provision of scour protection if required and agreed with statutory consultees.	
Moderate potential for later medieval remains associated with land reclamation (low asset significance); and for later medieval remains of ship building, barge beds, jetties and piers (Medium or High asset significance)	Assets affected by the construction of the cofferdams, campshed, outfall apron and scour protection. Assets removed by scour around temporary structures. Assets removed by construction of the CSO drop shaft, chambers and culverts. Asset significance reduced to negligible.	Minor adverse (reclamation) or Major adverse (river infrastructure)	Targeted archaeological investigation and recording, including environmental sampling, within the area of the temporary cofferdam and foreshore ground works. Monitoring of foreshore and provision of scour protection if required and agreed with statutory consultees.	Negligible
High potential for post-medieval remains of shipbuilding, barge beds, jetties and other structures on the	Assets affected by the construction of the cofferdams, campshed, outfall apron and scour protection. Assets removed by scour around temporary structures.	Minor adverse (river infrastructure) to Major adverse (significant river infrastructure/reused	Targeted archaeological investigation and recording, including environmental sampling, within the area of the	Negligible

Receptor (heritage asset)	Effect	Significance of effect	Mitigation	Significance of residual effect
foreshore (Low or medium asset significance) including post-medieval structures with re-used nautical timbers (High asset significance)	Assets removed by construction of the CSO drop shaft, chambers and culverts. Asset significance reduced to negligible.	nautical timbers)	temporary cofferdam and foreshore ground works. Monitoring of scour and provision of scour protection if required and agreed with statutory consultees. Archaeological watching brief during ground works landward of the river wall, to form preservation by record.	
High potential post-medieval industrial buildings, wharves and warehouses landward of the river wall (Low asset significance)	Localised removal or truncation of assets arising from demolition, site setup, landscaping and electrical and control kiosk landward of the river wall. Asset significance reduced to negligible.	Minor adverse effect	Archaeological watching brief during ground works landward of the river wall, to form preservation by record.	Negligible
Above-ground heritage assets				
King Edward Memorial Park (Medium asset significance)	Removal of trees and the temporary removal of a bandstand and benches. Detraction from views within and to the park.	Moderate adverse	No mitigation possible further to measures embedded within the proposed design. An English heritage level 1 survey would be undertaken to ensure	Moderate adverse

Receptor (heritage asset)	Effect	Significance of effect	Mitigation	Significance of residual effect
			accurate reinstatement of features.	
19th and 20th century river wall (Low asset significance)	Localised demolition of the handrails and plinth, and change to the alignment of the river wall	Minor adverse	English Heritage *Level 2* Standing structure recording and photographic survey to form preservation by record.	Negligible
Wapping Wall Conservation Area (High asset significance)	Detraction from views within and to the conservation area.	Moderate adverse	No mitigation possible further to that embodied within the proposed design and the *CoCP* and environmental design principles	Moderate adverse
Rotherhithe Tunnel Air Shaft (High asset significance)	Effects resulting from ground movement caused by construction works predicted to cause negligible damage risk, with cracks typically up to 0.1mm wide	Minor adverse	Any significant damage resulting from ground movement would be repaired using appropriate conservation techniques following the conclusion of significant settlement	Negligible
	Low magnitude of change to the setting of the structure	Moderate adverse	No mitigation possible further to that embodied within the proposed design and the *CoCP* and environmental design principles	Moderate adverse

Receptor (heritage asset)	Effect	Significance of effect	Mitigation	Significance of residual effect
Adjacent slipway (High asset significance)	Detraction from the setting of the structure (low magnitude of impact)	Minor adverse	No mitigation required further to that embodied within the proposed design and the *CoCP* and environmental design principles	Minor adverse

Vol 21 Table 7.10.2 Historic environment – summary of operational assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
King Edward Memorial Park (Medium asset significance)	The proposed development would enhance the quality of design within the park and views out of the Wapping Wall Conservation Area across the River Thames	Moderate beneficial	None	Moderate beneficial
Wapping Wall Conservation Area (High asset significance)	There would be a negligible improvement to the overall character of the Wapping Wall Conservation Area	Minor beneficial	None	Minor beneficial
Rotherhithe Tunnel Air Shaft (High asset significance)	There would be an improvement to the setting of the Rotherhithe Tunnel Air Shaft	Minor beneficial	None	Minor beneficial
Adjacent slipway (High asset significance)	The proposed development would detract slightly from the riverside setting of the slipway	Minor adverse	No mitigation required further to that embodied within the proposed design and design principles	Minor adverse

References

[1] *National Policy Statement for Waste Water* 2012 Department of Environment, Food and Rural Affairs

[2] Stow J, A survey of London (1603) (ed C L Kingsford), 2 vols, 1908 repr 1971, Oxford

[3] Department of Environment, Food and Rural Affairs. *National Policy Statement for Waste Water (*2012)

[4] Communities and Local Government. *National Planning Policy Framework* (March 2012)

[5] 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)

[6] *National Policy Statement for Waste Water* 2012 Department of Environment, Food and Rural Affairs

[7] London Borough of Tower Hamlets. *Wapping Wall Conservation Area*, *Character Appraisal.* (November 2009), 8.

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Thames Tideway Tunnel
Thames Water Utilities Limited

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Environmental Statement

Volume 21: King Edward Memorial Park Foreshore 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 King Edward Memorial Park Foreshore 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 these would impact upon the ecology and quality of water in the tidal reaches of the tidal Thames. The surface water section also considers likely significant effects to controlled waters from land contamination (eg, contaminated run-off) and use of contaminating substances during construction. No further assessment is made in the land quality section.

[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.

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 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 Table 8.3.1). The *CoCP* is provided in Vol 1 Appendix A. It contains general requirements (Part A) and site specific requirements for this site (Part B).

8.1.6 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Volume 21 King Edward Memorial Park Foreshore 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. temporary cofferdam and campshed construction which would be established within the river to facilitate construction of the permanent works

b. construction of an online combined sewer overflow (CSO) drop shaft, the invert of which would be located at a depth of approximately 60m below ground level (bgl) situated within the chalk. The diaphragm walls would extend further below this

c. partial demolition of existing river wall and construction of new section of river wall

d. near surface structures including interception chambers and connection culverts and overflow structures

e. construction of air management plant and equipment and associated below ground ducts and chamber. The above works would involve extensive below ground construction, resulting in the excavation and removal of material, including Made Ground and natural soils below.

8.2.3 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 in King Edward Memorial Park Foreshore site construction plan - see separate volume of figures).

Code of Construction Practice

8.2.4 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.

8.2.5 There are no site specific *CoCP* measures which are relevant to this land quality assessment.

8.2.6 Land quality issues would be managed in close liaison with the local authority, London Borough (LB) of Tower Hamlets, and the Environment Agency (EA) prior to and during construction.

Pre-construction

8.2.7 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*):

a. completion of a desk study which includes a review of available information sources (see Vol 21 Appendix F.1) and production of an initial conceptual site model

b. undertaking of specialist site surveys, such as Japanese Knotweed and UXO (see Vol 21 Appendix F.3 for the UXO survey).

8.2.8 In addition to the above, land quality will continue to be assessed via the following measures:

a. preparation of a preliminary risk assessment, ground investigation surveys which would include construction of exploratory test holes (such as boreholes - a number of which have already been drilled and 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.

8.2.9 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

8.2.10 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.

8.2.11 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 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 of the *CoCP*) and the spread of mud by vehicles (see public access, the highway and river transport section of the *CoCP*).

8.2.12 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 ecological (for invasive species, such as Japanese Knotweed)

b. dust and air/vapour monitoring (see *CoCP* (Section 7) 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 LB of Tower Hamlets was 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 21 Appendix F.1 and Vol 21 Appendix F.2.

Baseline

8.3.3 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

8.3.4 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.

8.3.5 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.

8.3.6 The construction assessment has been undertaken for Site Year 1 of the construction phase.

8.3.7 The base case and cumulative assessment in Site Year 1 of construction take into account the schemes described in Vol 21 Appendix N. The baseline is not anticipated to change substantially between the base case year and Site Year 1 of construction (2016). There is one proposed development within the 250m buffer area (as shown in Vol 21 Table 8.3.1) which is likely to be complete and operational before the commencement of the construction phase and as a result forms part of the construction base case.

8.3.8 There are no proposed developments expected to commence during Site Year 1 of construction and as a result there would be no cumulative effects on land quality.

Vol 21 Table 8.3.1 Land quality – construction base case and cumulative assessment development (2016)

Development	Distance from site	Construction base case	Cumulative impact assessment
John Bell House, King David Lane, London (redevelopment of existing site to provide student accommodation and landscaping)	150m north west	✓	✗

Symbols ✓ applies ✗ does not apply

8.3.9 Section 8.5 details the likely significant effects arising from the construction at the King Edward Memorial Park Foreshore 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

8.3.10 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.

8.3.11 The SPR conceptual model is based on guidance given in CLR11: *Model procedures for the management of land contamination* (EA, 2004)[2]. 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.

8.3.12 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 described in Vol 2 Section 8.4 and Vol 2 Section 8.5 respectively.

8.3.13 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.

8.3.14 The methodology for undertaking both source-pathway-receptor analysis and the impact assessment is provided in Vol 2 Section 8.

Assumptions and limitations

8.3.15 The assumptions and limitations associated with this assessment are presented in Vol 2. Assumptions and limitations specific to the site are detailed below.

Assumptions

8.3.16 It is assumed that the LLAU away from the foreshore 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 (for all areas but the foreshore) is present and that this has the potential to be contaminated.

8.3.17 The approach to remediation away from the foreshore cannot be defined at this stage due to a lack of data. It is therefore assumed that some contamination could 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).

8.3.18 It is assumed that no remediation would be necessary in the foreshore.

Limitations

8.3.19 There is limited site-specific data on soil or groundwater quality available within the LLAU. It is however, considered that there is sufficient information currently available 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 21 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 21 Appendix F, this section should also be read in conjunction with Vol 21 Figure F.1.1, Vol 21 Figure F.1.2 and Vol 21 Figure F.1.3 (see separate volume of figures).

Summary of baseline conditions

Geology

8.4.4 The site is underlain by River Terrace Deposits extending to 2.6m. This is underlain (in turn) the London Clay Formation, Lambeth Group, Thanet Sand Formation and Chalk Group (see Vol 21 Appendix F.1, Vol 21 Table F.3 for the full geological succession).

8.4.5 Away from the foreshore, a cover of Made Ground is also present beneath the park.

Contamination

8.4.6 The main part of the operational area where the CSO drop shaft and other underground structures would be located area would comprise the tidal Thames foreshore. The tidal Thames foreshore sediments along the tidal reaches have been found to contain low levels of polyaromatic hydrocarbons (PAHs), metals from historic activities and coliforms from sewage discharges (see the sediment sampling report Vol 2 Appendix F.2).

8.4.7 The levels of contamination of the sediments are relatively low in terms of risk to human health. These sediments are also restricted to the upper part of the proposed excavation works (less than one metre) and the majority of the excavated materials at the site from the drop shaft would be essentially uncontaminated.

8.4.8 The area within the LLAU has previously contained a number of potentially contaminating activities during the late 19th Century and early 20th Century, namely: refrigeration works, wharves and a dust yard. Contaminants associated with these activities could potentially include metals, oils, PAHs, and volatile organic compounds (VOCs).

8.4.9 It is possible that these contaminants could be present as soil, soil vapour and in groundwater (including perched water).

8.4.10 However, the area currently comprises soft landscaped parkland and hard surfaced recreation areas. Intrusive ground investigations undertaken within the area immediately to the north (within the park) generally did not indicate known historical land-uses to have impacted the underlying soils. With the exception of some relatively minor levels of benzo(a)pyrene within Made Ground at 4m to 6m depth, concentrations of soil contaminants tested for were found below generic screening values for a wide variety of potential contaminants.

8.4.11 The levels of contamination in the LLAU are however currently unknown. A layer of made ground associated with previous development is likely to be present and it is assumed that this has the potential to be contaminated.

UXO

8.4.12 A desk based assessment for UXO threat was undertaken by 6 Alpha Associates Limited for ground investigation works at the proposed development site (Vol 21 Appendix F.3). The report reviews information sources such as the Ministry of Defence (MoD), Public Records Office and the Port of London Authority (PLA). The report is presented in Appendix F.3.

8.4.13 Taking into account the findings of this study and the known extent of the proposed works at the King Edward Memorial Park Foreshore site, it was considered that there was an overall high threat from UXO.

Summary of receptors

8.4.14 The receptors identified at this site from the baseline survey (see Vol 21 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 and school (Pier Head Preparatory Montessori School) users (high sensitivity), King Edward Memorial Park users and Shadwell Basin Outdoor Activity Centre (medium sensitivity) and workers in the adjacent industrial or commercial land and Thames Path users (low sensitivity)

c. built environment: park maintenance buildings, recreational buildings (including the Shadwell Basin Outdoor Centre building), park structures, residential, commercial and light industrial properties and river wall, (low sensitivity) and Grade II listed Rotherhithe Tunnel Air Shaft and slipway (high sensitivity).

Construction base case

8.4.15 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 Section 9 of the *CoCP* and summary presented in Section 8.2) means that the land quality of the site may be different to that described in Section 8.4.

8.5.2 Land quality in the main shaft construction area would remain as the current conditions as this area comprises the tidal Thames Foreshore which is of low contamination risk.

8.5.3 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.

8.5.4 The areas occupied by construction activities would however be reinstated with suitable soils appropriate for the public park end use as part of the construction works (and agreed with the local authority as part of the remediation strategy, see Section 9 of the *CoCP*).

8.5.5 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.

Development of conceptual model

Interactions between source-pathway-receptor

8.5.6 The following section outlines how the contamination sources summarised in paras. 8.4.4 to 8.4.10 may interact with the receptors identified during the construction phase (see para. 8.4.14) following the application of the embedded measures (see Section 8.2).

8.5.7 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

c. the built environment (on and off site receptors) via the accidental detonation of previously unidentified UXO.

8.5.8 The SPR interactions are summarised in Vol 21 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 21 Table 8.5.1 Land quality – source-pathway-receptor summary (construction)

Receptors / Generic sources	Construction workers	Adjacent land-users	Built environment
Contaminated soils/ sediments	Inhalation, dermal contact, ingestion	Wind -blown dust, inhalation (and subsequent inhalation or ingestion)	N/A
Contaminated groundwater or liquids	Inhalation, dermal contact, ingestion	Migration in groundwater	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

8.5.9 The following section discusses the potential impacts and likely significant effects on receptors as a result of the land quality conditions at the site.

8.5.10 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

8.5.11 A number of embedded measures set out in Section 9 of 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

8.5.12 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.

8.5.13 The second stage comprises safe methods of work and management of contamination during construction, assuming that contaminated soils could remain, or previously unidentified contamination be found, during the main construction works.

8.5.14 Both of these stages include measures such as site-specific risk assessments, watching brief, safe methods of work, use of PPE and mitigation from a specialist contractor who is experienced at managing such risks.

8.5.15 With these measures in place, the overall magnitude of the impact to construction workers (both below and above ground) is assessed to be negligible.

8.5.16 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

8.5.17 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 the King Edward Memorial Park Foreshore site 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.

8.5.18 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.

8.5.19 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

8.5.20 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.

8.5.21 A number of embedded measures set out in the *CoCP* (Section 9), as summarised in Section 8.2, are designed to effectively manage any land quality impacts to the surrounding land-users associated with the construction phase of the proposed development.

8.5.22 These measures include:

a. the damping down of excavations, storage of potentially contaminated soils in secure (covered) areas, wheel washes at the site entrance and the construction, maintenance and cleaning of hardstanding

b. dust and air/vapour monitoring to provide a check that volatile contamination or construction dusts do not 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* (Section 9).

8.5.23 With these measures in place the overall magnitude if the impact to all surrounding land-users is assessed to be negligible.

8.5.24 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, Thames Path, King Edward Memorial Park and Shadwell Basin Outdoor Activity Centre users and a **minor adverse** effect on the adjacent residential and Pier Head Preparatory Montessori School users (although the effect is defined as minor adverse, it is considered unlikely that the effect would occur).

UXO

8.5.25 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* (Section 9), 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.

8.5.26 With these measures in place the overall magnitude of the impact to all adjacent land-users is assessed to be negligible.

8.5.27 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, Thames Path, King Edward Memorial Park and Shadwell Basin Outdoor Activity Centre users and a **minor adverse** effect on the adjacent residential and Pier Head Preparatory Montessori School users (although the effect is defined as minor adverse, it is considered unlikely that the effect would occur).

Built environment

8.5.28 Impacts from existing land quality relate to the accidental detonation of UXO during preliminary surveys or main construction works.

8.5.29 A number of embedded design measures set out in the *CoCP* (Section 9), 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.

8.5.30 With these measures in place the overall magnitude of the impact to the built environment is assessed to be negligible.

8.5.31 Based on the assessed impact magnitude receptor sensitivity, it is considered that the proposed development would result in a **negligible** effect on the park structures, recreational and park maintenance buildings, residential, commercial, light industrial buildings and river wall and a **minor adverse** effect on the listed Rotherhithe Tunnel Air Shaft and slipway structures (although the effect is defined as minor adverse, it is considered unlikely that the effect would occur).

8.6 Operational effects assessment

8.6.1 Operational effects have not been assessed for land quality (see para. 8.1.4).

8.7 Cumulative effects assessment

Construction effects

8.7.1 As described in Section 8.3 there are no schemes in Vol 21 Appendix N which meet the project criteria for inclusion in the cumulative assessment. Therefore no assessment of cumulative effects has been undertaken.

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* (Section 9). No further mitigation, enhancement or monitoring is required.

8.9 Residual effects assessment

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 21 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 caused by 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 caused by 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, light industrial/commercial land-users and Thames Path users (Low)	Health effects caused by exposure to wind-blown dusts or vapours	Negligible	None	Negligible
	Health effects from detonation of UXO	Negligible	None	Negligible
Adjacent land-users, King Edward Memorial Park users and Shadwell Basin Outdoor Activity Centre users (Medium)	Health effects caused by exposure to wind-blown dusts or vapours	Negligible	None	Negligible
	Health effects from detonation of UXO	Negligible	None	Negligible
Adjacent land-users, residential and Pier Head Preparatory Montessori School users (High)	Heath effects caused by exposure to wind-blown dusts or vapours	Minor adverse	None	Minor adverse*
	Health effects from detonation of UXO	Minor adverse	None	Minor adverse*

Receptor (sensitivity)	Effect	Significance of effect	Mitigation	Significance of residual effect
Built environment, park structures, recreational and park maintenance buildings, residential, commercial and light industrial buildings and river wall (Low)	Damage to structures from detonation of UXO	Negligible	None	Negligible
Built environment, listed structures, Rotherhithe Tunnel Air Shaft and slipway (High)	Damage to listed structures from detonation of UXO	Minor adverse	None	Minor adverse*

**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] Environment Agency. *Model procedures for the management of land contamination: Contaminated Land Report 11* (2004).

Thames Tideway Tunnel
Thames Water Utilities Limited

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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 King Edward Memorial Park Foreshore 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 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 The tunnel drive for the main tunnel runs beneath this location. 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.

9.1.5 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.

9.1.6 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Volume 21 King Edward Memorial Park Foreshore 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, cofferdam fill (both import and export), main tunnel secondary lining aggregates (import), and shaft, main tunnel and other excavated material (export) would be transported by barge. For the noise assessment it has been assumed that 90% of these materials would be taken by river. This allows for periods when the river is unavailable and material unsuitable for river transport. All other materials would be transported by road. Estimated barge and vehicle numbers and haul routes are presented in Vol 21 Sections 3.3 and 12.2.

Construction activities

9.2.3 Vol 21 Section 3.3 sets out the assumed construction duration and programme for the King Edward Memorial Park Foreshore site.

9.2.4 The construction works at this location would involve the following standard activities:

a. fencing and site setup

b. demolition

c. cofferdam construction

d. diaphragm wall shaft construction

e. excavation

f. shaft secondary lining

g. culvert works

h. landscaping (including construction and fit-out of permanent facility).

9.2.5 Further detail on the plant used in these construction stages is given in Vol 21 Appendix G.

9.2.6 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 be approximately twice a week, during the diaphragm walling for the main tunnel shaft for a period of approximately three months, and then approximately once a month during the remainder of the construction programme during other major concrete pours.

Code of Construction Practice

9.2.7 The Code of Construction Practice (*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 to be suitably sited so as to minimise noise impact on sensitive receptors

c. use of site enclosures, and temporary stockpiles, where practicable and necessary, 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 are planned with regard to local occupants and sensitive receptors.

f. hoarding would be of a height and extent to achieve appropriate noise attenuation.

9.2.8 Site specific measures have been incorporated into the *CoCP Part B* (sections 4 and 6) to reduce noise and vibration effects at King Edward Memorial Park. These comprise:

a. the areas around the shaft construction site and the multi sport/park maintenance site would have full standard 2.4m hoarding

b. site hoardings would be increased from 2.4m to 3.6m around the main shaft working areas

c. noise barriers at 2.4m high would be located on the cofferdam sections perpendicular to the river wall on both sides, and on the southern boundary of the lorry route (the section that backs onto the properties on Shadwell Pier head only) to the point where it meets Glamis road

d. the use of low vibration piling, eg. hydraulic jacking/hydraulic press methods, would be required for the construction of the cofferdam where practicable and where ground conditions allow these methods to be adopted. In the piling methods, the contractor would need to give consideration to the proximity of sensitive receptors including Free Trade Wharf South

e. compaction of material on site would be undertaken using machinery generating the lowest practicable vibration levels which still enables the required level of compaction to be completed. Specifically the use of large vibratory rollers would only be used in locations where vibration levels can be controlled to less than the impact criteria

f. the loading and unloading of barges would only be carried out during standard working hours.

Operation

9.2.9 A ventilation structure would be constructed to contain plant and filter equipment and to house the ventilation columns. The plant installed would have the potential to create noise impacts. These are considered in the assessment.

9.2.10 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

9.2.11 The operational plant associated with the surface structures would incorporate environmental design measures to control noise emission to the nearest noise sensitive receptors to acceptable noise limits. These limits are as defined by the Local Authority in which the receptor lies. At King Edward Memorial Park Foreshore site, receptors within the London Borough (LB) of Tower Hamlets, alongside receptors on the opposite bank of the Thames which lie within the London Borough of Southwark have been considered, (see para. 9.3.17). The environmental design measures have considered the following noise sources:

a. hydraulic plant for penstock operation (pumps, motors)

b. uninterruptable power supply (UPS) plant

9.2.12 In considering the noise from the above items, the sound insulation of the housing for the equipment has been taken into consideration.

9.2.13 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.

9.3 Assessment methodology

Engagement

9.3.1 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 noise and vibration are presented here. There were no other site specific comments from consultees in relation to noise and vibration raised at scoping or other consultation stages.

9.3.2 LB of Tower Hamlets and LB of Southwark were consulted over the survey methodology and monitoring locations.

9.3.3 Consultation comprised of meetings and presentations at the EHO forums held in November 2010 and February 2011 together with a Position Paper setting out the proposed noise assessment methodology, issued in December 2010.

9.3.4 Additional consultation on the survey methodology was undertaken with regards to the need for continuous monitoring locations. For this site it was agreed that representative data could be obtained by leaving two unattended continuous monitoring kits securely within King Edward Memorial Park and in the garden of a property on Shadwell Pierhead overnight for a typical weekday and weekend.

9.3.5 Consultation comments relevant to this site for the assessment of noise and vibration are presented in Vol 21 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 21 Table 9.3.1 Noise and vibration – Consultation comments

Organisation	Comment	Response
LB Tower Hamlets, response February 2012	The concept of Best Practicable Means from the Control of Pollution Act 1974 is not limited to these measures and a commitment from the developer is needed that contractors will ensure all appropriate measures will be employed for the lifetime of the construction works. This commitment could be by way of a condition or requirement within the Development Consent Order (DCO) for the project.	This commitment is provided in the *CoCP Part A*

Baseline

9.3.6 The baseline methodology follows the methodology provided in Vol 2 Section 9. There are no site specific variations for this site.

Construction

9.3.7 The construction phase assessment methodology follows the methodology provided in Vol 2 Section 9. There are no site specific variations for undertaking the construction assessment of this site.

9.3.8 The predicted construction noise levels represent the worst-case forecast noise levels at a given receptor within any month of the construction works.

9.3.9 Section 9.5 details the likely significant effects arising from the construction at the King Edward Memorial Park Foreshore site. There are no other Thames Tideway Tunnel project 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 project sites are considered in this assessment.

9.3.10 The construction noise and vibration assessment has considered the effects across the whole duration of the construction phase (Years 1 to 4) and the worst-case exposure levels are reported. The development case (with the Thames Tideway Tunnel project) has been assessed against the base case (without the Thames Tideway Tunnel project).

9.3.11 The site development schedule (see Vol 21 Appendix N) does not identify any developments within 300m of the main site which are not covered by other receptors in this assessment (that are closer to the site); therefore no future developments are considered relevant to the construction assessment base case.

9.3.12 There are no schemes that are considered relevant for the construction cumulative assessment as the schemes identified in the site development schedule (see Vol 21 Appendix N) are all assumed to be built and operational by the start of construction.

9.3.13 Traffic flows on construction traffic routes have been examined to determine if there are any connecting 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 Vol 2 Section 9. The results show that there will be 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. 9.5.58.

9.3.14 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

9.3.15 As described in Vol 2 Section 9 the assessment area potentially 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

9.3.16 The operational phase assessment methodology follows the methodology provided in Vol 2 Section 9. Site specific variations to this methodology are set out below.

9.3.17 For residential receptors at this site, the London Borough of Tower Hamlets and the London Borough of Southwark requires that noise emissions from this type of source are designed to meet a rating level (as defined in BS4142[2]) which is 10dB below the typical background noise level over the operational period of the plant at 1m from the facade of the nearest residential receptor.

9.3.18 The operational assessment year is taken to be Year 1 of operation.

9.3.19 Section 9.6 details the likely significant effects arising from the operation of the King Edward Memorial Park Foreshore site. There are no other Thames Tideway Tunnel project sites which could give rise to additional noise and vibration effects within the assessment area for this site, therefore no other Thames Tideway Tunnel project sites are considered in this assessment.

9.3.20 The site development schedule (see Vol 21 Appendix N) does not identify any consented developments within 300m of the main site which are not covered by other receptors in this assessment (that are closer to the site); therefore no future developments are considered relevant to the operational assessment base case.

9.3.21 There are no schemes identified in the site development schedule (see Vol 21 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.

9.3.22 Based on the traffic flow, speed or composition change criteria specified in Vol 2 Section 9, there are no routes where potential for operational traffic noise effects would occur.

9.3.23 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

9.3.24 Operational effects are considered up to 300m from the site boundary, although the focus is on the closest receptors. Effects at more distant receptors are assessed by reference to the impacts at primary receptors.

Assumptions and limitations

9.3.25 The assumptions and limitations associated with this assessment are presented in Vol 2 Section 9. The site specific assumptions and limitations are presented in the following section. There are no site specific limitations.

Assumptions

9.3.26 The working hours assumed for the assessment are as described in para. 9.2.6.

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 full 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 21 Appendix G.2. Vol 21 Table 9.4.1 below shows the measured ambient noise levels for the day and evening periods.

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 sensitive receptors selected for the noise and vibration assessment are identified in Vol 21 Table 9.4.1 below (and shown in plan view in Vol 21 Figure 9.4.1, see separate volume of figures). These were selected as they are 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 21 Table 9.4.2.

9.4.5 The nearest residences to the site in London Borough of Tower Hamlets on the north bank of the Thames are at Free Trade Wharf, Shadwell Pierhead, Glamis Road, Prospect Wharf and the Highway. In London Borough of Southwark on the south bank of the Thames, the nearest residences are those off Rotherhithe Street (Abbotshade Road).

9.4.6 Shadwell Basin Outdoor centre and the Pier Head Preparatory School are non-residential noise sensitive receptors selected for assessment.

Receptor sensitivity

9.4.7 The sensitivities of noise and vibration receptors have been determined using the methodology outlined in Vol 2 Section 2.3. The sensitivities of all assessed receptors are presented in Vol 21 Table 9.4.1 along with the measured average ambient noise levels at each corresponding survey location.

Vol 21 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 dBL$_{Aeq}$*	Noise survey location
KE1	Prospect Wharf (residence)	High	LB of Tower Hamlets	54/52	KEM02
KE2	Shadwell Basin Outdoor centre (leisure centre)	Medium	LB of Tower Hamlets	54/52	KEM02
KE3	Pier Head Prep. School (school)	High	LB of Tower Hamlets	54/52	KEM02
KE4	4 Shadwell Pierhead (residence)	High	LB of Tower Hamlets	54/52	KEM02
KE5	35 Peartree Lane (residence)	High	LB of Tower Hamlets	54/52	KEM02
KE6	The Highway (residence)	High	LB of Tower Hamlets	78/76	KEM05
KE7	Free Trade Wharf North (residence)	High	LB of Tower Hamlets	78/76	KEM05
KE8	Free Trade	High	LB of	71/69	KEM05 &

Ref	Receptor addresses	Sensitivity	Local authority	Measured average ambient noise level, day/ evening dBL_{Aeq*}	Noise survey location
	Wharf Middle (residence)		Tower Hamlets		KEM01
KE9	Free Trade Wharf South (residence)	High	LB of Tower Hamlets	64**/62**	KEM01
KE10	Abbotshade Road (residence)	High	LB of Southwark	54/52	KEM02

** Noise level includes correction for façade acoustic reflection unless receptor position is an open outdoor space (eg park)*
***Noise level derived from the relationship between the PTH1X LT2 day, evening and night-time measurements.*

9.4.8 The baseline noise level is considered representative of the relevant receptor. 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).

9.4.9 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 King Edward Memorial Park Foreshore site have been identified and are shown in Vol 21 Table 9.4.2. As described in the assessment methodology, this follows the method as defined in Vol 2 Section 9.

9.4.10 The assessment of significance at non-residential receptors is made according to the construction noise level relative to the ambient noise level (see Vol 21 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 21 Table 9.4.2 Noise – residential receptors and assessment categories

Ref	Noise sensitive receptor* (No. of dwellings)	Ambient noise level, rounded to nearest 5dBLAeq* day/ evening	Assessment category* day/ evening	Impact criterion threshold level*, day, dBLAeq 10hour/ evening dBLAeq 1hour
KE1	Prospect Wharf (20)	55/50	A/A	65/55

Ref	Noise sensitive receptor* (No. of dwellings)	Ambient noise level, rounded to nearest 5dBLAeq* day/ evening	Assessment category* day/ evening	Impact criterion threshold level*, day, dBLAeq 10hour/ evening dBLAeq 1hour
KE4	4 Shadwell Pierhead (3)	55/50	A/A	65/55
KE5	35 Peartree Lane (10)	55/50	A/A	65/55
KE6	The Highway (25)	80/75	C**/C**	78/76
KE7	Free Trade Wharf North (20)	80/75	C**/C**	78/76
KE8	Free Trade Wharf Middle (20)	70/70	C/ C**	75/69
KE9	Free Trade Wharf South (20)	65/60	B/C	70/65
KE10	Abbotshade Road (30)	55/50	A/A	65/55

** From 'ABC' method – BS5228:2009 (British Standards Institution, 2009)*[3]
*** 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

9.4.11 The construction base case only considers the King Edward Memorial Park Foreshore site development.

9.4.12 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 considered likely that they would increase compared to the measured data from 2011 due to natural traffic growth. The assessment based on data from 2011 therefore presents a worst case assessment.

9.4.13 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.

9.4.14 No existing major sources of vibration have been identified and therefore it is considered that vibration levels are unlikely to change between the present time and the future base case.

Operational base case

9.4.15 The operational base case considers the King Edward Memorial Park Foreshore site development.

9.4.16 The base case in Year 1 of operation has been estimated from traffic flow expectations for the Year 1 of the operational phase as a result of natural growth 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 21 Table 9.5.1 and Vol 21 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 21 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, Vol 21 Plates G.5 to G.14 Appendix G show the estimated noise levels plotted month-by-month over the duration of the works. The appendix also lists the construction plant and operations assumed for the calculations. The predicted impacts and assessed effects at each representative receptor location are described below.

Impacts at residential receptors

9.5.3 The results for residential receptors are shown below (Vol 21 Table 9.5.1).

Vol 21 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
KE1/ Prospect Wharf (20)	65 (day)	52 – 67 (day)	62	2	+2*	1
	55 (evening)	33 – 51 (eve)	33	0	-4	0
KE4/ 4 Shadwell Pierhead (3)	65 (day)	39 – 57 (day)	50	0	-8	0
	55 (evening)	30 – 45 (eve)	30	0	-10	0
KE5/ 35 Peartree Lane (10)	65 (day)	39 – 56 (day)	50	0	-9	0
	55 (evening)	29 – 44 (eve)	29	0	-11	0
KE6/ The Highway (25)	78 (day)	50 – 65 (day)	58	0	-13	0
	76 (evening)	36 – 52 (eve)	36	0	-24	0
KE7/ Free Trade Wharf North (20)	78 (day)	57 – 70 (day)	61	0	-8	0
	76 (evening)	42 – 56 (eve)	42	0	-20	0
KE8/ Free Trade Wharf Middle (20)	75 (day)	59 – 72 (day)	62	0	-3	0
	69 (evening)	42 – 57 (eve)	42	0	-12	0
KE9/ Free Trade Wharf South (20)	70 (day)	63 – 80 (day)	65	12	+10*	1
	65 (evening)	44 – 61 (eve)	44	0	-4	0
KE10/ Abbotshade Road (30)	65 (day)	49 – 64 (day)	56	0	-1	0
	55 (evening)	38 – 53 (eve)	38	0	-2	0

[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*

Prospect Wharf (KE1)

9.5.4 Prospect Wharf is a five storey residential block. The upper floors of this building would have a view into the site, albeit at a distance of 150m. predicted noise levels at these dwellings due to construction activities are shown in Vol 21 Table 9.5.1.

9.5.5 The typical daytime noise levels (most frequently occurring monthly level) is 62dBL_{Aeq}. The construction of the shaft is expected to cause the worst-case noise level of 67dBL_{Aeq} for one month.

9.5.6 During the evening, the concreting associated with the shaft is expected to cause an average monthly noise level of 51dBL_{Aeq} at this receptor.

9.5.7 The construction noise levels are estimated to exceed the ABC potential significance criteria for a residential receptor during the day for two months.

9.5.8 As potentially significant effects have 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 Vol 2 Section 9. 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 31dBL_{Aeq} for one month with windows closed or approximately 50dBL_{Aeq} if windows were opened on the most exposed facade. For the other month during which the potential significance threshold is exceeded, the internal noise levels are estimated to be 30dBL_{Aeq} with windows closed. The worst-case noise level is expected for only a short proportion of the works (one month), and as this impact is of short duration and is not above BS 8233 internal guidance noise level[4] of 40dBL_{Aeq} it is assessed as **not significant**.

9.5.10 During the evening, the worst-case internal noise levels are below the ABC potential significance threshold and therefore assessed as **not significant**.

9.5.11 Other than those assessed there are no other residential properties in the vicinity of this receptor (other than those considered below) that are close enough to also be subject to significant adverse effects.

4 Shadwell Pierhead (KE4)

9.5.12 4 Shadwell Pierhead is comprised of two storey residential properties. The upper floors would be screened to the main worksite by the site hoarding and the haul route through the park will be partially screened at the upper floors. The predicted noise levels at these dwellings due to construction activities are shown in Vol 21 Table 9.5.1.

9.5.13 The typical daytime noise levels (most frequently occurring monthly level) is 50dBL_{Aeq}. The site establishment works are expected to cause the worst-case noise level of 57dBL_{Aeq} for one month.

9.5.14 During the evening, the concreting associated with the shaft is expected to cause an average monthly noise level of 45dBL_{Aeq}.

9.5.15 The construction noise levels are not estimated to exceed the potential significance criteria for a residential receptor. The effect is therefore **not significant**.

9.5.16 Other than those assessed there are no other residential properties in the vicinity of this receptor (other than those considered below) that are close enough to also be subject to significant adverse effects.

35 Peartree Lane (KE5)

9.5.17 The residential premises on Peartree Lane are three storey properties. The upper floors would be screened to the main worksite by the site hoarding, and existing wall. The haul route through the park will be partially screened to all floors. The predicted noise levels at these dwellings due to construction activities are shown in Vol 21 Table 9.5.1. The typical daytime noise levels (most frequently occurring monthly level) is 50dBL_{Aeq}. The site establishment works are expected to cause the worst-case noise level of 56dBL_{Aeq} for two months.

9.5.18 During the evening, the concreting activities associated with the shaft construction are expected to cause an average monthly noise level of 44dBL_{Aeq}.

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 Other than those assessed there are no other residential properties in the vicinity of this receptor (other than those considered below) that are close enough to also be subject to significant adverse effects.

The Highway (KE6)

9.5.21 The residential premises on The Highway are three storey properties. The upper floors would be partially screened to the main worksite by the site hoarding and existing features. The predicted noise levels at these dwellings due to construction activities are shown in Vol 21 Table 9.5.1.

9.5.22 The typical daytime noise levels (most frequently occurring monthly level) is 58dBL_{Aeq}. The site establishment works are expected to cause the worst-case noise level of 65dBL_{Aeq} for two months.

9.5.23 During the evening, the concreting activities associated with the shaft construction are expected to cause an average monthly noise level of 52dBL_{Aeq}.

9.5.24 The construction noise levels are not estimated to exceed the potential significance criteria for a residential receptor. The effect is therefore **not significant**.

9.5.25 Other than those assessed there are no other residential properties in the vicinity of this receptor that are close enough to be subject to significant adverse effects.

Free Trade Wharf North (KE7)

9.5.26 Free Trade Wharf is a ten storey residential block, the upper floors of the northern section would be partially screened to areas of the main worksite by the site hoarding, albeit at a distance of 65m from the site boundary. The predicted noise levels at these dwellings due to construction activities are shown in Vol 21 Table 9.5.1.

9.5.27 The typical daytime noise levels (most frequently occurring monthly level) is 61dBL_{Aeq}. The site establishment works are expected to cause the worst-case noise level of 70dBL_{Aeq} for one month.

9.5.28 During the evening, the concreting activities associated with the shaft construction are expected to cause an average monthly noise level of 56dBL_{Aeq}.

9.5.29 The construction noise levels are not estimated to exceed the potential significance criteria for a residential receptor. The effect is therefore **not significant**.

9.5.30 Other than those assessed there are no other residential properties in the vicinity of this receptor that are close enough to be subject to significant adverse effects.

Free Trade Wharf Middle (KE8)

9.5.31 Free Trade Wharf is a ten storey residential block, the upper floors of the middle section would be partially screened to areas of the main worksite by the site hoarding, albeit at a distance of 40m from the site boundary. The predicted noise levels at these dwellings due to construction activities are shown in Vol 21 Table 9.5.1

9.5.32 The typical daytime noise levels (most frequently occurring monthly level) is 62dBL_{Aeq}. The site establishment works are expected to cause the worst-case noise level of 72dBL_{Aeq} for one month.

9.5.33 During the evening, the concreting activities associated with the shaft construction are expected to cause an average monthly noise level of 57dBL_{Aeq}.

9.5.34 The construction noise levels are not estimated to exceed the potential significance criteria for a residential receptor. The effect is therefore **not significant**.

9.5.35 Other than those assessed there are no other residential properties in the vicinity of this receptor that are close enough to be subject to significant adverse effects.

Free Trade Wharf South (KE9)

9.5.36 Free Trade Wharf is ten storey residential block, the upper floors of the southern section would be unscreened to the main worksite at a distance of 10m from the site boundary. The predicted noise levels at these dwellings due to construction of the shaft and cofferdam construction activities are shown in Vol 21 Table 9.5.1.

9.5.37 The typical daytime noise levels (most frequently occurring monthly level) is 65dBL_{Aeq}. The construction of the shaft and cofferdam construction works are expected to cause the worst-case noise level of 80dBL_{Aeq} for one month.

9.5.38 During the evening, the concreting associated with the shaft is expected to cause an average monthly noise level of 61dBL_{Aeq}.

9.5.39 The construction noise levels are estimated to exceed the ABC potential significance criteria for a residential receptor during the day for twelve months.

9.5.40 As potentially significant effects have 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 Vol 2 Section 9. Single glazed openable windows have 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.

9.5.41 The worst case internal noise level during the day is estimated to be 49dBL_{Aeq} for one month with windows closed or approximately 62dBL_{Aeq} if windows were opened on the most exposed facade. For the other twelve months during which the potential significance threshold is exceeded, the internal noise levels are estimated to be between 39 - 46dBL_{Aeq} with windows closed. Although the worst-case noise level is expected for only a short proportion of the works (one month), this impact, together with the other periods over the BS 8233 internal guidance noise level4 of 40dBL_{Aeq} is assessed as causing a **significant** effect given the number of affected residences.

9.5.42 During the evening, the worst-case internal noise levels are below the ABC potential significance threshold and therefore assessed as **not significant**.

9.5.43 Other than those assessed there are no other residential properties in the vicinity of this receptor (other than those considered below) that are close enough to also be subject to significant adverse effects.

Abbotshade Road (KE10)

9.5.44 South of the river, the residential properties on Abbotshade Road are three storey properties. The upper floors would be unscreened to the main worksite by the site hoarding, albeit at a distance of over 250m. The predicted noise levels at these dwellings due to construction activities are shown in Vol 21 Table 9.5.1.

9.5.45 The typical daytime noise levels (most frequently occurring monthly level) is $56dBL_{Aeq}$. The site establishment works are expected to cause the worst-case noise level of $64dBL_{Aeq}$ for one month.

9.5.46 During the evening, the concreting activities associated with the shaft construction are expected to cause an average monthly noise level of $53dBL_{Aeq}$.

9.5.47 The construction noise levels are not estimated to exceed the potential significance criteria for a residential receptor. The effect is therefore **not significant**.

9.5.48 Other than those assessed there are no other residential properties in the vicinity of this receptor that are close enough to be subject to significant adverse effects.

Impacts at non-residential receptors

9.5.49 The results for non-residential receptors are shown below.

Vol 21 Table 9.5.2 Vibration – 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 <u>all</u> works, months	Worst-case excess above ambient, dBL_{Aeq}
KE2/ Shadwell Basin Outdoor centre	Low	42 – 62 (day)	54	42	10	+8
KE3/ Pier Head Prep. School	High	47 – 65 (day)	54	47	26	+11

[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*

Shadwell Basin Outdoor Centre (KE2)

9.5.50 Shadwell Basin Outdoor Centre is located over 100m from the main site boundary although within 10m of the access road. The upper floor of the Shadwell Basin Outdoor Centre building is occupied by the Pier Head Preparatory School. The prediction is made to the most affected windows of the Outdoor Centre.

9.5.51 The typical daytime noise levels (most frequently occurring monthly level) is 42dBL_{Aeq}. The worst-case daytime noise level of 62dBL_{Aeq} shown in Vol 21 Table 9.5.2 would occur during the site set up works for approximately one month. This worst-case noise level is greater than the current ambient noise level for the daytime period.

9.5.52 Although the noise level would increase relative to the current ambient noise level and this is likely to be noticeable in areas inside the building, the worst-case noise level is expected for only a short proportion of the works (one month). Noise at this receptor is considered to be **not significant**.

Pier Head Preparatory School (KE3)

9.5.53 Pier Head Preparatory School is located above the Shadwell Basin outdoor centre. The prediction is made to the most affected windows of the school.

9.5.54 The typical daytime noise levels (most frequently occurring monthly level) is 47dBL_{Aeq}. The worst-case daytime noise level shown in Vol 21 Table 9.5.2 would occur during the site set up works for approximately one month. This noise level of 65dBL_{Aeq} during the daytime is greater than the current ambient noise level for the daytime period.

9.5.55 Although the noise level would increase relative to the ambient noise level and this is likely to be noticeable in areas inside the building, the increase in average noise levels inside the building is not expected to exceed guideline noise levels for teaching spaces based on typical noise insulation for a façade of this type with windows closed.

9.5.56 However, there remains a risk that for short durations the guidance levels for classrooms would be exceeded.

9.5.57 Given the sensitivity of the receptor and that there is a risk that the guidance levels would potentially be exceeded, construction noise at this receptor has been assessed as **significant**.

Road-based construction traffic

9.5.58 The location of the site provides direct access to the major road network through London. The construction programme will result in varying traffic generation over a period of three and a half years. During the peak construction period the traffic generation is forecast to average 82 heavy goods vehicles (HGV) per day, assuming all construction traffic from the sections of The Highway immediately to east and west of Glamis Road use Glamis Road to access and exit the site.

9.5.59 The major road links adjacent to and leading to the site are The Highway, Limehouse Link and Butcher Row. Vehicles will also use Glamis Road to access the site. Other local roads will not be used.

9.5.60 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. Alternatively, a change in number of HGVs of 5% is also considered to cause a change in noise level of approximately 1dB.

9.5.61 The traffic modelling shows that the 18hr Annual Average Weekday Traffic (AAWT) flow on The Highway, the major link which is adjacent to the site, is currently just below 63,000 vehicles per day (vpd), with average speeds of 23 mph (37 kph) and 9.0% HGVs. The total number of HGVs is therefore currently 5,410 per day.

9.5.62 Limehouse Link has the highest flow, with just over 72,000 vpd and 8.7% HGVs. The flow on The Highway ranges from above 53,000 vpd to just below 63,000 vpd, with the flow on Butcher Row being significantly lower with just above 21,000 vpd. The flow on the section of Glamis Road adjacent to the site is significantly lower, with the flow being just below 4,000 vpd. However, Glamis Road has a HGV percentage of 12.2%, which is higher than the HGV percentage on the major links, which range from 7.2% to 9.8%.

9.5.63 The modelling of construction traffic on these links shows that the highest percentage increase in total flow due to construction traffic will occur on the section of Glamis Road adjacent to the site, assuming that all construction traffic from the sections of The Highway to the east and west of Glamis Road use the road to access the site. The average daily number of construction HGVs on this link during the peak month of construction is 82. The average daily number of Worker cars and office/operational light vehicles is 26. There is a percentage increase in flow of 2.8% and an increase of HGVs of 1.72%.

9.5.64 Additionally, the modelling of the construction traffic on these links shows that the highest increase in HGV composition will also occur on the section of Glamis Road adjacent to the site. The average daily number of construction HGVs on this link during the peak month of construction is 82, which, taking into account the number of worker cars and office/operational light vehicles, represents an increase in HGV composition to 13.7%.

9.5.65 Therefore, the percentage flow change and change in HGV percentage do not meet the criteria for causing a 1dB change in noise level. The additional numbers of HGVs will cause only negligible change to the traffic noise levels and the effects are assessed as **not significant**.

River-based construction traffic

9.5.66 The use of barges for the transport of materials to and from the site could result in noise impacts at nearby receptors.

9.5.67 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 (Peter Brett Associates)[5]. The engine noise from movement of the barges on the river Thames is limited to 75dB(A) at 25m (Port of London Authority)[6].

9.5.68 The use of tugs is planned for two periods, during which they will be operating twice a day with the tide. Each movement (delivery and removal) will be 10 minutes.

9.5.69 The operation, loading and removal of the river barges whilst within the site boundary has been considered in the construction noise assessment.

9.5.70 The operation of the tugs on the river outside of the site boundary have been assessed to the nearest residential receptors, Free Trade Wharf to the east and Prospect Wharf to the west and at the closest part of the park.

9.5.71 At Freetrade Wharf the tugs will operate at a minimum distance of 55m. At this distance the predicted noise from this activity during the day/evening (7am to 11pm) will be 51dBL_{Aeq}. The survey indicates that the day/evening noise level at this location is 61dB$L_{Aeq,15mins}$, as identified in Vol 21 Appendix G, Vol 21 Table G.9, which is greater than the tug noise and therefore the noise from river based construction traffic is considered to be **not significant**.

9.5.72 At Prospect Wharf the tugs will operate at a minimum distance of 60m. At this distance the predicted noise from this activity during the day/evening (7am to 11pm) will be 50dBL_{Aeq}. The survey indicates that the day/evening noise level at this location is 54dBL_{Aeq}, as identified in Vol 21 Appendix G, Vol 21 Table G.9, which is greater than the tug noise and therefore the noise from river based construction traffic is considered to be **not significant.**

9.5.73 At the closest point within King Edward Memorial Park the tugs will operated at a distance of 45m. At this distance the predicted noise from this activity during the day/evening (7am to 11pm) will be 50dB$L_{Aeq,}$ The survey indicates that the day/evening noise level at this location is 51dBL_{Aeq}, as identified in Vol 21, Appendix G, which is greater than the tug noise and therefore the noise from river based construction traffic is considered to be **not significant.**

Vibration

9.5.74 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.

9.5.75 The assessment has been conducted using the methodology defined in Vol 2 Section 9.

9.5.76 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 21 Table 9.5.3.

Vol 21 Table 9.5.3 Vibration – human vibration impacts

Ref	Receptor	Impact (highest predicted eVDV across all activities, $m/s^{1.75}$)*	Value/ sensitivity	Magnitude
KE1	Prospect Wharf	<0.1	High	Below Low probability of adverse comment – No impact
KE2	Shadwell Basin Outdoor centre	<0.2	Low	Below Low probability of adverse comment – No impact
KE3	Pier Head Prep. School	<0.1	High	Below Low probability of adverse comment – No impact
KE4	4 Shadwell Pierhead	<0.1	High	Below Low probability of adverse comment – No impact
KE5	35 Peartree Lane	<0.1	High	Below Low probability of adverse comment – No impact
KE6	The Highway	<0.1	High	Below Low probability of adverse comment – No impact
KE7	Free Trade Wharf North	<0.2	High	Below Low probability of adverse comment – No impact
KE8	Free Trade Wharf Middle	<0.4	High	Low probability of adverse comment –

Ref	Receptor	Impact (highest predicted eVDV across all activities, $m/s^{1.75}$)*	Value/ sensitivity	Magnitude
				No impact
KE9	Free Trade Wharf South	1.6	High	Adverse comment probable - Impact
KE10	Abbotshade Road	<0.1	High	Below Low probability of adverse comment – No impact

**Most affected floor*

9.5.77 The predicted eVDV levels at all residential receptors except Free Trade Wharf south fall within or below the 'Low probability of adverse comment' band, as described in Vol 2 Section 9 and therefore it has been assessed as **not significant** at these locations.

9.5.78 The predicted eVDV levels at Free Trade Wharf South fall within the 'Adverse comment probable' band, as described in Vol 2 Section 9. The *CoCP Part A* seeks to ensure that piling methods which limit noise and vibration are selected where possible (*CoCP Part A* para 6.4.3d). If ground conditions at the King Edward Memorial Park site are such that these methods could be implemented, effects would not be significant. However as the specific ground conditions encountered would not be known until piling is underway; it cannot be guaranteed that these measures can be implemented. Therefore, in the worst case, **significant** effects would arise from piling at these locations.

9.5.79 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 Vol 2 Section 9. The results of the assessment of construction vibration are presented in Vol 21 Table 9.5.4.

Vol 21 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*
KE1	Prospect Wharf	<0.1	High	Below threshold

Ref	Receptor	Impact (highest predicted PPV across all activities, mm/s)	Value/ sensitivity	Magnitude*
				of potential cosmetic damage - No impact
KE2	Shadwell Basin Outdoor centre	<0.1	Low	Below threshold of potential cosmetic damage - No impact
KE3	Pier Head Prep. School	<0.1	High	Below threshold of potential cosmetic damage - No impact
KE4	4 Shadwell Pierhead	<0.1	High	Below threshold of potential cosmetic damage - No impact
KE5	35 Peartree Lane	<0.1	High	Below threshold of potential cosmetic damage - No impact
KE6	The Highway	<0.1	High	Below threshold of potential cosmetic damage - No impact
KE7	Free Trade Wharf North	<0.1	High	Below threshold of potential cosmetic damage - No impact
KE8	Free Trade Wharf Middle	<0.3	High	Below threshold of potential cosmetic damage - No impact
KE9	Free Trade Wharf	1.5	High	Below threshold

Ref	Receptor	Impact (highest predicted PPV across all activities, mm/s)	Value/ sensitivity	Magnitude*
	South			of potential cosmetic damage – No impact
KE10	Abbotshade Road	<0.1	High	Below threshold of potential cosmetic damage - No impact

** Predicted vibration levels assume groundborne transmission. For boats moored in the river it is expected that vibration transmission would be reduced and the vibration levels would be lower than those estimated.*

9.5.80 The vibration levels reported here are well below the levels likely to cause cosmetic building damage according to the criteria described in Vol 2 Section 9.

9.5.81 Vibration effects are not significant to any receptors with the exception of at Free Trade Wharf South where **significant** effects to occupants (not building structure) are predicted.

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 site development schedule (see Vol 21 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 A passive ventilation system is to be installed at King Edward Memorial Park Foreshore site and therefore there is no requirement to install active ventilation equipment for the drop shaft at this location.

9.6.3 The appropriate emission limits are shown below in Vol 21 Table 9.6.1 based on local authority requirements to ensure that no adverse effects would occur. As there is no active ventilation plant for the drop shaft to generate noise at this site, these limits would only apply to any minor plant equipment. If cooling fans for the kiosks are required this equipment would be controlled to meet the criteria in Vol 21 Table 9.6.1 although such equipment would be expected to have a relatively low noise emission (approximately 45dB(A) at 3m).

9.6.4 The prediction method and assumptions are described in Vol 2 Section 9. Vol 21 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 21 Table 9.6.1 Noise – operational airborne noise impacts

Ref	Receptor	Lowest baseline noise level	Impact	Value/ sensitivity	Magnitude
KE1	Prospect Wharf	Night-time baseline not measured at this location*	Plant noise emission to be designed to a rating level at receptor 5dB below the typical background noise level	High	Plant noise level below night-time local authority limit**,– no adverse impact
KE2	Shadwell Basin Outdoor centre	$54dBL_{Aeq,}$ 15 minutes	Plant noise emission level at receptor less than $54dBL_{Aeq.}$	Medium	Plant noise level below ambient daytime level – no adverse impact
KE3	Pier Head Prep. School	$54dBL_{Aeq,}$ 15 minutes	Plant noise emission level at receptor less than $54dBL_{Aeq.}$	High	Plant noise level below ambient daytime level – no adverse impact
KE4	4 Shadwell Pierhead	Night-time baseline not measured at this location*	Plant noise emission to be designed to a rating level at receptor 5dB below the typical background	High	Plant noise level below night-time local authority limit**,– no adverse impact

Ref	Receptor	Lowest baseline noise level	Impact	Value/ sensitivity	Magnitude
			noise level		
KE5	35 Peartree Lane	Night-time baseline not measured at this location*	Plant noise emission to be designed to a rating level at receptor 5dB below the typical background noise level	High	Plant noise level below night-time local authority limit**,– no adverse impact
KE6	The Highway	Night-time baseline not measured at this location*	Plant noise emission to be designed to a rating level at receptor 5dB below the typical background noise level	High	Plant noise level below night-time local authority limit**,– no adverse impact
KE7	Free Trade Wharf North	Night-time baseline not measured at this location*	Plant noise emission to be designed to a rating level at receptor 5dB below the typical background noise level	High	Plant noise level below night-time local authority limit**,– no adverse impact
KE8	Free Trade Wharf Middle	Night-time baseline not measured at this location*	Plant noise emission to be designed to a rating level at receptor 5dB below the typical background noise level	High	Plant noise level below night-time local authority limit**,– no adverse impact
KE9	Free Trade Wharf South	Night-time baseline	Plant noise emission to	High	Plant noise level below

Ref	Receptor	Lowest baseline noise level	Impact	Value/ sensitivity	Magnitude
		not measured at this location*	be designed to a rating level at receptor 5dB below the typical background noise level		night-time local authority limit**,– no adverse impact
KE 10	Abbotshade Road	Night-time baseline not measured at this location*	Plant noise emission to be designed to a rating level at receptor 5dB below the typical background noise level	High	Plant noise level below night-time local authority limit**,– no adverse impact

** Refer to para 9.6.5*
*** Limit referred to is that identified for the Local Authority in which the receptor is located (see para. 9.3.17)*

9.6.5 Background noise level measurements have not been undertaken for the night-time period at King Edward Memorial Park Foreshore site as the site is not identified as requiring 24 hour continuous working. A noise survey would be completed before the installation of the equipment and these levels used to design the equipment to achieve the night-time local authority limit.

9.6.6 From the results given above in Vol 21 Table 9.6.1 and the statement in para. 9.6.5, no adverse impacts are anticipated and the effects of plant noise at these emission levels is assessed as **not significant**. This assumes that design measures are taken to ensure compliance with the appropriate local authority requirements to prevent disturbance.

Noise and vibration from tunnel filling

9.6.7 Measurements from existing sites, taken during storm and non-storm events, at drop structures equivalent to those being considered for the Thames Tideway Tunnel project have been used to inform the assessment of noise and vibration during tunnel filling events. These studies (Jain and Kennedy, 1983)[7], which were of drop structures in the US, are described in Vol 2 Section 9. From the studies, the highest noise levels measured on a mesh grille directly over the drop shaft were 61dBL_{Aeq} during a severe storm event.

9.6.8 These events are not typical and only occur during severe rain storms. At King Edward Memorial Park Foreshore site, the drop shaft will be enclosed and any noise at the surface will 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 at the nearest residential receptor is likely to be less than the prevailing ambient noise level.

9.6.9 The highest peak particle velocity (PPV) measured directly at the existing drop shaft sites used in the case study as described in Vol 2 Section 9 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 Vol 2 Section 9. Similarly, the levels are well below the transient and continuous vibration guideline criterion for building damage.

9.6.10 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

9.6.11 As part of the operation of the tunnel, there would need to be routine but infrequent maintenance carried out at the site. A crane would be required for 10 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.

9.6.12 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.

9.6.13 As no impacts have been identified from the operation of the site, this is assessed as **not significant**.

Noise from operational traffic

9.6.14 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.

9.6.15 As a proportion of the existing traffic on the road network these vehicles will not contribute to the traffic noise level and the noise effects of these movements are assessed as **not significant**.

Sensitivity test for programme delay

9.6.16 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 site development schedule (see Vol 21 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 None of the projects described in Section 9.3, are considered relevant to the cumulative assessment at King Edward Memorial Park Foreshore site as they are all assumed to be complete before the commencement of the works at this site. As such, no cumulative construction 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.

Operational effects

9.7.2 None of the projects described in Section 9.3, are considered relevant to the operational cumulative assessment at King Edward Memorial Park Foreshore site as due to their use they are not expected to generate significant noise or vibration levels during their operation. 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 during the construction phase at Free Trade Wharf South and Pier Head Preparatory School. However, no further practicable noise mitigation can be adopted above those measures identified in the *CoCP*.

9.8.2 A *noise insulation and temporary re-housing policy* has been established (see Schedule 2 of the *Statement of Reasons* which accompanies this application). The policy seeks to offset the potential adverse noise effects arising from construction and would be available to those residents where predicted or measured construction noise levels exceed trigger levels published in the policy. As there is no guarantee that the noise control measures would be accepted by the affected party, the two scenarios (with and without implementation of the policy) are presented in the residual effects section below.

9.8.3 Free Trade Wharf South may be eligible for noise insulation as described in the policy. This is a commonly used measure to control construction noise ingress to residential properties.

9.8.4 The effect of noise insulation on noise exposure inside the properties has been assessed in Section 9.9.

9.8.5 Pier Head Preparatory School does not qualify for noise insulation under the *Thames Tideway Tunnel noise insulation and temporary re-housing policy* as it is not a residential property.

9.8.6 Pier Head Preparatory School may be eligible to apply for compensation through the *Thames Tideway Tunnel project 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 *Environmental Statement* for this receptor do not take the offsetting effect of the compensation programme into account.

9.8.7 The above assessment has also concluded that there are significant adverse construction vibration effects (human response) during the construction phase at Free Trade Wharf South. The use of low vibration piling methods where practicable is specified in *CoCP Part A*. As discussed in para. 9.5.78, it cannot be guaranteed that these measures can be implemented and as such significant adverse vibration effects are predicted. There are no further mitigation measures that can be adopted beyond those measures set out in the *CoCP*. The residents of Free Trade Wharf South may be eligible to apply for compensation through the Thames Tideway Tunnel Compensation Programme (see Schedule 2 of the *Statement of Reasons,* which accompanies the application) which has been established to address claims of exceptional hardship or disturbance.

9.8.8 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 *Environmental Statement* for this receptor do not take the offsetting effect of the compensation programme into account.

Operation

9.8.9 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

9.8.10 Monitoring of construction noise will be carried out as described in the *CoCP*. It is not anticipated that there will be any need for monitoring of operational noise.

9.9 Residual effects assessment

Construction effects

Noise

Free Trade Wharf South (KE9)

9.9.1 The construction noise assessment set out above in Section 9.5 has identified significant effects at Free Trade Wharf South.

9.9.2 The significant noise effects assessed at Free Trade Wharf South could be addressed by noise insulation as set out in the *Thames Tideway Tunnel noise insulation and temporary re-housing policy* (see para. 9.8.2). It must be recognised, however, that the affected residents of Free Trade Wharf South may not wish to take up the offer of noise insulation and thus the residual construction noise effects remains as presented in Section 9.5.

9.9.3 If a noise insulation package as described in the *Thames Tideway Tunnel noise insulation and temporary re-housing policy* were installed, the internal daytime noise levels at Free Trade Wharf South are estimated to reduce during the short period of worst-case noise levels to below the guidance criteria for living rooms. With the inclusion of a noise insulation package the construction noise effects would be rated as **not significant**.

Pier Head Preparatory School (KE3)

9.9.4 As discussed at para. 9.8.5, Pier Head Preparatory School does not qualify for noise insulation as it is a non residential premises. Pier Head Preparatory School 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 *Environmental Statement* do not take the offsetting effects of the compensation programme into account and therefore construction noise effects would remain as presented in Section 9.5.

9.9.5 The use of low vibration piling methods where practicable would be used. However, it cannot be guaranteed that these measures could be implemented. Hence, the construction vibration effects would remain as presented in Section 9.5.

Vibration

9.9.6 The residents of Free Trade Wharf South may also be eligible for compensation for vibration effects under the *Thames Tideway Tunnel project compensation programme*. For the purpose of the assessment the residual effects reported in the *Environmental Statement* do not take the offsetting effects of the compensation programme into account. In addition, the use of low vibration piling methods where practicable would be used. However, it cannot be guaranteed that these measures could be implemented. Hence, the construction vibration effects would remain as presented in Section 9.5.

Operational effects

9.9.7 As no mitigation measures are proposed, the residual operational effects remain as presented in Section 9.6.

9.10 Assessment summary

Vol 21 Table 9.10.1 Noise – summary of construction assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
KE1 - Prospect Wharf	Noise	Not Significant	None	Not significant
KE2 - Shadwell Basin Outdoor centre	Noise	Not significant	None	Not significant
KE3 - Pier Head Prep. School	Noise	Significant	No further on site mitigation practicable	Significant, however properties may be eligible for compensation (see para.9.9.4)
KE4 - 4 Shadwell Pierhead	Noise	Not significant	None	Not significant
KE5 - 35 Peartree Lane	Noise	Not significant	None	Not significant
KE6 - The Highway	Noise	Not significant	None	Not significant
KE7 - Free Trade Wharf North	Noise	Not significant	None	Not significant
KE8 - Free Trade Wharf Middle	Noise	Not significant	None	Not significant
KE9 - Free Trade Wharf South	Noise	Significant	No further on site mitigation practicable	Significant, however properties may be eligible for noise insulation, which if accepted, would reduce the effect to not significant. See

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
				para. 9.9.3)
KE10 - Abbotshade Road	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
River-based construction traffic				
KE1 - Prospect Wharf	Noise	Not significant	None	Not significant
KE9 - Free Trade Wharf South	Noise	Not significant	None	Not significant

Vol 21 Table 9.10.2 Vibration – summary of construction assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect	Comments
KE1 - Prospect Wharf	Vibration	Not significant	None	Not significant	
KE2 - Shadwell Basin Outdoor centre	Vibration	Not significant	None	Not significant	
KE3 - Pier Head Prep. School	Vibration	Not significant	None	Not significant	
KE4 - 4 Shadwell Pierhead	Vibration	Not significant	None	Not significant	
KE5 - 35 Peartree Lane	Vibration	Not significant	None	Not significant	
KE6 - The Highway	Vibration	Not significant	None	Not significant	
KE7 - Free Trade Wharf North	Vibration	Not significant	None	Not significant	
KE8 - Free Trade Wharf Middle	Vibration	Not significant	None	Not significant	
KE9 - Free Trade Wharf South	Vibration	Significant	No further on site mitigation practicable	Significant, however properties may be eligible for compensation (see para. 9.8.7)	As discussed in para. 9.5.78, successful implementation of low vibration piling as set out in the *CoCP* would reduce the effect to not significant.
KE10 - Abbotshade Road	Vibration	Not significant	None	Not significant	

Vol 21 Table 9.10.3 Noise – summary of operational assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
KE1 - Prospect Wharf	Noise	Not significant	None	Not significant
KE2 - Shadwell Basin Outdoor centre	Noise	Not significant	None	Not significant
KE3 - Pier Head Prep. School	Noise	Not significant	None	Not significant
KE4 - 4 Shadwell Pierhead	Noise	Not significant	None	Not significant
KE5 - 35 Peartree Lane	Noise	Not significant	None	Not significant
KE6 - The Highway	Noise	Not significant	None	Not significant
KE7 - Free Trade Wharf North	Noise	Not significant	None	Not significant
KE8 - Free Trade Wharf Middle	Noise	Not significant	None	Not significant
KE9 - Free Trade Wharf South	Noise	Not significant	None	Not significant
KE10 - Abbotshade Road	Noise	Not significant	None	Not significant

Vol 21 Table 9.10.4 Vibration – summary of operational assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
KE1 - Prospect Wharf	Vibration	Not significant	None	Not significant
KE2 - Shadwell Basin Outdoor centre	Vibration	Not significant	None	Not significant
KE3 - Pier Head Prep. School	Vibration	Not significant	None	Not significant
KE4 - 4 Shadwell Pierhead	Vibration	Not significant	None	Not significant
KE5 - 35 Peartree Lane	Vibration	Not significant	None	Not significant
KE6 - The Highway	Vibration	Not significant	None	Not significant
KE7 - Free Trade Wharf North	Vibration	Not significant	None	Not significant
KE8 - Free Trade Wharf Middle	Vibration	Not significant	None	Not significant
KE9 - Free Trade Wharf South	Vibration	Not significant	None	Not significant
KE10 - Abbotshade Road	Vibration	Not significant	None	Not significant

References

[1] National Policy Statement for Waste Water (2012) Department of Environment, Food and Rural Affairs. 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*. British Standards Institution (1997).

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

[4] British Standards Institution, BS 8233 Code of Practice for Sound insulation and noise reduction for buildings, British Standards Institution (1999).

[5] 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*.

[6] Port of London Authority. *Draft Thames Freight Operations Vessel Standards.*

[7] 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).

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.21**

Volume 21: King Edward Memorial Park Foreshore site assessment

Section 10: Socio-economics

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

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Thames Tideway Tunnel

Creating a cleaner, healthier River Thames

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Thames Tideway Tunnel

Environmental Statement

Volume 21: King Edward Memorial Park Foreshore 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 the King Edward Memorial Park Foreshore site. At this site, effects during construction are considered on users of King Edward Memorial Park, users of the Thames Path National Trail and Right of Way (Thames Path), users of Shadwell Basin Outdoor Activity Centre and Pier Head Preparatory School and nearby residents. During the operational phase, effects are considered on users of King Edward Park and the associated future open space that would be created as a result of the project.

10.1.2 The likely significant project-wide socio-economic effects, including employment generation, stimulation of industry, and leisure and recreation related effects on users of the River Thames are described in Volume 3 Project-wide effects assessment. This includes consideration of effects during the operational phase on users of the River Thames including users of Shadwell Basin Outdoor Activity Centre.

10.1.3 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.

10.1.4 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Volume 21 King Edward Memorial Park Foreshore Figures).

10.1.5 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 Approximately 0.55ha of the King Edward Memorial Park grounds, including the existing children's playground, part of the multi-use games area (MUGA or also known as an all weather pitch)[i], the bandstand and some areas of landscaped amenity space would be temporarily enclosed

[i] The MUGA can serve as both a football pitch and basketball court.

within the proposed construction site hoardings and would be unavailable to park users for the majority of the construction period.

10.2.3 A section of the Thames Path National Trail and Public Right of Way (Thames Path) would be temporarily diverted via two alternative routes for the duration of the construction period.

10.2.4 An access route would be created between Glamis Road and the main part of the construction site.

10.2.5 The children's playground would be relocated within the park at the start of construction, would be available for the duration of the construction period and would remain *in-situ* after the construction phase is complete.

10.2.6 The bandstand would be removed temporarily for the duration of the construction works and would be repositioned after the construction phase is complete.

10.2.7 A small area of the MUGA would fall within the hoarded area occupied by the construction access route, for the duration of the construction phase. Prior to construction of the temporary access road, the existing sports pitches would be reconfigured within the area of the MUGA outside the hoarded area and then returned to public use. On completion of construction, the area of the MUGA within the hoarding would be returned to public use.

10.2.8 A temporary cofferdam would be constructed in the river foreshore, adjacent to the park and near to the Shadwell Basin Outdoor Activity Centre.

10.2.9 Works at the site are expected to last approximately three and a half years. For detail on construction working hours, see Section 3.3 of this volume.

10.2.10 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

10.2.11 Construction is expected to require a maximum workforce of approximately 40 workers at any one time. The number and type of workers is shown in Vol 21 Table 10.2.1.

Vol 21 Table 10.2.1 Socio-economics - construction worker numbers

Contractor		Client
Staff*	**Labour****	**Staff*****
08:00-18:00	**0800 - 1800**	**08:00-18:00**
15	20	5

** Contractor Staff – contract staff brought in to project manage the engineering work and site.*
***Labour – those working on site doing engineering, construction and manual work.*
**** Client Staff – engineering and support staff managing the project and supervising the Contractor*

Code of Construction Practice

10.2.12 Measures applicable to all sites incorporated into the *Code of Construction* Practice *(CoCP) Part A* to limit significant adverse air quality, construction dust (Section 7), noise, vibration (Section 6), and visual impacts (Section 4) would help to reduce socio-economic effects, particularly amenity effects.

10.2.13 The *CoCP Part A* requires the contractor to undertake the works in such a manner as to limit undue inconvenience to the public and other river users arising from increased barge movements, as far as is reasonably practicable. It also states that a *River Transport Management Plan* would be produced which would include assessment of risks to recreational river users and consider the potential for mitigation measures that can be employed (see Section 5 within the *CoCP Part A*).

10.2.14 The *CoCP Part A* states 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 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*).

10.2.15 Further site-specific measures, which could 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 assessments (Sections 4.2, 9.2, and 11.2, respectively within this volume) for details on the types of measures that would be employed.

10.2.16 The *CoCP Part B* (Section 4) notes that outside of standard working hours at weekends, the steel mesh fencing on the construction access route would be removed to allow for open access through the park to the river frontage.

[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.

10.2.17 The *CoCP Part B* also includes provision to ensure the Thames Path diversion would be adequately signed. It further requires a gated crossing to be installed across the construction access route to enable access to the riverfront section of the Thames Path. The gates would only be closed during vehicle movements. The gate would be operated by a traffic marshal to ensure safe public crossing. Advance notice and publicly accessible information would also be given to inform regular users of changes to the opening of the route, and timings of route closures. Additionally, high quality screening hoardings would be installed at the site, except on the construction access route which would use mesh hoardings in order to retain views of the river from the park to the north (see Section 5 within the *CoCP Part B*).

10.2.18 The *CoCP Part B* makes provision for the permanent relocation of the existing children's playground (see Section 4 within the *CoCP Part B*). The *CoCP Part B* also includes provision to ensure the continued use of the MUGA during construction. During Phase 1 of construction, the MUGA would fall within the maximum extent working area and a small area would be located within the site hoarding. However, prior to construction of the temporary access road, the slightly reduced area of the MUGA outside of the hoarding, would be reconfigured and returned to public use (see Section 5 within the *CoCP Part B*).

Operation

10.2.19 The requirement for above-ground structures is described in Section 3 of this volume, and would result in the extension of the existing river wall out into the River Thames. These structures would be within the parameter areas shown on the Site parameter plan (see separate volume of figures - Section 1). This would create a new area of publicly accessible open space at the same level as the existing Thames Path that runs along the riverfront of the park. It would be available for passive recreational use by the public during the park's opening hours and would become an extension of the public open space within the park.

10.2.20 To provide a permanent access route for maintenance vehicles from Glamis Road it would be integrated with the proposals for operational phase landscaping at the site. Once the permanent access route for the project is open, the existing western end of the Thames Path may become redundant and may be removed in agreement with the local authority. In association with this, there would be a permanent change in landscaping of this part of the park, the final design for which is yet to be determined and will be finalised in conjunction with the local authority and local stakeholders.

Environmental design measures

10.2.21 Measures which have been incorporated into the design of the proposed development (described in the design principles) include:

a. integration of the permanent vehicle access route which would fully integrated with the landscaping proposals for the park as part of a new area of public realm and a potential new alignment of a widened

Thames Path that would be accessible to pedestrians and cyclists during park opening hours

b. reinstatement of the memorial benches and bandstand as shown on the Landscape Plan, unless otherwise agreed with the local authority

c. circulation onto and around the foreshore structure which would be clear and legible and integrated as far as possible with circulation around the park and along the Thames Path

d. a design which would reinforce the character of the park, specifically by planting large tree species close to the river frontage wherever possible. Existing pats and landscaped areas would be extended onto the foreshore structure where practicable in order to integrate it into the surroundings

e. design of the permanent access route to facilitate improved views of the Rotherhithe tunnel ventilation shaft which at the present is not visible from the western end of the Thames Path.

10.3 Assessment methodology

Engagement

10.3.1 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 socio-economics are presented in Vol 21 Table 10.3.1.

Vol 21 Table 10.3.1 Socio-economics - stakeholder engagement

Organisation	Comment	Response
Environment Agency, April 2011	It is considered that the use of foreshore sites is likely to lead to a number of detrimental effects in relation to flood risk management, Biodiversity and recreation.	The impact of the proposed development at the site on recreational facilities (including in relation to Shadwell Basin Outdoor Centre's use of the river foreshore) has been considered within this socio-economic assessment as appropriate. Flood risk and biodiversity are considered in other sections within this volume.
London Borough (LB) of Tower Hamlets, July 2012	The open space usage survey methodology should take account of Ramadan and not schedule any usage surveys during Ramadan.	The open space usage survey methodology was adapted accordingly and no surveys of King Edward Memorial Park were conducted during Ramadan in either 2011 or 2012.
LB of Tower Hamlets,	An extension of the foreshore could be	Consideration of the impact on open space users in the

Organisation	Comment	Response
February 2012	seen as an extension of a valuable 'quiet space', however this needs to be considered alongside other issues relevant to landscape and other amenity issues.	operational phase has taken account of the range of landscape and amenity issues factors that would be relevant to the effect on open space users. See para.10.6.1 for further detail.
London Councils, February 2012	The noise, pollution and congestion caused by site traffic will impact on quality of life for local residents.	Consideration of the impact of the proposed development on residential amenity has drawn on the air quality and odour, noise and vibration and townscape and visual assessments. All of these assessments have taken account of the impact of construction traffic in concluding their findings, and consideration of this issue has been considered as part of the amenity effect assessment conducted in this socio-economic assessment.

Baseline

10.3.2 The baseline methodology follows the methodology described in Vol 2 Section 10.5. 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 Section 10.5.

10.3.4 The assessment methodology for the construction phase follows that described in Vol 2 Section 10.5. There are no site-specific variations for undertaking the construction assessment for this site.

10.3.5 Section 10.5 details the likely significant effects arising from the construction at King Edward Memorial Park Foreshore site. 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 Thames Tideway Tunnel project sites are considered in this assessment.

10.3.6 Of the developments listed in the site development schedule (see Vol 21 Appendix N), one has been considered relevant in the construction assessment base case. This development is John Bell House, located approximately 150m northwest of the site, including residential (student accommodation) floorspace. It is considered relevant as it is within 250m of the site and so it falls within the amenity assessment area at this site. It has been assumed that it would be fully complete and operational by the assessment year, thereby altering the existing baseline by introducing new residential receptors into the amenity effect assessment area.

10.3.7 It is not anticipated that any developments would be under construction at the same time as the Thames Tideway Tunnel project at this site (see Vol 21 Appendix N). Therefore, there would not be any cumulative effects.

Operation

10.3.8 The base case is Year 1 of operation. The assessment area is as set out in Vol 2 Section 10.5.

10.3.9 The assessment methodology for the operation phase follows that described in Vol 2 Section 10.5. There are no site-specific variations for undertaking the operation assessment of this site.

10.3.10 Section 10.6 details the likely significant effects arising from the operational development. 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 and so no other Thames Tideway Tunnel project sites are considered in this assessment.

10.3.11 Of the developments listed in the site development schedule (see Vol 21 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 receptors covered in the operational assessment are the users of the new extension to King Edward Memorial Park. While developments may increase the population within the catchment area for the new open space, none of would affect the sensitivity of such users as a receptor.

Assumptions and limitations

10.3.12 The assumptions and limitations associated with this assessment are presented in Vol 2 Section 10.5.

10.3.13 The following assumptions are specific to the assessment of this site:

a. It is assumed that the daytime Thames Path diversion route would be accessible for at least the majority of the time and that closures to it would be relatively short term during vehicle movements.

b. It is assumed, based on observations and the range and frequency of scheduled activities, that the Shadwell Basin Outdoor Activity Centre is a well used facility and that both children and adults are regular users of the centre. Further details underpinning this assumption can be found in para. 10.4.38.

10.3.14 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 In the area within 250m surrounding the site, the predominant land use is residential except for some mixed use and light industrial areas to the northeast of the site and water bodies (including the River Thames and Shadwell Basin) to the south and west respectively. There are a number of recreational land uses within 250m of the site, including the Thames Path, as well as amenity green space within the park itself (see Vol 21 Figure 2.1.2 in separate volume of figures). Within 1km of the site, residential uses also predominate although there is a greater mix of other uses including commercial and industrial premises.

Community profile

10.4.3 A detailed community profile is outlined in Vol 21 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 3,050 within 250m of the site and approximately 41,300 within 1km of the site at the time of the last census for which data is available[iv].

b. Within 250m of the site, the proportion of under 16 year olds within 250m of the site (21.5%) is broadly in line with the proportion in Greater London (20.2%) and the LB of Tower Hamlets (22.8%).

c. Within 250m and 1km and at a borough wide level, the proportion of over 65 year olds (9.3%, 8.7% and 9.3% respectively) is broadly in line, albeit somewhat lower than the average for Greater London (12.4%).

d. Within 250m of the site, the proportion of White residents (54.7%) is broadly in line with the proportion within 1km (53.7%) and the LB of Tower Hamlets (51.4%); however it is lower than Greater London (71.2%).

e. Within 250m, 1km and at a borough wide level, the proportion of Asian residents (35.5%, 36.1% and 36.6% respectively) is approximately three times as high as the proportion of Asian residents in Greater London (12.1%). Within 250m and 1km and at a borough wide level, Black residents account for approximately half the proportion that they do across Greater London (10.9%).

f. Within 250m and 1km, the proportion of residents suffering from a long term or limiting illness (both 15.7%) is in line with the Greater London (15.5%) average. The proportion of residents claiming disability living allowance within 250m of the site (5.4%) is slightly higher than within 1km (4.9%) and Greater London (4.5%).

[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.

g. Death rates in the local area from major illnesses such as cancer, stroke, heart disease, respiratory disease and circulatory disease are high relative to the Greater London average, and there are also low rates of physical activity. Child obesity is also high relative to other London boroughs, although adult obesity is comparatively lower.

h. The incidence of income deprivation and overall deprivation[v] within 250m of the site (both 78.7%) is broadly reflective of the relatively high levels of the LB of Tower Hamlets overall (76.6% and 69.6%). Within 1km, the incidence of such deprivation is somewhat lower (affecting a little over half of all households); although it is still considerably higher than the level for London overall (where such deprivation affects roughly one in five households).

10.4.4 The above community profile suggests that the community is diverse with a high proportion of Asian residents. The community generally experiences poor health and low life expectancy. Deprivation is more pronounced within 250m of the site than within 1km, although it is still considerably higher relative to Greater London. The profile demonstrates that while the local community is ethnically diverse and suffers relatively high levels of deprivation, these trends are less pronounced than for the LB of Tower Hamlets overall.

Economic profile

10.4.5 A local economic profile (based on 2012 data) is presented in Vol 21 Appendix H.2. The following points provide a summary of the profile and provide context to this socio-economic assessment:

a. Within approximately 250m of the site there are approximately 800 jobs and 170 businesses[vi].

b. The three largest sectors as measured by employment within approximately 250m are: Professional, Scientific and Technical Activities; Accommodation and Food Service Activities; and Wholesale and Retail Trade / Repair of Motor Vehicles and Motorcycles.

c. The three largest sectors as measured by number of businesses at locations / units within approximately 250m are: Professional, Scientific and Technical Activities; Information and Communication; and Wholesale and Retail Trade / Repair of Motor Vehicles and Motorcycles.

d. At all geographical levels most businesses fall within the micro size band (one to nine employees), with the proportion of these within

[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 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.

250m closely reflecting the proportions recorded for both the LB of Tower Hamlets and Greater London as a whole.

e. Businesses of micro size also account for the majority within each of the leading sectors within 250m. However the number of small businesses (ten and 24 employees) within these leading sectors is considerably greater than the average across all sectors and within the LB of Tower Hamlets and Greater London as a whole. The Information and Communication sector is an exception with 100% being micro businesses.

Receptors

Public open space: King Edward Memorial Park

10.4.6 The park is a semi formally landscaped public open space situated on the north bank of the River Thames which offers opportunities for active and passive recreation. The park has panoramic views over the river to the southeast and southwest.

10.4.7 It is approximately 3.3ha in size and is classified as a 'local park' under the GLA Open Space Hierarchy (GLA, 2011)[2]. As a 'local park and open space', according to the Open Space Hierarchy, it would typically serve a 400m radius although this is an indicative figure that is subject to local conditions. Given the park's location, the views over the River Thames, the surrounding area being predominantly residential, and the existence of the Thames Path which runs through the southern portion of the park (see para. 10.4.22), users of King Edward Memorial Park are likely to come from an area wider than the typical 400m catchment area.

10.4.8 Vol 21 Figure 10.4.1 (see separate volume of figures) shows the location of this receptor.

10.4.9 Approximately one third of the park area is given over to lawns, surrounded by formally planted flower beds, a number of mature trees and wheelchair accessible paved footpaths. Facilities within the park (a number already identified in Section 10.2) include a children's playground with equipment suitable for children up to twelve years old, a wildflower garden, the MUGA, four tennis courts, a bowling green and the bandstand. There are also seating areas including sixteen park benches situated on the Thames Path overlooking the River Thames.

10.4.10 The bowling green is open for daytime use between May and September and is the home of Shadwell Bowls Club. The sports facilities cannot be pre-booked and fees are payable for the use of the bowling green, netball and tennis facilities (the MUGA is free for public use) (LB of Tower Hamlets, 2008)[3]. The facilities within the park are also used to host school sports days, which are sponsored and organised in association with the Trees for Cities Programme[vii] (Trees for Cities website, 2012)[4].

[vii] Trees for Cities is an independent charity which operates a tree planting programme worldwide, and is involved in events within the park

10.4.11 There are five access gates to the securely fenced park. The park is accessible between dawn and dusk, with opening hours changing seasonally.

10.4.12 The Thames Path passes through the park. At night when the park is closed, there is an alternative signposted Thames Path route around the northern edge of the park via The Highway and Glamis Road.

10.4.13 The park has been awarded Green Flag status on the basis of the secure and attractive areas for recreation, a nature conservation area, a variety of foliage and planting and views of the river[viii] (Green Flag Awards, 2012)[5].

10.4.14 Usage surveys were undertaken for the various facilities in the park, including the tennis courts and MUGA (see Vol 21 Appendix H.3). The tennis courts were well used during the survey period, with all four courts being in concurrent use regularly during weekdays and weekends. Users were predominantly males aged between 18 and 39 years old, with over 70% of users observed to be White.

10.4.15 The MUGA was not frequently or consistently used. When it was in use, it was predominantly used by individuals rather than by larger groups, with over 60% of users being from Black and Ethnic Minority (BME) backgrounds.

10.4.16 The bowling green was not observed to be used at all for bowls during the usage surveys.

10.4.17 The main lawn within the park was well used during surveys, with a peak usage of over 100 users engaging in passive recreation on a hot summer weekend. The number of users undertaking passive recreation in the park during the weekday surveys amounted to less than one third of weekend levels. Together with the riverfront section of the park, the main lawn area was recorded as having the highest volume of users of all survey areas within the park.

10.4.18 The children's playground was moderately well used during surveys. There are no known or observed regular users of the bandstand; however it is understood that organised events take place there during the summer. See Vol 21 Appendix H.3 for further detail.

10.4.19 The main factor affecting the sensitivity of the users of the park is the availability of alternative open spaces within an accessible distance for potential users. In this regard, the provision of open space up to 800m from the site is a relevant consideration. The park falls within an area of 'low' open space deficiency, as classified by the LB of Tower Hamlets Open Space Strategy (LB of Tower Hamlets, 2005)[6] although the presence of the park itself is likely to be a contributing factor to this[ix].

[viii] Green Flag Award status is a benchmark standard for good quality parks and gardens in the UK. Awards are given annually, and winning spaces must apply each year to renew their Green Flag status, in order to ensure that the quality of winning spaces is retained.

[ix] The Borough has established a deficiency scale based on National Playing Field Association (NPFA) standards of 2.4ha open space provision per 1,000 people as a benchmark standard. Based on 2001 Census data , the LB of Tower Hamlets established that the Borough had approximately 1.2ha open space per 1,000 people , and set this as the benchmark standard ratio which the Borough should not fall below. The *LB of Tower Hamlets Annual*

10.4.20 The following details of alternative nearby spaces and facilities are relevant to this assessment:

a. There are three alternative public open spaces of local park size (ie, above 2ha as classified under the GLA Open Space Hierarchy) within approximately 850m of the site. Two of these (Stepney Green and Wapping Gardens / John Orwell Sports Centre) provide similar recreational facilities to King Edward Memorial Park. The other space, the 3.1ha Wapping Canal System (including Shadwell Basin to the west across Glamis Road) provides open areas for passive recreation, walking and jogging.

b. Additionally, there are approximately six small open spaces (spaces sized between 0.4ha and 2ha as per the GLA Open Space Hierarchy) located approximately 200m to 800m from the park which mostly provides opportunities for passive recreation. Ease of access to some of these spaces varies, owing to major roads, railways and canals.

c. There are a limited number of alternative children's playground facilities within the local area. The Glamis Adventure Playground, situated approximately 50m north of the park, however caters to older children aged between six and 16 years old (Glamis Adventure Playground website, 2012)[7].

d. The closest alternative tennis court facility available for public hire is located at the John Orwell Sports Centre. Tennis courts are also located at Mile End Stadium, approximately 1,300m to the north east.

e. The closest alternative football pitches are located approximately 850m to the west at John Orwell Sports Centre (one astroturf pitch and one smaller concrete pitch which also serves as a tennis or netball court) or to the north at Stepney Green Park (one grass pitch and one astroturf pitch). Both alternative facilities are situated at established sports centres which are likely to be well used. The A13 and railway line to the north are likely to make access difficult for some users who live near to King Edward Memorial Park wishing to access the facility at Stepney Green Park.

f. The closest park with river frontage is Waterside Gardens (under 1ha in size and located at Wapping New Stairs) approximately 1km to the west. The park includes a bandstand facility similar to the one in King Edward Memorial Park. There are no comparably sized open spaces with river frontage within 800m of the park, although the Thames Path does run along the riverfront for a large portion of this distance in both directions.

10.4.21 Based on the above factors, it is considered that users of King Edward Memorial Park would have a medium level of sensitivity to any temporary

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Monitoring Report 2007/8 indicates that the Borough is falling short of this target; currently providing only 1.14ha per 1,000 population. A ward by ward analysis conducted in 2005/6 showed that Shadwell ward (which the park falls within) has 0.8 to 1.2ha publicly accessible open space per 1,000 people while St Katherine's and Wapping ward (to the south and west of the park) has 1.2 to 1.6ha open space per 1,000 people .

reduction in the size of open space, reduced functionality or amenity within the park.

Thames Path

10.4.22 The Thames Path is a recreational asset and national trail. It follows the river for almost its entire length, and in east and central London it runs on both sides of the river. At this location, the Thames Path mostly runs along the river embankment, directly adjacent to the River Thames foreshore in the form of a pedestrian promenade. To the west, it connects users with Shadwell Basin and Wapping and to the east with Limehouse. At night, when the park is closed, the alternative signposted route for the Thames Path is via The Highway and Glamis Road.

10.4.23 Vol 21 Figure 10.4.1 (see separate volume of figures) shows the location of this receptor.

10.4.24 The section of the Thames Path within the park is studded with trees and benches facing the River Thames.

10.4.25 The usage surveys (see Vol 21 Appendix H.3) found the path to be moderately well used, with a peak usage recorded of 260 movements per hour during the weekday surveys and 264 movements per hour on the weekend. Many weekday users appeared to be commuters whereas, during weekends, recreational users were predominant.

10.4.26 Usage by joggers was particularly notable during weekday lunchtimes (approximately 12pm to 2pm), accounting for over 50% of users during the busiest observed survey period. The route was also well used by cyclists; particularly recreational cyclists on weekends.

10.4.27 The usage survey results are corroborated by pedestrian and cycle surveys undertaken as part Section 12 of this volume. These recorded a peak of approximately 65 pedestrian movements in each direction (ie, approximately 130 movements in total) during the AM peak hour. The Thames Path is therefore assessed as being moderately well used at this location.

10.4.28 The main factor affecting the sensitivity of the users of the Thames Path is the availability of alternatives. The Thames Path is a metropolitan wide recreational asset, and users have access to many alternative and comparable (if not better) stretches of the Thames Path on both sides of the river across east and central London. More locally, with regard to the section of the path that runs past the site, there are alternative routes available via pedestrian footpaths through King Edward Memorial Park, or by the night time Thames Path route. Both these routes would divert users away from the river although would not require users to cross any existing roads.

10.4.29 In terms of their sensitivity to amenity impacts most users of the Thames Path are only likely to be near the site for the time it takes them to walk through the area (likely to be a few minutes for most users). Therefore, the duration for which users could experience any amenity effects from the proposed development would be limited.

10.4.30 Taking account of the above factors, it is considered that users of the Thames Path in this location would have a low level of sensitivity to diversion of the existing path and impacts that would cause a loss of or reduction in amenity.

Residential

10.4.31 There are existing and base case residential developments near the proposed construction site, as identified in the air quality, noise and vibration and townscape and visual assessments.

10.4.32 Land that is predominantly used for residential development is shown in the land use plan for this site (Vol 21 Figure 2.1.2 in see separate volume of figures).

10.4.33 The sensitivity of nearby residents to overall amenity effects is likely to 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. Therefore, as outlined in the methodology for this socio-economic impact assessment (see Vol 2 Section 10.5) the sensitivity of nearby residential receptors to amenity impacts would be medium during the day and high during the evening and night.

Shadwell Basin Outdoor Activity Centre

10.4.34 The Shadwell Basin Outdoor Activity Centre is located to the southwest of the site and is accessed via Shadwell Pierhead. Vol 21 Figure 10.4.1 (see separate volume of figures) shows the location of this receptor.

10.4.35 The centre is operated as a registered charity and provides affordable facilities for members of the local community to learn water sports. While the centre falls outside the construction area boundary, the proposed construction vehicle access route lies just to the north of the centre buildings.

10.4.36 The centre provides a large of number of outdoor recreation facilities, including a climbing wall, zip wire and canoeing. There is a small slipway for launching canoes and boats, situated approximately 35m from the proposed construction site boundary.

10.4.37 Users make use of the river foreshore for water based activities, such as canoeing and sailing. Water sports classes for beginners (and children) take place mainly within Shadwell Basin, which is sheltered and located inland from the foreshore area, while more experienced boat users sail within the foreshore and River Thames (Shadwell Basin Outdoor Activity Centre website, 2012)[8]. It is understood that the centre's facilities for launching boats into the River Thames have some practical and safety limitations. While the centre does attract and train inexperienced users and children (both of whom would be more sensitive to any safety issues related to the cofferdam presence and barge movements) they are most likely to use the basin inlet, which is physically separated from the River Thames by the basin inlet gates which are permanently closed.

10.4.38 Shadwell Sailing Club meets weekly in the evenings, between late April and October, and is open to both first time and experienced participants.

Sessions last from ninety minutes up to four hours depending on tide and weather conditions. The club also offers activity classes, and evening sailing and racing events for more experienced club members, throughout the year (Shadwell Sailing Club website, 2012)[9].

10.4.39 The main factor affecting the sensitivity of the centre and its members is the degree to which the proposed development would interrupt their current activities and the availability of alternative river space that they can use. In terms of their sensitivity, users are only likely to make use of the foreshore area for a few hours at a time. There are also likely to be alternative areas of the River Thames which can be used for outdoor water-borne activities. The presence of Shadwell Basin (situated inland from the foreshore) provides a further area of river space which may be used, however the basin may not be suitable for all rowing and sailing activities, due its size and layout.

10.4.40 Taking account of the above factors, it is considered that users of Shadwell Basin Outdoor Activity Centre would have a medium sensitivity to disruption and impacts that could cause a reduction in amenity.

Community facility - Pier Head Montessori Preparatory School

10.4.41 An independent preparatory school, ‘Pier Head Montessori Prep’ is situated on Shadwell Pierhead to the southwest of the site, sharing the same address as the Shadwell Basin Outdoor Activity Centre. It has indoor and outdoor teaching and play facilities for children aged two to seven years old.

10.4.42 Vol 21 Figure 10.4.1 (see separate volume of figures) shows the location of this receptor.

10.4.43 The school provides nursery facilities for children aged under five years old and primary education facilities for children aged five to seven years old and provides opportunities for indoor and outdoor play and learning. The school is open from 8am to 5.30pm Monday to Friday.

10.4.44 In terms of the sensitivity of users to amenity impacts, the school is used by both children and staff. Overall, children are generally considered to be relatively more sensitive in comparison to adults to certain amenity related impacts, particularly with regard to effects on their learning capabilities related to noise from sources such as road traffic (DfT, 2011)[10] and to effects on health arising from air pollution (GLA, 2007)[11]. With regard to visual impacts, it is considered that children are likely to be focused on the internal learning environment rather than the external views from the classroom when indoors.

10.4.45 Younger children may not attend the school every day (attendance for under five year olds is mandatory for a minimum of two full days, or four half days per week, but can be up to five full days). Attendance for pupils aged five to seven years is five days per week. It is therefore likely that some children attend the school for long periods of time each day. The main timeframe for exposure to any amenity impacts would be before and after school and during lunch times, since most learning activity occurs indoors. While exposure to amenity effects may still occur indoors, the school buildings would offer a considerable level of protection from air quality, construction dust, noise and vibration. While external views may be more perceptible than other amenity impacts should they occur, children are likely to be focused on the internal learning environment rather than the external views from the classroom.

10.4.46 Taking account of the above factors, it is considered that pupils and employees of this community facility would have a medium level of sensitivity to impacts that could cause a reduction in amenity.

Summary

10.4.47 A summary of receptors as described in the baseline and their sensitivity is provided in Vol 21 Table 10.2.1.

Vol 21 Table 10.4.1 Socio-economics - receptor values / sensitivities

Receptor	Value / sensitivity and justification
Users of King Edward Memorial Park	Medium – users have access to some alternative areas of public open space and some other comparable facilities nearby which offer similar recreational opportunities and levels of amenity within approximately 800m of the site.
Users of the Thames Path	Low – alternative, mostly riverside, routes are available locally and more widely. Most users would be near the site for only a short duration.
Residents	Medium / High – residents would have limited opportunity to avoid effects however they would have medium sensitive to amenity effects overall during the day and high sensitivity to amenity effects overall during the evening and night.
Users of Shadwell Basin Outdoor Activity Centre	Medium – centre users make use of the river area and foreshore which is located close to the centre but only for short periods at a time. Access to the river for the Activity Centre users is limited. Alternative areas of the river situated further away from the foreshore (as well as Shadwell Basin inlet) can be used for sailing activities, especially by less experienced boat users.
Users of community facility – Pier Head Montessori Preparatory School	Medium – pupils and staff would have limited opportunity to avoid effects, however are less exposed to amenity impacts when indoors.

Construction base case

10.4.48 The construction assessment year and area are as set out in para. 10.3.3.

10.4.49 The base case in the peak year of construction, taking into account the schemes described in para. 10.3.6, is expected to differ from baseline in the following way:

a. It would include additional residential receptors that could 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.

10.4.50 Other than the above, it is considered that the other base case socio-economic conditions at the site would remain largely the same as existing baseline conditions.

Operational base case

10.4.51 The operational assessment year and area are as set out in para. 10.3.8.

10.4.52 As described in para. 10.3.11, there are no developments relevant to the operational assessment within the assessment area that would alter the base case.

10.5 Construction effects assessment

Temporary reduction in the provision of public open space

10.5.1 The construction works would result in the temporary fencing off and closure of parts of the southern and southwestern portion of the park. The magnitude of impact is influenced by the following factors:

a. The proposed construction site would prevent access to 0.5ha of the park (including the parts of the existing Thames Path) for the duration of construction. Temporary closure of these parts of the park would result in a reduction in the total area of grassed lawn space that can be used for active and passive recreation, equivalent to approximately five to ten percent of similar space within the park. A reduced size MUGA would be provided at the start of construction and would still comply within the published minimum required pitch size (Football Association, 2005)[12]. The children's playground would be permanently relocated elsewhere within the park at the start of construction.

b. Temporary loss of this space would affect a high number of park users and users of the riverfront walk, which was well used (see Vol 21 Appendix H.3 for further details).

c. Temporary closure of the space would last for approximately three and a half years.

d. For people who use the space for active and passive recreation, there would still be opportunity to undertake the same types of activities further north within the park's boundaries, as the wildflower garden, upper terrace, tennis courts and the majority of the main lawn areas would not be directly affected.

e. The relocation of the children's playground within the park would ensure the continuing provision of child play space during the construction period.

f. The temporary removal of the bandstand would leave users of the park without such a facility for the duration of the construction works.

However, it is not clear whether the bandstand has any regular or formal use.

g. The reduction in size of the MUGA could alter the way in which users are able to make use of this facility, however the capacity of the reduced size pitches would still allow games to take place in the same way as currently.

h. The usage surveys indicate that the MUGA is poorly used. However, of those people who did use it, most users were south Asian males and the MUGA has the potential to offer an important recreational resource for this group, as well as other users.

i. Relocation of the park maintenance compound would not affect the availability of recreational opportunities for users directly.

10.5.2 On the basis of the above factors, it is assessed that the impact on open space users arising from the temporary closure of part of the open space would be medium.

10.5.3 Given the medium magnitude of impact and the medium sensitivity of park users, it is assessed that the effect on users of park open space would be **moderate adverse**.

Temporary diversion of a section of the Thames Path

10.5.4 The Thames Path would be temporarily diverted via the provision of two sign posted diversion routes (one approximately 300m longer than the other) during the construction period.

10.5.5 The shorter diversion route would be only slightly longer than the existing Thames Path route and would divert a short distance away from the river to the north of the main part of the construction site. Closures on this route would be for relatively short periods (during vehicle movements along the construction access route) and it would be accessible for the majority of the time during daylight. The longer diversion route connects the northwest corner of the park along existing paths to the diverted Thames Path route to the north of the main part of the construction site.

10.5.6 The magnitude of impact is influenced by the following factors:

a. It is estimated that the longer diversion route would add approximately four to five minutes to users' journey times (based on an average walking speed of 4.8km per hour or 800 metres per ten minutes). Part of this route would follow the existing night time route and users would not need to cross over any roads. As outlined in the *CoCP Part B* (Section 5) signage, and advance warnings of closures where possible, would be provided.

b. Users would only need to use the longer diversion route when the gated, manned construction access route (which intersects the Thames Path) is in use by a vehicle. During these times the gated controlled crossing would be closed and the shorter diversion route effectively unavailable.

c. It is anticipated that the shorter diversion would result in an increased journey time of less than one or two minutes and would be easily navigable. This diversion runs largely parallel to the existing Thames Path, and pedestrians would continue to use the existing Thames Path entrance ways to the park at both ends.

d. The usage surveys indicated that the temporary closure would be likely to affect moderate numbers of people, the majority of which would be likely to be from the local community and catchment areas further along the Thames Path in either direction.

e. Given the scale of the diversion, it is not considered that users would avoid making use of the Thames Path at this location or the adjoining stretches in either direction as a strategic recreational facility.

10.5.7 On the basis of the above factors, it is considered that the overall impact magnitude would be low.

10.5.8 Given the low impact magnitude and the low sensitivity of users, it is assessed that the effect on Thames Path users would be **negligible**.

Effect on the amenity of public open space users

10.5.9 Assessments have been undertaken to examine the 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 King Edward Memorial Park Foreshore site:

a. Local air quality would be **negligible** at the three receptors (the Thames Path, KEMP and tennis courts) identified within the confines of the park. Construction dust effects would be **minor adverse** at all three receptors.

b. No noise or vibration receptors were identified in relation to the King Edward Memorial Park at this location.

c. Of the four viewpoints, visual effects would be **major adverse** at one (viewpoint 2.1), and **minor adverse** at the remaining three viewpoints (2.2, 2.3 and 2.4).

10.5.10 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 three and a half year construction programme, the significant effect noted above would be likely to be experienced over a medium term period.

b. The park is well used for active and passive recreation and so amenity impacts are likely to be experienced by a moderate number of people, depending on the time of day.

c. The usage surveys found that a significant proportion of park users tended to congregate along the river front which indicates that the park's river front aspect is one of the major elements of the park's appeal for users. However, a significant proportion of users also made use of the non river front parts of the park including the sports pitches / courts, the children's playground and lawn areas. Therefore, it is assumed that a loss of river views would affect different users to varying degrees and in different ways; thereby affecting users' amenity experience to similar varying degrees.

d. The installation of mesh hoardings along the construction access route (see the *CoCP Part B* Section 4 for further detail) and continued access to part of the river front would allow users of the park to continue to see the river.

10.5.11 On the basis of the above findings and factors, it is considered that some park users may avoid making use of the park during the construction phase. Considering the potential frequency, duration and number of people affected, it is considered that the overall amenity impact magnitude would be medium.

10.5.12 Given the medium magnitude of impact and the medium sensitivity of park users, the effect on the amenity of public open space users would be **moderate adverse**.

Effect on amenity of Thames Path users

10.5.13 Assessments have been undertaken to examine the 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, Section 9 and Section 11). 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 at this site.

c. Visual effects would be **major adverse** from one of the two viewpoints (viewpoint 2.1) identified and **moderate adverse** at the other viewpoint (viewpoint 2.5).

10.5.14 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 three and a half year construction programme, the effects noted above would be likely to be experienced over a medium term period.

b. The Thames Path is moderately used at this location and so amenity impacts could be experienced by a moderate number of people, depending on the time of day.

c. The major and moderate adverse effects on viewpoints 2.1 and 2.5 are representative of the effects that path users would experience on views over the River Thames during the time that they are in the immediate vicinity, particularly for those sections of the path where the diversion would place the construction site between the Thames Path and the River Thames. However, it is considered unlikely that these changes would significantly detract from users' amenity considering that a considerable proportion of users of the Thames Path (eg, joggers and cyclists) would only be near to the site for the time that it takes them to travel past (which would be a minute or two for most users). In addition, the outlook from riverside sections of the path to the east and west of the park would continue to provide river views for users of the path only a short distance from the site.

d. The shorter diversion lies closer to the construction access route and would almost certainly be used more frequently. However, the longer diversion diverts further away from the site and so when the longer diversion is in use, users would be likely to be less directly exposed to any adverse amenity impacts.

10.5.15 On the basis of the above findings and factors, it is considered that the overall amenity impact magnitude would be medium.

10.5.16 Given the medium magnitude of the impact and the low sensitivity of users, the effect on the amenity of Thames Path users would be **minor adverse**.

Effect on the amenity of residents

10.5.17 Assessments have been undertaken to examine the likelihood of 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, Section 9 and Section 11). The following points summarise the residual effect findings of those assessments in relation to nearby residential receptors:

a. Local air quality effects would be **minor adverse** at one receptor and **negligible** at the remaining three receptors identified. Construction dust effects would be **minor adverse** at two receptors and **negligible** at the remaining two receptors identified.

b. Noise effects would be **significant** at one (Free Trade Wharf South)[x] of the eight receptors identified and **not significant** at the remaining seven. This finding is informed in part by the estimate that construction noise levels would exceed the potential significance criteria for a residential receptor during the day at Free Trade Wharf South for 12 months. No exceedance during the evening is estimated, and no assessment has been made of effects during the night as there would be no night time working at this site. Noise effects from road-based construction traffic would be **not significant**. The noise assessment states that the noise from river-based construction traffic is considered to be **not significant** for the closest residential receptors at Prospect Wharf and Free Trade Wharf South. Vibration effects

[x] The noise and vibration assessment reports that the residual effect for Free Trade Wharf South is considered significant, however properties may be be eligible for a noise insulation package, which if accepted, would reduce the effect to not significant (see Vol 21 Section 9.9).

would be **significant** at one (Free Trade Wharf South) of the eight residential receptors identified and **not significant** at the remaining seven.

c. Of the four residential receptor viewpoints within 250m of the site on the north bank of the River Thames, visual effects would be **major adverse** at one (viewpoint 1.1), **moderate adverse** at one (viewpoint 1.5), **minor adverse** at one (viewpoint 1.3) and **negligible** at the remaining viewpoint (viewpoints 1.4).

10.5.18 In assessing the magnitude of amenity impact, the above findings have been taken into account, together with the following factors that are considered relevant to the receptor's overall experience of amenity at the site:

a. Given the three and a half year construction programme, the significant effects noted above would be likely to be experienced over a medium term period. The exceptions are:

i For local air quality, the effect may be less than minor adverse over some phases of the construction period as the assessment is based on the peak construction year and the effect may be negligible in other years for the one affected receptor.

ii For noise, the significant adverse assessment result is based on an estimated noise exceedence at one receptor lasting for 12 months, meaning the effect would be short term.

b. While it is estimated that there would be a major adverse visual effect at one viewpoint, 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 this viewpoint are also likely to have views in other directions that are either not as severely affected or are not affected at all.

10.5.19 On the basis of the above findings and factors, it is considered that the magnitude of overall amenity impacts would be medium.

10.5.20 Given the medium magnitude of the impact and the medium sensitivity of residents, the effect on the amenity of a limited number of residential receptors would be **moderate adverse**.

10.5.21 This assessment relates primarily to those residential receptors that would experience adverse local air quality, construction dust, noise and visual effects. For residential receptors not subject to all of these effects, it is considered that there would be a lower effect on their amenity. For residential receptors not subject to these effects, it is considered that there would be a negligible effect on their amenity. These findings also present a peak year scenario. At times when the above noted effects are not occurring, the effect significance would be likely to be lower.

Effect on the Shadwell Basin Outdoor Activity Centre and its users due to construction

10.5.22 Users of the Shadwell Basin Outdoor Activity Centre may be inconvenienced by encroachment of the cofferdam into the foreshore space which they regularly use for sailing. Additionally, amenity impacts such as noise, dust or unpleasant views may result in a reduction in amenity for centre users. For this reason, the effects from both take up of the river foreshore and the amenity as experienced by users of the Shadwell Basin Outdoor Activity Centre are considered below.

10.5.23 Assessments have been undertaken to examine the likelihood of 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, Section 9 and Section 11). The following points summarise the residual effects findings of those assessments in relation to the River Thames and the Shadwell Basin Outdoor Activity Centre:

a. Local air quality effects would be **minor adverse** on the Shadwell Basin Outdoor Activity Centre building and **negligible** on the Shadwell Basin Outdoor Activity Centre playground and the River Thames. Construction dust effects would be **minor adverse** on the River Thames and the Shadwell Basin Outdoor Activity Centre building, and would be **negligible** on the Shadwell Basin Outdoor Activity Centre playground.

b. Noise effects and vibration effects (human response) on the Shadwell Basin Outdoor Activity Centre would be **not significant**.

c. No visual receptors were identified for assessment in relation to the Shadwell Basin Outdoor Activity Centre.

10.5.24 In assessing the overall magnitude of amenity 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 three and a half year construction programme, the effects noted above would be likely to be experienced over a medium term period. An exception is that local air quality effects which are likely to be lower than minor adverse for periods over the construction period as the assessment is based on the peak construction year and these effects may be negligible in other years.

10.5.25 In addition to amenity effects, the magnitude of impact arising from the incursion of the cofferdam into the river foreshore and its interference with the Centre's use of the river for water-based activities is influenced by the following factors:

a. The presence of the cofferdam, and, potentially, barges alongside the construction site, could interfere with the Shadwell Basin Outdoor Activity Centre's use of the river foreshore for its recreational activities due to their location in close proximity to users of the foreshore area of the river. In particular, it is possible that the position of the cofferdam combined with the current at this position in the river could exacerbate the effects of the tidal flows and this together with barge movements could somewhat reduce the periods of time when it is considered safe for the centre's members to use the River Thames for their activities. However, it is understood the in the existing conditions the centre's facilities for launching boats are compromised and not regarded to be as safe as they could be. This means that the impact would be experienced in the context of existing limitations.

b. As well as potentially curtailing the time during which users could make use of the river for recreational activities, there is a risk that a reduced sailing time operating window could in turn impact on the centre's booking schedule.

c. The additional river space within Shadwell Basin inlet is physically separated as a water space from the river foreshore. The centre does make use of this sheltered space, and more inexperienced river users and children are likely to use the basin and basin inlet more than the river foreshore; therefore those users would not be affected by the construction related barge movements.

10.5.26 On the basis of the above findings and factors in relation to both the physical incursion into the River Thames and amenity effects, it is considered that the magnitude of impact would be low.

10.5.27 Given the low magnitude of the impact and the medium sensitivity of Shadwell Basin Outdoor Activity Centre, the effect on the centre and its users would be **minor adverse**.

Effect on amenity of Pier Head Montessori Preparatory School users

10.5.28 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, Section 9 and Section 11). The following points summarise the residual effect findings of those assessments in relation to the Pier Head Montessori Preparatory School:

a. Local air quality effects and construction dust effects would be **minor adverse** on the Pier Head Montessori Preparatory School building and **negligible** on the Pier Head Montessori Preparatory School playground.

b. Noise effects would be **significant**. This finding is informed in part by the estimate that, although the increase in average noise levels inside the building is not expected to exceed guideline noise levels for teaching spaces (based on typical noise insulation for a façade of this type) there remains a risk that for short durations the guidance levels for classrooms would be exceeded. Vibration (human response) effects would be **not significant**.

c. No visual receptors were identified for assessment in relation to Pier Head Montessori Preparatory School.

10.5.29 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 three and a half year construction programme, the effects noted above would be likely to be experienced over a medium term period.

b. 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 these effects may be negligible in other years.

c. For noise, the assessment result is based on an estimated noise exceedance for short term periods. If noise levels did exceed the ambient noise level, as per the identified risk within the noise assessment, then there would potentially be effects on the classroom learning environment.

10.5.30 On the basis of the above findings and factors, including that the noise assessment has identified that there is a risk that the guidance levels would potentially be exceeded, it is considered that the overall amenity impact magnitude would be medium.

10.5.31 Given the medium impact magnitude and the medium sensitivity, it is assessed that the effect on the amenity of school users would be **moderate adverse**.

10.5.32 With regard to the potential effects on the school, these findings present a peak year scenario, which is particularly due to the effect on the school as a result of potential noise impacts that could occur. When or if no significant noise effects occur, the effect on the amenity of the school would be minor adverse or potentially negligible (on the basis of a medium sensitivity and a low or potentially negligible magnitude of impact)

10.5.33 The noise assessment states that there would be regular liaison with the school to manage the works in a manner which reduces the disturbance from noise and vibration. This would include amending working schedules to avoid key periods in the school term and if practicable, programming noisier activities for holidays and outside of the normal school day.

10.6 Operational effects assessment

Permanent increase in an area of public open space and landscaping changes at KEMP

10.6.1 The extension of the river wall out into the foreshore would permanently provide a new permanent area of landscaped space measuring approximately 500m^2. The new open space would be alongside the existing Thames Path and its location adjacent to the existing park means that it would be able to function overall as an extension to the park itself.

10.6.2 A landscaped permanent maintenance vehicle access route (which would be accessible to pedestrians and cyclists, incorporating a widened

Thames Path) would provide access to the operational site from Glamis Road and would be integrated with the landscaping of the park.

10.6.3 The magnitude of the impact is influenced by the following factors:

a. The new area of public amenity space would create an additional extended area of open space for the park and permanently increase its capacity to cater to those seeking opportunities for passive recreation within this area of the park. Additionally the foreshore structure would provide additional landscaped circulation space and a point of interest overlooking the river.

b. All recreational facilities that were present in the baseline would be reinstated in full in the operational phase (although there may be some reconfiguration of some facilities).

c. Given the high numbers of people that use the park and moderate number of pedestrians using this section of the Thames Path, the new space is likely to benefit a moderate to high number of users.

d. The changes in landscaping, the additional public amenity space, and the repositioning of some facilities – such as the children's playground facilities – within the park would potentially change the way in which some users experience and make use of the park as a public open space. However, it is assessed that these changes would be neutral in effect rather than adverse, as all of the existing facilities (and recreational opportunities that the facilities provide for) in the existing condition would be reinstated after construction.

10.6.4 Taking account of the above factors, in particular the permanent legacy that would arise as a result of the increase area that would be available for public use as part of the park (other than during occasional maintenance periods), it is considered that the magnitude of the impact would be medium.

10.6.5 Given the medium magnitude of the impact and the medium sensitivity of park users, it is considered that the effects on users of the public open space arising from the increased area of space and associated landscaping would be **moderate beneficial**.

10.7 Cumulative effects assessment

Construction effects

10.7.1 As described in Section 10.3, no developments within the amenity effect assessment area would be under construction at the same time as the Thames Tideway Tunnel project at this site. Therefore, no cumulative effects are likely to arise.

10.7.2 Therefore, the effects on socio-economics would remain as described in Section 10.3.

Operational effects

10.7.3 As described in Section 10.3, there are no developments that would have the same type of effect as that considered in Section 10.6. Therefore, the effects on socio-economics would remain as described in Section 10.6.

10.8 Mitigation and compensation

Mitigation

Construction

10.8.1 The above assessment concludes that there is potential for a temporary moderate adverse effect to arise on park users as a result of the temporary loss of part of the park and in relation to amenity effects on some nearby residents, park users and the school.

10.8.2 In respect of the impact on users of the park, the development has already been designed to minimise the area of the park that would be used and to minimise the duration of the works. As a result, no further mitigation is considered practicable in this regard.

10.8.3 The assessment relating to amenity effects on open space users is based on the residual findings of the air quality, construction dust, noise, vibration and visual effect assessments. Where practicable and applicable, embedded measures have been included and no further practicable measures or mitigation can be adopted above those methods identified in the *CoCP*.

10.8.4 The assessment relating to amenity effects on some nearby residential receptors and on the Pier Head Montessori Preparatory School is based on the residual findings of the air quality, construction dust, noise, vibration and visual effect assessments. Where practicable and applicable, embedded measures have been included and no further practicable measures or mitigation can be adopted above those methods identified in the *CoCP*.

10.8.5 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

10.8.6 The above assessment has concluded that operational effects would be beneficial and therefore mitigation is not needed.

Compensation

Construction

10.8.7 A compensation programme has been established (included within Schedule 2 of the *Statement of Reasons*, which accompanies the application) 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.

10.8.8 In relation to the effects on residential amenity and the effects on Pier Head Montessori Preparatory School, 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).

10.8.9 The programme measures are not considered to be mitigation as there is no guarantee that the receptor in question would be eligible for compensation or that they would be accepted by the affected party and therefore the residual effects reported in this *Environmental Statement* do not take the 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 mitigation is practicable, beyond the measures included within the *CoCP*, and as compensation only offsets rather than mitigates (ie, reduces) a significant adverse effect, the effects on open space users, residents, and the school 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 required, 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 21 Table 10.10.1 Socio-economics - summary of construction assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect	Compensation
Users of the public open space: KEMP	Effect on users from temporary reduction in the provision of public open space	Moderate adverse	No further on site mitigation practicable.	Moderate adverse	None
Users of the Thames Path	Effect on users from temporary diversion of the Thames Path	Negligible	None	Negligible	None
Users of the public open space: KEMP	Effect on amenity of public open space users	Moderate adverse	No further on site mitigation practicable.	Moderate adverse	None
Users of the Thames Path	Effect on amenity of Thames Path users	Minor adverse	None	Minor adverse	None
Residents	Effect on amenity of residents	Moderate adverse	No further on site mitigation practicable.	Moderate adverse	Compensation mechanisms available for amenity related disturbance during the construction phase
Users of the Shadwell Basin Outdoor Activity Centre	Effect on the Shadwell Basin Outdoor Activity Centre and its users due to construction	Minor adverse	None	Minor adverse	
Users of the Community facility: Pier Head Preparatory School	Effect on amenity of Pier Head Montessori Preparatory School users	Moderate adverse	None	Moderate adverse	Compensation mechanisms available for amenity related disturbance during the construction phase

Vol 21 Table 10.10.2 Socio-economics - summary of operational assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Public open space: KEMP (future)	Permanent increase in an area of public open space and landscaping changes at KEMP	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: **6.2.21**

Volume 21: King Edward Memorial Park Foreshore site assessment

Section 11: Townscape and visual

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

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Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

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Thames Tideway Tunnel

Environmental Statement

Volume 21: King Edward Memorial Park Foreshore 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 of the proposed development on townscape and visual amenity at the King Edward Memorial Park Foreshore site. 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 assessment includes effects on townscape character areas, and visual effects during daytime for the peak construction year, and Year 1 and Year 15 of operation. The assessment also identifies mitigation measures where appropriate.

11.1.3 Effects arising from lighting during the construction and operational phases have not been assessed. This is on the basis that there would not be any significant effects (this is further explained in para. 11.3.7 for construction and para. 11.3.16 for operation).

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 (Defra, 2012)[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 21 King Edward Memorial Park Foreshore Figures).

11.1.7 A separate but related assessment of effects on the setting of heritage assets is included in Section 7 of this volume.

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

11.2.2 The specific construction works which may give rise to effects on townscape character and visual receptors are listed as follows, with the activities likely to give rise to the most substantial townscape and visual effects described first:

a. clearance of the site in advance of works, including removal of trees along the river frontage of the park

b. use of cranes during shaft construction

c. construction of a temporary cofferdam using a piling rig

d. vehicular construction access to the site off Glamis Road and along the river frontage of the park

e. provision of welfare facilities, assumed to be a maximum of two storeys in height

f. installation of 2.4m high hoardings around the boundary of the construction site, including on the eastern and western edges of the temporary cofferdam

g. relocation of an existing children's playground.

Code of Construction Practice

11.2.3 Measures incorporated into the *Code of Construction Practice* (*CoCP*)[i] *Part A* to reduce townscape and visual impacts include:

a. protection of existing trees in accordance with *BS5837 'Trees in Relation to Construction – Recommendations'* (Section 11)

b. protection of listed structures, including the Rotherhithe Tunnel Air Shaft (Section 12)

c. installation of well-designed visually attractive hoardings incorporating climbing plants (Section 4)

d. the use of appropriate capped and directional lighting when required (Section 4).

11.2.4 Measures incorporated into the *CoCP Part B* (Section 4) to reduce townscape and visual impacts include:

a. use of climbing plants along the public facing sections of hoarding

b. use of a green painted open mesh fencing along the access road to minimise its visual intrusion on the open space

c. use of 3.6m high hoardings around the main shaft working areas

d. use of dark green painted welfare facilities to tie in with the character of the open space and the planted hoardings.

[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*).

Operation

11.2.5 The particular components of importance to this topic include the:

a. design, layout and materials used in the public realm including planting, paving, seating, railings and boundaries

b. design, siting and materials used for the ventilation columns and control kiosks, and the zones within which these above ground structures may be located

c. design and materials used for the river wall around the new foreshore structure

d. reinstatement of the sports pitches and children's playground.

Environmental design measures

11.2.6 Figures illustrating the proposed development during operation are contained in a separate volume (see separate volume of figures – Section 1). Where photomontages have been prepared to assist the assessment of effects, these are referenced in the appropriate viewpoint in Section 11.6.

11.2.7 Measures which have been incorporated into the design of the proposed development include (see also *Design Principles* report in Vol 1 Appendix B):

a. the design would reinforce the character of the park, including through maximising the planting of large tree species close to the river frontage where technically possible and extending the existing layout of paths and landscaped areas onto the foreshore structure where possible to integrate it into the surroundings

b. the use of durable materials for the public realm in keeping with the surrounding character, including paving, seating and railings

c. the integration of large hatches into the surrounding paving or landscape treatment

d. as a minimum, the number of trees removed would be replaced by the same number of native species, with a view to maximising the number of trees towards and along the river frontage

e. a commitment to a high quality design for the ventilation columns, and locating these on the new foreshore structure to minimise changes to the existing character of the park

f. the integration of the permanent operational access route with the landscape proposals for the park

g. the reinstatement of the memorial benches, bandstand and sports pitches

h. the use of timber fenders on the river wall, in keeping with the surrounding townscape character

i. locating the main control kiosk on the boundary of the park to minimise its visibility, and the inclusion of a brown roof on the structure.

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 Tower Hamlets, LB of Southwark (located on the opposite side of the river) and English Heritage have been consulted on the detailed approach to the townscape and visual assessment, including the number and location of viewpoints. The LB of Tower Hamlets (January 2011) has provided feedback in terms of the scope, number and location of viewpoints, which have been incorporated into the visual assessment. The LB of Tower Hamlets also requested additional verifiable photomontages, particularly from within King Edward Memorial Park, which are included in the visual assessment and are shown on Vol 21 Figure 11.4.6 (see separate volume figures). English Heritage (May 2011) has confirmed acceptance of the proposed viewpoints. The LB of Southwark has 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 confirmed that King Edward Memorial Park Foreshore did not fall into their remit.

11.3.4 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 of this volume.

Baseline

11.3.5 The baseline methodology follows the methodology described in Vol 2 Section 11. 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 (December 2010).

b. Photographic survey of townscape character areas (September 2011).

c. Winter photographic surveys of the view from each visual assessment viewpoint (January 2012 and February 2012).

d. Summer photographic survey of the view from visual assessment viewpoints considered in the operational assessment (September 2011).

e. Verifiable photography (March 2011) and verifiable surveying (March 2011) for the viewpoints requiring a photomontage to be produced, as agreed with the stakeholders (described in para. 11.3.2).

11.3.6 With specific reference to the King Edward Memorial Park Foreshore 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 Tower Haml*ets (LB of Tower Hamlets, 2010)[2].

b. Saved policies from the LB of Tower Hamlets *Unitary Development Plan* and the *Core Strategy and Development Control Plan Interim Planning Guidance* (LB of Tower Hamlets, October 2007)[3].

c. The *Core Strategy for the LB of Southwark* (LB of Southwark, April 2011)[4].

d. *Wapping Wall* (LB of Tower Hamlets , 2007)[5], St Paul's Shadwell (LB of Tower Hamlets , 2007)[6] and Narrow Street (LB of Tower Hamlets , 2009)[7] *Conservation Area Character Appraisals and Management Guidelines*, produced by the LB of Tower Hamlets.

Construction

11.3.7 The assessment methodology for the construction phase follows that described in Vol 2 Section 11. Site specific variations are described below.

11.3.8 The peak construction phase relevant to this topic at the King Edward Memorial Park Foreshore site would be during Site Year 2 of construction, when the shaft would be under construction. Cranes would be present at the site and some material would be taken away by road. This has therefore been used as the assessment year for townscape and visual impacts.

11.3.9 One verifiable photomontage has been prepared for this site to assist the assessment of construction phase effects. This is shown in Vol 21 Figure 11.5.1 (see separate volume of figures).

11.3.10 No assessment of effects on night time character is made for this site during construction on the basis that:

a. the site would generally only be lit in the early evening during winter, except for short durations of extending working hours during major concrete pours

b. all site lighting would have minimal spill into the wider area due to the measures set out in the *CoCP Part A* and *Part B* (Section 4)

c. the surrounding area is lit in the early evening by street lighting and by light spill from surrounding buildings

d. visual receptors have limited sensitivity to additional lighting in the early evening.

11.3.11 The assessment area, defined using the methodology provided in Vol 2 Section 11, is indicated in Vol 21 Figure 11.4.6 for townscape and Vol 21 Figure 11.4.7 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 proposed construction activity 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 proposed construction activity would be barely perceptible. All visual assessment viewpoints are located within the ZTV.

11.3.12 The construction assessment area for this site intersects with the assessment area for the proposed Thames Tideway Tunnel project site at Chambers Wharf, therefore likely significant effects on receptors arising from construction at both 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 King Edward Memorial Park Foreshore site, it is assumed that the following developments would be complete and occupied by Site Year 2 of construction:

a. John Bell House 6-11 storey student accommodation development, 150m northwest of the site on King David Lane.

b. a residential seven storey development along Cable Street, Schoolhouse Lane and Glasshouse Fields (100m north of the site).

11.3.14 As detailed in the site development schedule (Vol 21 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 arising from the development at King Edward Memorial Park Foreshore and other developments in the construction phase.

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 Section 11. Any site specific variations are described below.

11.3.17 Five verifiable photomontages have been prepared for this site to assist the assessment of operational effects. These are shown in Vol 21 Figure 11.6.1 to Vol 21 Figure 11.6.5 (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 operational or public realm lighting requirements, due to the park being closed at night, apart from a low level light on the kiosk door to allow access for maintenance when necessary (design principle: PTH1X.8). 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 Section 11, is indicated in Vol 21 Figure 11.4.6 for townscape and Vol 21 Figure 11.4.7 for visual (see separate volume of figures). The scale of the townscape and visual assessment areas are based on the operational phase ZTV, following the principles set out in para. 11.3.11 for construction.

11.3.20 Section 11.6 details the likely significant effects arising from the operation at King Edward Memorial Park Foreshore. There are no other Thames Tideway Tunnel project sites which could give rise to additional townscape and visual effects within the operational assessment area for this site, therefore no other Thames Tideway Tunnel project sites are included in this assessment.

11.3.21 No developments within the operational phase assessment areas have been identified that meet the criteria for inclusion in the operational base case over and above those detailed in the construction base case (see para. 11.3.13). Therefore, no other developments are considered in the assessment of effects arising from the proposed development at the King Edward Memorial Park Foreshore site in the operational phase.

11.3.22 In addition, no schemes have been identified within 1km of the site which meets the criteria for inclusion in the cumulative assessment and so no assessment of cumulative effects has been undertaken for effects on the King Edward Memorial Park Foreshore 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 Section 11. 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, site hoardings, welfare facilities and access points are in the location shown on Construction phases – phase 2 (shaft construction) (see 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 (shown on Construction phases plans in separate volume of figures – Section 1), with the permanent structures under construction located within the zones shown on the Site works parameter plan (see 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 and areas of hardstanding are in the location shown on the illustrative Proposed landscape plan (see 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 relevant zones (shown on the Site works parameter plan, see 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 at daytime from all visual assessment viewpoints, during 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. The assessment area includes a number of conservation areas, which are shown on Vol 21 Figure 11.4.1 (see separate volume of figures).

Topography

11.4.3 The terrestrial part of the site is located on relatively flat ground adjacent to the River Thames. The ground in King Edward Memorial Park gently rises away from the river up to The Highway along the northern boundary of the park.

Land use

11.4.4 The assessment area to the north of the river is characterised by a mix of residential and commercial uses aligned along the river and around other townscape features including King Edward Memorial Park, Shadwell Basin to the west and Limehouse Basin to the east. To the south of the river, the land use is predominantly residential, aligned along the river and backing onto green spaces beyond the assessment area.

Development patterns and scale

11.4.5 Vol 21 Figure 11.4.2 (see separate volume of figures) illustrates the pattern and scale of development and building heights within the assessment area.

11.4.6 The northern bank of the river features a diverse pattern of development, including residential terraces with private gardens and larger, taller residential blocks towards the river. The pattern of development is generally aligned along the river and around open spaces including King Edward Memorial Park, and Shadwell and Limehouse Basins.

11.4.7 On the southern bank, the townscape is characterised by two to four storey residential terraces, including a linear band of development along the river, north of Salter Road.

Vegetation patterns and extents

11.4.8 Vol 21 Figure 11.4.3 (see separate volume of figures) illustrates the pattern and extent of vegetation, including tree cover, within the assessment area.

11.4.9 Street trees are relatively uncommon within the assessment area both to the north and south of the river. However, vegetation is found within private rear gardens, shared communal spaces and public parks.

11.4.10 There are no knownTree Preservation Orders within or close to the site, although trees in the conservation areas on both sides of the river (shown on Vol 21 Figure 11.4.1 – see separate volume of figures) are indirectly protected.

Open space distribution and type

11.4.11 Vol 21 Figure 11.4.4 (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.

11.4.12 King Edward Memorial Park and King's Stairs Gardens represent the only notable public open spaces within the assessment area, located on the north and south banks respectively. The setting of residential areas on the south bank is influenced by large areas of open space to the south, beyond the assessment area. The main open spaces are described in more detail in Vol 21 Table 11.4.1 below.

Vol 21 Table 11.4.1 Townscape – open space type and distribution

Open space	Distance from site	Character summary
King Edward Memorial Park	0m	3.3ha public open space comprising a bowling green, tennis courts, sports pitch, children's playground, formal gardens and wildlife area. The Rotherhithe Tunnel Air Shaft is also located within the park, along the river frontage. Characterised as a local park in the GLA open space hierarchy.
Glamis Adventure Playground	100m north (north of river)	Small adventure playground. Categorised as a small open space in the GLA open space hierarchy.
King's Stairs Gardens	850m southwest (south of river)	Riverside public park characterised by amenity grassland, including a grassed mound within the space, and a large number of mature trees, including avenues of London plane trees. Characterised as a local park in the GLA open space hierarchy.

Transport routes

11.4.13 Vol 21 Figure 11.4.5 (see separate volume of figures) illustrates the transport network within the assessment area, including cycleways, footpaths and Public Rights of Way.

11.4.14 The site is located to the south of The Highway, which is characterised by high levels of traffic. The Rotherhithe Tunnel represents the other main strategic, heavily trafficked route in the assessment area, and this road passes underneath King Edward Memorial Park. The majority of other streets in the assessment area are narrow and characterised by low levels of both vehicular and pedestrian traffic.

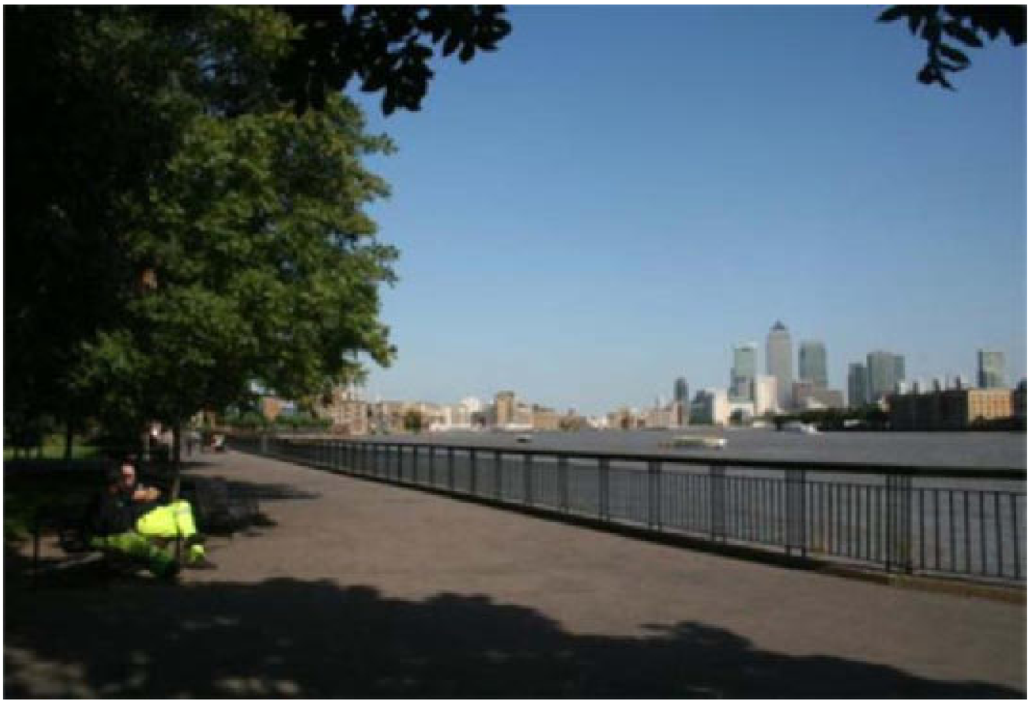
11.4.15 The Thames Path runs along both banks of the river, although it is diverted inland at regular intervals on the northern bank around riverfront development. In King Edward Memorial Park, the Thames Path route through the park is locked at night but an alternative signed route is available along The Highway around the park.

Site character assessment

11.4.16 The site is located within Wapping Wall Conservation Area in the LB of Tower Hamlets. The terrestrial part of the site is located partially along the river frontage of King Edward Memorial Park and partially within the River Thames. The remainder of the site is located in the west of the park on areas of hardstanding, sports pitches, an existing children's playground and the Thames Path. The river is characterised by a relatively narrow intertidal foreshore visible at low tide.

11.4.17 The character of the site is illustrated in Vol 21 Plate 11.4.1 and Vol 21 Plate 11.4.2, and the components of the site are described in more detail in Vol 21 Table 11.4.2 below.

Vol 21 Plate 11.4.1 The character of the eastern part of the site



Date taken: 1 September 2011. 18mm lens.

Vol 21 Plate 11.4.2 The character of the western part of the site

Date taken: 6 December 2010. 18mm lens.

Vol 21 Table 11.4.2 Townscape – site components

ID	Component	Description	Condition
01	Boundary trees and shrub borders	Tall, well established trees along the boundary with the footpath	Good

ID	Component	Description	Condition
		running parallel to Shadwell Pierhead.	
02	Boundary fencing and walls	Fencing to the park maintenance yard and western boundary.	Good
03	Formal paths and steps	Predominantly asphalt paving with some extensive steps to the Thames Path.	Good
04	Sports pitches	All-weather football pitch at the edge of the park.	Fair
05	Bandstand	Small bandstand comprising a simple roof structure supported on cast iron columns.	Good
06	Memorial benches	Memorial benches along the riverside.	Good
07	Children’s playground	Small children’s playground with typical play equipment set into rubberised safety surfacing.	Good
08	Mature parkland trees	Mature deciduous parkland trees from 8-12m in height.	Good
09	River wall and railings	Concrete river wall with painted metal railings running along the frontage.	Fair
10	Existing seating area	Small area of hard surfaced public realm to the west of the Rotherhithe Tunnel Air Shaft, screened from the park by a tall band of evergreen trees.	Poor

11.4.18 A baseline description of King Edward Memorial Park as a heritage asset is provided in Section 7.4 of this volume.

11.4.19 The condition of the townscape within the site is generally good. However, there are good opportunities for enhancement along the route of the Thames Path, which is narrow and overshadowed through the western portion of the site, and along some of the river frontage.

11.4.20 The riverside location of the site and its position at the edge of King Edward Memorial Park, means it has a high level of tranquillity, which is strengthened by the change of levels between the site and The Highway to the north.

11.4.21 The site is located within a regionally valued stretch of the River Thames, providing the setting to a number of conservation areas on both sides of the river.

11.4.22 Due to the good condition and regional significance of the site's character, and high levels of tranquillity, the site has a high sensitivity to change.

Townscape character assessment

11.4.23 The townscape character areas surrounding the site are identified in Vol 21 Figure 11.4.6 (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 – East London Reach TCA

11.4.24 This reach of the River Thames begins at King's Stairs Gardens in the west to the start of the Isle of Dogs peninsula in the east. The reach is characterised by dense residential development along both banks, including both heritage terraces and modern apartment blocks. The character of this area is illustrated in Vol 21 Plate 11.4.3 below.

Vol 21 Plate 11.4.3 River Thames - East London Reach TCA

Date taken: 1 September 2011. 18mm lens.

11.4.25 The river itself is characterised by numerous jetties, inlets, docks and former docks. The northern bank of the river has a wide area of foreshore, while the foreshore along the southern bank begins wide and tapers away as the river goes round a natural meander. The overall character is largely urban, with very little planting along the river banks, with the exception of green frontages at King Edward Memorial Park and King's Stairs Gardens.

11.4.26 The jetties, river wall and bridges are well maintained. The overall townscape condition is fair.

11.4.27 This reach has a moderate level of tranquillity, due to the limited usage of the river, offset against the limited level of vegetation or tree cover along both banks.

11.4.28 This reach is a regionally valued stretch of the river, providing the setting to a number of conservation areas on both banks.

11.4.29 Therefore, despite the regional value of the reach, due to the fair condition and moderate levels of tranquillity, this character area has a medium sensitivity to change.

Wapping Wall TCA

11.4.30 This area comprises Wapping Wall Conservation Area and St Paul's Shadwell Conservation area. The area is characterised by 19th century warehouses set amongst stairs that provide access to the river and 20th century jetties. The character area also incorporates King Edward Memorial Park and the Shadwell Basin. The pattern of development is predominantly linear, which divides the river from surrounding character areas, and also encloses King Edward Memorial Park and the Shadwell Basin. The character of this area is illustrated in Vol 21 Plate 11.4.4 below.

Vol 21 Plate 11.4.4 Wapping Wall TCA

Date taken: 1 September 2011. 18mm lens.

11.4.31 A baseline description of Wapping Wall Conservation Area as a heritage asset is provided in Section 7.4 of this volume.

11.4.32 The buildings and public realm within the area are well maintained. The overall townscape condition is good.

11.4.33 The area has a moderate level of tranquillity due to the riverside location and presence of two large open spaces. This is offset by the busy traffic associated with The Highway along the northern boundary of part of the character area.

11.4.34 The character of the area is valued at the borough level by virtue of the conservation area designations.

11.4.35 Due to the good condition and borough value of the townscape, this character area has a high sensitivity to change.

Shadwell Residential North TCA

11.4.36 This area is dominated by residential uses, interspersed with sizeable pockets of commercial and light industrial uses, including hotels and offices. The majority of buildings are between two and five storeys in height, although there are several tower blocks of up to 20 storeys. The pattern of development is contained by Cable Street to the north and The Highway to the south, which is partially lined by street trees. The remainder of the character area features few street trees and therefore vegetation does not form a dominant component of the character of the area. The streets within the character area are narrow and feature prominent traffic calming measures. The character of this area is illustrated in Vol 21 Plate 11.4.5 below.

Vol 21 Plate 11.4.5 Shadwell Residential North TCA

Date taken: 1 September 2011. 18mm lens.

11.4.37 The buildings and public realm within the area are generally well maintained, although there are also a number of poorly maintained buildings and areas of hardstanding. Therefore, the overall townscape condition is considered to be fair.

11.4.38 Tranquillity within the area is limited by the presence of busy traffic along Cable Street and The Highway, the lack of vegetation and the intermittent presence of commercial and light industrial uses. Therefore the area has a low level of tranquillity.

11.4.39 The area is likely to be locally valued by residents within the character area.

11.4.40 Due to the fair condition and local value of the townscape, this character area has a medium sensitivity to change.

Narrow Street Conservation Area TCA

11.4.41 This area comprises Narrow Street Conservation Area, characterised by 19th and 20th century industrial buildings associated with Regent's Dock, which have now been mostly redeveloped into residential apartments. The riverside is lined with one to three storey small warehouses and industrial buildings on narrow plots, which have been converted into residential use whilst still retaining their historic architectural character. The area has few open spaces, and vegetation is generally restricted to small private and semi-private gardens. The pattern of development is entirely focused along the river and Narrow Street which runs parallel to it beyond the first row of buildings. The pattern of development means the character of this area is largely enclosed in nature. The character of this area is illustrated in Vol 21 Plate 11.4.6 below.

Vol 21 Plate 11.4.6 Narrow Street Conservation Area TCA

Date taken: 1 September 2011. 18mm lens.

11.4.42 The buildings and public realm within the area are well maintained. The overall townscape condition is good.

11.4.43 The area has a moderate level of tranquillity due to the residential use and narrow streets, offset against the lack of vegetation and street trees.

11.4.44 The character of the area is valued at the borough level by virtue of the conservation area designation.

11.4.45 Due to the good condition and borough value of the townscape, this character area has a high sensitivity to change.

Rotherhithe Street Residential TCA

11.4.46 This area comprises a linear band of residential development along the southern bank of the River Thames and Rotherhithe Street which runs parallel to the river beyond the first row of buildings. The area, formally part of the Surrey Docks, was largely infilled during the 1980s and is now characterised by three to five storey modern residential properties with some commercial and retail facilities. There is limited street tree planting within this area although the riverfront is characterised by some intermittent tree planting. The character of this area is illustrated in Vol 21 Plate 11.4.7 below.

Vol 21 Plate 11.4.7 Rotherhithe Street Residential TCA

Date taken: 1 September 2011. 18mm lens.

11.4.47 The buildings and public realm within the area are well maintained. The overall townscape condition is good.

11.4.48 The area has a moderate level of tranquillity due to the residential use and riverside location, offset against the presence of relatively high levels of traffic along Rotherhithe Street.

11.4.49 The area is likely to be locally valued by residents within the character area.

11.4.50 Therefore, despite the local scale of value of the townscape, due to the good condition and importance of the surrounding setting, this character area has a high sensitivity to change.

Rotherhithe Residential West TCA

11.4.51 This area comprises two to six storey residential apartments, housing estates and terraced properties along streets aligned in a grid pattern. Part of the area is designated as St Marys Rotherhithe Conservation Area, and incorporates St Mary's Church and the surrounding historic buildings that form the extent of the old Rotherhithe Village. The area is densely developed, with few open spaces, although street trees are relatively frequent. The area is dissected by Brunel Road and Rotherhithe Street and is thus characterised by relatively high levels of traffic, although other local routes are fairly quiet. The southern entrance to the Rotherhithe tunnel is located in this character area alongside Brunel Road. Despite the riverside location, the pattern of development is largely enclosed, and focused around the internal road network. The character of this area is illustrated in Vol 21 Plate 11.4.8 below.

Vol 21 Plate 11.4.8 Rotherhithe Residential West TCA

Date taken: 1 September 2011. 18mm lens.

11.4.52 The buildings and public realm within the area are generally well maintained. The overall townscape condition is good.

11.4.53 The area has a moderate level of tranquillity due to its residential use, the presence of street trees and riverside location, offset against the presence of relatively high levels of traffic along Brunel Road and Rotherhithe Street.

11.4.54 The area is likely to be locally valued by residents within the character area, although the historic cluster of buildings around St Mary's Church are valued at the borough level by virtue of the conservation area designation.

11.4.55 Due to the good condition, local/borough value of the townscape and inward looking pattern of development, this character area has a medium sensitivity to change.

King's Stairs Gardens TCA

11.4.56 This character area comprises King's Stairs Gardens, a large open space located on the river frontage. The area is designated as Edward III's Rotherhithe Conservation Area and also as Metropolitan Open Land. The riverside open space is characterised by scattered mature trees, open grassland, a large grassed mound, an enclosed children's playground and a network of tree lined paths. The character of this area is illustrated in Vol 21 Plate 11.4.9 below.

Vol 21 Plate 11.4.9 King's Stairs Gardens TCA

Date taken: 1 September 2011. 18mm lens.

11.4.57 The landscape of the open space is well managed. The overall townscape condition is good.

11.4.58 The area has a high level of tranquillity due to the widespread presence of tree planting, limited levels of activity and relative seclusion offered from the surrounding built environment.

11.4.59 The area is valued at a regional scale due to the scale of the interconnected open spaces and the Metropolitan Open Land designation.

11.4.60 Due to the good condition and regional value of the townscape, and high level of tranquillity, this character area has a high sensitivity to change.

Visual baseline

11.4.61 Vol 21 Figure 11.4.7 (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, while the second part relates to the summer view for viewpoints included in the operational assessment.

Residential

11.4.62 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 Free Trade Wharf on the eastern edge of King Edward Memorial Park

11.4.63 This viewpoint is representative of the typical view from residential properties adjacent to the Thames Path on the northern bank of the River Thames, immediately adjacent to the eastern edge of King Edward Memorial Park.

Vol 21 Plate 11.4.10 Viewpoint 1.1: winter view

Date taken: 6 January 2012. 18mm lens.

11.4.64 The view (illustrated in Vol 21 Plate 11.4.10) is characterised at the lower level by semi-mature trees within the park and an open panorama over the river. From upper storeys, the view is open over King Edward Memorial Park and encompasses the river and Rotherhithe on the opposite bank. The Rotherhithe Tunnel Air Shaft is a prominent feature in the middle ground of the view. Views of the site, largely located on the foreshore, are unobstructed, particularly from upper storeys.

Vol 21 Plate 11.4.11 Viewpoint 1.1: summer view

Date taken: 1 September 2011. 18mm lens.

11.4.65 In summer, the view towards parts of the site within King Edward Memorial Park (illustrated in Vol 21 Plate 11.4.11) is more noticeably screened by mature trees.

Viewpoint 1.2: View northwest from residences on Sovereign Crescent

11.4.66 This viewpoint is representative the typical oblique view from residential properties on Sovereign Crescent located on the southern bank of the river, opposite the site.

Vol 21 Plate 11.4.12 Viewpoint 1.2: winter view

Date taken: 6 January 2012. 35mm lens.

11.4.67 The view (illustrated in Vol 21 Plate 11.4.12) is an open panorama over the river, accentuated by the location at a prominent bend in the river. The view is focused on the green frontage of King Edward Memorial Park. The Free Trade Wharf residential development adjacent to the site forms a key component of the view across the river. Tall buildings in the City of London form the background to the view. Views of the site are unobstructed from this location.

Vol 21 Plate 11.4.13 Viewpoint 1.2: summer view

Date taken: 1 September 2011. 35mm lens.

11.4.68 In summer, the view towards the site (illustrated in Vol 21 Plate 11.4.13) is largely unchanged although, as they are in leaf, the deciduous trees along the river frontage in King Edward Memorial Park form a more prominent feature.

Viewpoint 1.3: View northeast from residences on Wapping High Street

11.4.69 This viewpoint is representative of the oblique view from residential properties on the frontage of the River Thames, along Wapping High Street.

Vol 21 Plate 11.4.14 Viewpoint 1.3: winter view

Date taken: 6 January 2012. 18mm lens.

11.4.70 The view (illustrated in Vol 21 Plate 11.4.14) is an open panorama along the river, focused on residential premises fronting onto the river. Oblique views towards the site are partially obscured by the presence of buildings, and wharves and jetties that protrude into the river.

Viewpoint 1.4: View east from residences on Maynards Quay

11.4.71 This viewpoint is representative of the glimpsed view from residential properties on Maynards Quay along the western edge of Shadwell Basin.

Vol 21 Plate 11.4.15 Viewpoint 1.4: winter view

Date taken: 6 January 2012. 18mm lens.

11.4.72 The view (illustrated in Vol 21 Plate 11.4.15) features the expanse of Shadwell Basin, which is framed by low-rise residential apartments and mature trees surrounding St Paul's Church to the north of the former dock. Views through to King Edward Memorial Park and the site are largely obscured by intervening buildings and mature trees, although wider views are more apparent from upper storeys. The tall buildings of Canary Wharf form prominent elements in the background of the view.

Viewpoint 1.5: View northeast from residences on Trafalgar Court

11.4.73 This viewpoint is representative of the typical view from northeast facing residential properties on the frontage of the River Thames, along Trafalgar Court.

Vol 21 Plate 11.4.16 Viewpoint 1.5: winter view

Date taken: 6 January 2012. 18mm lens.

11.4.74 The view (illustrated in Vol 21 Plate 11.4.16) is an open panorama over the river, focused on residential premises either side of King Edward Memorial Park. Further properties in the same development are orientated towards the river, with oblique views towards the site. Views of the part of the site projecting into the river are unobstructed from this location.

Vol 21 Plate 11.4.17 Viewpoint 1.5: summer view

Date taken: 1 September 2011. 18mm lens.

11.4.75 In summer, deciduous trees provide some screening of views towards the site (illustrated in Vol 21 Plate 11.4.17).

Recreational

11.4.76 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 where 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 northeast from the Thames Path close to the Rotherhithe Tunnel Air Shaft

11.4.77 This viewpoint is representative of the typical view recreational users of the Thames Path experience from within King Edward Memorial Park, close to the Rotherhithe Tunnel Air Shaft.

Vol 21 Plate 11.4.18 Viewpoint 2.1: winter view

Date taken: 6 January 2012. 18mm lens.

11.4.78 The linear view (illustrated in Vol 21 Plate 11.4.18) down the river towards Canary Wharf is framed to by an avenue of trees along the frontage of King Edward Memorial Park, which forms the immediate foreground of the view, set between the large residential Free Trade Wharf development on the eastern edge of the park and the river. Views of the site are unobstructed from this location which would be immediately in front of this location.

Vol 21 Plate 11.4.19 Viewpoint 2.1: summer view

Date taken: 1 September 2011. 18mm lens.

11.4.79 In summer, the view into the park (illustrated in Vol 21 Plate 11.4.19) is heavily screened by deciduous trees along the river frontage. However, the majority of the site, projecting into the river, remains highly visible.

Viewpoint 2.2: View southeast from close to the tennis courts in King Edward Memorial Park

11.4.80 This viewpoint is representative of the typical view recreational users of King Edward Memorial Park experience from the northwest corner of the park, close to existing tennis courts.

Vol 21 Plate 11.4.20 Viewpoint 2.2: winter view

Date taken: 6 January 2012. 18mm lens.

11.4.81 The foreground of the view (illustrated in Vol 21 Plate 11.4.20) is characterised by tennis courts and a bowling green, with intermittent vegetation along their boundaries. Beyond the active sports area of the park, the remainder of the open space is visible, and is characterised by open grassland and scattered mature trees, which partially screen views towards the site and the river.

Vol 21 Plate 11.4.21 Viewpoint 2.2: summer view

Date taken: 1 September 2011. 18mm lens.

11.4.82 In summer, views towards the site (illustrated in Vol 21 Plate 11.4.21) are more noticeably screened by intervening vegetation within the park.

Viewpoint 2.3: View southeast from the bowling green in King Edward Memorial Park

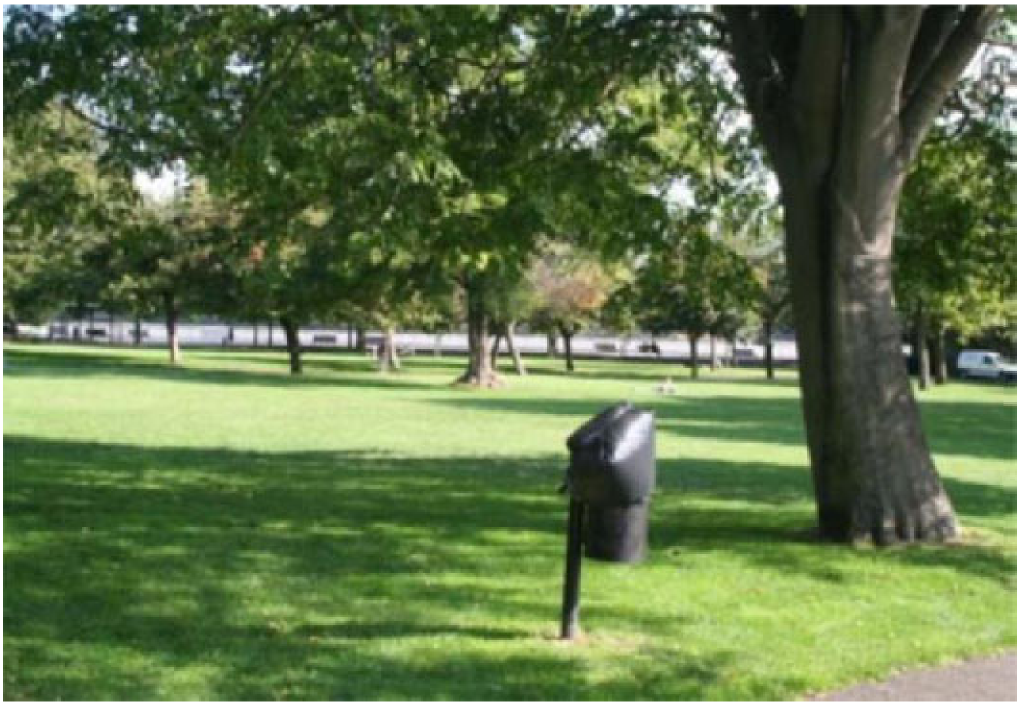
11.4.83 This viewpoint is representative of the typical view recreational users of King Edward Memorial Park experience from the footpath along the northern edge of the bowling green.

Vol 21 Plate 11.4.22 Viewpoint 2.3: winter view

Date taken: 6 January 2012. 35mm lens.

11.4.84 The foreground of the view (illustrated in Vol 21 Plate 11.4.22) features open grassland and scattered mature trees, which partially screen views towards the site and river.

Vol 21 Plate 11.4.23 Viewpoint 2.3: summer view



Date taken: 1 September 2011. 35mm lens.

11.4.85 In summer, the crowns of mature trees within the park, in the middle ground of the view more noticeably screen views towards the site (illustrated in Vol 21 Plate 11.4.23).

Viewpoint 2.4: View south from the eastern side of King Edward Memorial Park

11.4.86 This viewpoint is representative of the typical view recreational users of King Edward Memorial Park experience from the north-south footpath running through the eastern side of the park. Due to a level change between the river frontage and The Highway at the north of the park, this viewpoint is elevated slightly higher than the site which increases the area of visible site.

Vol 21 Plate 11.4.24 Viewpoint 2.4: winter view

Date taken: 6 January 2012. 18mm lens.

11.4.87 The foreground of the view (illustrated in Vol 21 Plate 11.4.24) is characterised by open grassland and scattered mature trees which partially screen views towards the site and river.

Vol 21 Plate 11.4.25 Viewpoint 2.4: summer view

Date taken: 1 September 2011. 18mm lens.

11.4.88 In summer, the line of vegetation along the eastern side of the path provides dense screening to the east. Views towards the majority of the site and the river (illustrated in Vol 21 Plate 11.4.25) are further filtered by deciduous trees within the park, including along the river frontage.

Viewpoint 2.5: View southwest from the Thames Path outside Free Trade Wharf

11.4.89 This viewpoint is representative of the typical view for recreational users of the Thames Path, outside Free Trade Wharf residential development, toward its eastern end.

Vol 21 Plate 11.4.26 Viewpoint 2.5: winter view

Date taken: 6 January 2012. 18mm lens.

11.4.90 The view (illustrated in Vol 21 Plate 11.4.26) is an open panorama over the river, with foreground views in the direction of the site characterised by the presence of an existing jetty structure. The green frontage of King Edward Memorial Park and Rotherhithe Tunnel Air Shaft form notable components within the middle ground of the view, beyond the dominant Free Trade Wharf building. Views of the part of the site projecting into the river are unobstructed from this location.

Vol 21 Plate 11.4.27 Viewpoint 2.5: summer view

Date taken: 1 September 2011. 18mm lens.

11.4.91 In summer, the view towards the site (illustrated in Vol 21 Plate 11.4.27) is largely unchanged, although the deciduous trees in the backdrop provide greater screening of views into the park.

Viewpoint 2.6: View west from the Thames Path at the entrance to Limehouse Basin

11.4.92 This viewpoint is representative of the typical view for recreational users of the Thames Path, at Victoria Wharf on the eastern side of the entrance to Limehouse Basin.

Vol 21 Plate 11.4.28 Viewpoint 2.6: winter view

Date taken: 6 January 2012. 35mm lens.

11.4.93 The view (illustrated in Vol 21 Plate 11.4.28) is an open panorama over the river focused on Free Trade Wharf and King Edward Memorial Park. The park is a distinctive component of the view as it represents a green frontage bounded by buildings on either side. The Rotherhithe Tunnel Air Shaft forms a distinct component in the middle ground of the view within the park. Views of the site are unobstructed from this location.

Viewpoint 2.7: View north from the Thames Path outside the Old Salt Quay public house

11.4.94 This viewpoint is representative of the typical view for recreational users of the Thames Path on the south bank of the river, in the vicinity of the Old Salt Quay public house, and also users of pub garden which faces the river.

Vol 21 Plate 11.4.29 Viewpoint 2.7: winter view

Date taken: 6 January 2012. 35mm lens.

11.4.95 The view (illustrated in Vol 21 Plate 11.4.29) is an open panorama over the river, with direct cross river views to King Edward Memorial Park, which is distinctive by virtue of its green frontage set amongst an otherwise built-up riverside. The Rotherhithe Tunnel Air Shaft forms a distinctive component of the view within the park, and the Free Trade Wharf residential development is a key element of the wider setting. Views of the site are unobstructed from this location.

Vol 21 Plate 11.4.30 Viewpoint 2.7: summer view

Date taken: 1 September 2011. 35mm lens.

11.4.96 In summer, the view towards the site (illustrated in Vol 21 Plate 11.4.30) is largely unchanged, although the deciduous trees in the backdrop provide noticeably greater screening of views into the park.

Viewpoint 2.8: View northeast and west from the Thames Path in King's Stairs Gardens

11.4.97 This viewpoint is representative of the typical distant view for recreational users of the Thames Path in King's Stairs Gardens public open space on the opposite side of the river.

Vol 21 Plate 11.4.31 Viewpoint 2.8: winter view towards King Edward Memorial Park Foreshore (northeast)

Date taken: 6 January 2012. 18mm lens.

11.4.98 The view (illustrated in Vol 21 Plate 11.4.31) is an open panorama over the river, including oblique views to King Edward Memorial Park. Views of the King Edward Memorial Park Foreshore site are unobstructed although distant from this location.

Vol 21 Plate 11.4.32 Viewpoint 2.8: winter view towards Chambers Wharf (west)

Date taken: 15 February 2012. 35mm lens.

11.4.99 This viewpoint is also located within the ZTV of the proposed Thames Tideway Tunnel project site at Chambers Wharf (refer to para. 11.3.12). The typical view (illustrated in Vol 21 Plate 11.4.32) is an open panorama over the river towards Tower Bridge in the west. The view is characterised by the dense urban frontage and jetties along the southern bank of the river. The Chambers Wharf site is on the periphery of the panorama, and views in that direction are partially obscured by intervening piers and moorings.

Construction base case

11.4.100 The base case in Site Year 2 of construction taking into account the proposed developments described in para. 11.3.13 would alter the character of Shadwell Residential North TCA to a limited extent through redeveloping existing plots of land into new residential and student accommodation blocks. However, the changes would not alter the overall sensitivity of the character area, which would remain medium as described in para. 11.4.40.

11.4.101 All other receptors would remain as detailed in the baseline.

Operational base case

11.4.102 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 the King Edward Memorial Park Foreshore site taking account of Chambers Wharf (as detailed in Section 11.3).

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 (Defra, 2012)[8] 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. Therefore, it is important to note that such effects are commonplace in urban environments and the following assessment should be viewed in this context.

11.5.3 Illustrative plans of the possible layout of the site during construction are contained in a separate volume (Construction phases plans, see 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 partial removal of the river wall, removal of vegetation and trees, removal of street furniture including the bandstand and memorial benches, relocation of the children's playground, installation of site hoardings, creation of the access route from Glamis Road, construction of the haul road across the river frontage of the park, and construction activity associated with the construction of the cofferdam, shaft and ventilation equipment. The impacts on specific components of the site are described in Vol 21 Table 11.5.1 below.

Vol 21 Table 11.5.1 Townscape – impacts on existing site components during construction

ID	Component	Impacts
01	Boundary trees and shrub borders	One tree on the boundary with Glamis road would be removed to allow for construction of the access road across the river frontage of the park. Six further (mostly small) trees would be removed in the vicinity of the children's playground.
02	Boundary fencing and walls	These would be partially removed to allow for construction of the access road across the river frontage of the park.

ID	Component	Impacts
03	Formal paths and steps	These would be removed within the site working area to facilitate the construction of the access road and establishment of the compound.
04	Sports pitches	Some existing facilities would be removed to facilitate establishment of the compound.
05	Bandstand	This structure would be removed and stored for reinstatement following the works.
06	Memorial benches	These would be removed and stored for reinstatement following the works.
07	Children's playground	This would be removed and relocated within the park for the duration of the construction phase.
08	Mature parkland trees	17 trees would be removed along the river frontage to facilitate construction and access. Further trees would be pruned to allow for construction access beneath them.
09	River wall and railings	These would be removed along the stretch in which the cofferdam is proposed to be constructed.
10	Existing seating area	This would be retained throughout construction.

11.5.5 The high levels of tranquillity in the site would be substantially altered due to introduction of construction vehicles, plant equipment and the high levels of activity in the park and part of the river that is not currently intensively used.

11.5.6 Due to clearance of trees and structures and the intense level of construction activity affecting the character of the site and the levels of tranquillity, the magnitude of change is considered to be high.

11.5.7 The high magnitude of change, assessed alongside the high sensitivity of the site, would result in **major adverse** effects.

11.5.8 The assessment of specific effects on the setting of King Edward Memorial Park as a heritage asset is set out in Section 7 of this volume. The historic environment assessment identifies a moderate adverse effect on the setting of this asset as parts of the park would remain unaffected by the proposed construction activities.

Townscape character areas assessment

River Thames – East London Reach TCA

11.5.9 The proposed site is adjacent to this reach of the river, and would introduce high levels of construction activity within a part of the river not currently intensively used. The construction activity would be set in front of the green frontage of King Edward Memorial Park, which represents one of only two substantial green spaces along the riverfront in the assessment area. Given the size of the projection into the river from the temporary cofferdam, this reach of the river would be substantially affected by the construction activity associated with the site.

11.5.10 The area has moderate levels of tranquillity at present, which would be affected by the introduction of construction activity, including piling and demolition, and barging operations.

11.5.11 Due to the scale of the cofferdam projecting into the river and the intensity of construction activities at the site, the magnitude of change is considered to be high.

11.5.12 The high magnitude of change, assessed alongside the medium sensitivity of this character area, would result in **moderate adverse** effects.

Wapping Wall TCA

11.5.13 The proposed site is set directly to the south of this character area, and would largely segregate King Edward Memorial Park from the river due to the presence of construction activity and site hoardings. The setting of the park would be substantially affected by the presence of site hoardings, construction activity and construction plant on the temporary cofferdam, the access route along the frontage of the park, and facilities in the west of the park. This would alter the existing open setting of the river. The effect on the setting of the park would be reduced slightly through the use of climbing plants on the hoardings along the northern edge of the eastern part of the construction site and the use of open mesh fencing along the access route, preserving visual connectivity with the river. The riverside setting of the remainder of the character area would be affected only to a limited extent by the wider presence of construction activity. The setting of the area around Shadwell Basin and St Paul's Shadwell Conservation Area, would be largely unaffected.

11.5.14 The area has moderate levels of tranquillity at present, which would be affected by construction activities at the site, including piling and demolition.

11.5.15 Due to changes to the setting of the eastern part of the character area (King Edward Memorial Park), minimised through the use of climbing plants on the hoardings, and the limited changes to the wider riverside setting of the remainder of the area, the magnitude of change is considered to be medium.

11.5.16 The medium magnitude of change, assessed alongside the high sensitivity of this character area, would result in **moderate adverse** effects.

11.5.17 The assessment of specific effects on the setting of Wapping Wall Conservation Area as a heritage asset is set out in Section 7 of this volume.

Shadwell Residential North TCA

11.5.18 The proposed site does not form part of the setting for the majority of this character area. Towards the eastern extent of the character area, the riverside setting would be affected to a limited extent by the presence of tall construction plant at the temporary cofferdam. The area to the north of King Edward Memorial Park would also be affected to a limited extent by the presence of these elements. However, the setting of the majority of the area would be unaffected.

11.5.19 The low levels of tranquillity in the area would be largely unaffected by the proposed works.

11.5.20 Therefore, the magnitude of change is considered to be low.

11.5.21 The low magnitude of change, assessed alongside the medium sensitivity of this character area, would result in **minor adverse** effects.

Narrow Street Conservation Area TCA

11.5.22 The proposed site does not form part of the setting for this character area, which is largely inward looking and unlikely to be indirectly affected by construction traffic. The wider presence of tall construction plant and cranes is not likely to substantially alter the setting of the area.

11.5.23 The area has moderate levels of tranquillity at present, which would be largely unaffected by the proposed works.

11.5.24 Therefore, the magnitude of change is considered to be negligible.

11.5.25 The negligible magnitude of change, assessed alongside the medium sensitivity of this character area, would result in a **negligible** effect.

Rotherhithe Street Residential TCA

11.5.26 The proposed site forms a direct part of the riverside setting of this character area, which is strongly focused on the river. The presence of the temporary cofferdam, construction plant, ongoing construction activity and road transport along the frontage of King Edward Memorial Park would substantially affect the riverside setting of this character area. The setting would also be affected by the removal of mature trees at the site. However, the wider riverside setting of this area would be unaffected

11.5.27 The moderate levels of tranquillity in the character area at present would be affected to a limited extent by construction activities at the site, including piling and demolition.

11.5.28 Due to the substantial changes to part of the immediate riverside setting of the area, the magnitude of change is considered to be medium.

11.5.29 The medium magnitude of change, assessed alongside the high sensitivity of this character area, would result in **moderate adverse** effects.

Rotherhithe Residential West TCA; and King’s Stairs Gardens TCA

11.5.30 The proposed site forms part of the wider riverside setting of these character areas, despite the pattern of development being largely enclosed. The presence of the temporary cofferdam, construction plant and ongoing construction activity would affect the wider riverside setting of these character areas. However, the majority of the setting would remain unchanged.

11.5.31 The moderate to high levels of tranquillity in these character areas at present would be unlikely to be substantially affected by construction activities at the site.

11.5.32 Due to the changes in the wider riverside setting, the magnitude of change is considered to be low.

11.5.33 The low magnitude of change, assessed alongside the medium and high sensitivity of these character areas respectively, would result in **minor adverse** effects.

Townscape – sensitivity test for programme delay

11.5.34 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 11.5.33). 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 11.4.60).

Visual assessment

11.5.35 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 Free Trade Wharf on the eastern edge of King Edward Memorial Park

11.5.36 Views from residences at ground level would be characterised by the cofferdam that would form a major part of the site projecting substantially into the river by approximately 47m, the site hoardings and construction plant. The view would also be affected by the removal of trees along the river frontage. From higher levels, there would be direct views of construction activity within the site working boundary and filtered views across the park to the welfare facilities located to the west. Therefore, the magnitude of change on this viewpoint would be high, affecting a valued view over the river.

11.5.37 The high magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **major adverse** effects.

Viewpoint 1.2: View northwest from residences on Sovereign Crescent

11.5.38 Views from residences across the river would encompass the temporary cofferdam projecting into the river, construction plant and ongoing construction activities. The view would also be affected by the removal of trees along the river frontage. The construction activity would partially screen views of King Edward Memorial Park. The construction activities and associated facilities in the western part of the park would be screened by intervening buildings and mature trees. The majority of the view both along and directly across the river would be largely unaffected. Therefore, the magnitude of change is considered to be medium.

11.5.39 The medium magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **moderate adverse** effects.

Viewpoint 1.3: View northeast from residences on Wapping High Street

11.5.40 Oblique views from residences towards the site would be affected to a limited extent during construction, by visibility of the temporary cofferdam, site hoardings, tall construction plant and cranes. The majority of the panorama across the river would be unaffected. Therefore, the magnitude of change is considered to be low.

11.5.41 The low magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **minor adverse** effects.

Viewpoint 1.4: View east from residences on Maynards Quay

11.5.42 Views from residences towards the site would be affected to a limited extent during construction, by intermittent visibility of tall construction plant and cranes. However, views would be largely partially screened by mature trees within King Edward Memorial Park, and wider visibility would be obscured by intervening buildings. Therefore, the magnitude of change to this viewpoint would be negligible.

11.5.43 The negligible magnitude of change, assessed alongside the high sensitivity of the receptor, would result in a **negligible** effect.

Viewpoint 1.5: View northeast from residences on Trafalgar Court

11.5.44 Views from residences at ground level would be characterised by the temporary cofferdam projecting into the river, site hoardings, construction plant and ongoing construction activity, partially obscured by intervening river jetties and existing mature trees within King Edward Memorial Park. From higher levels, there would be more direct views of construction activity within the site working boundary, but these would be partially screened by existing mature trees within the park. Therefore, the magnitude of change on this viewpoint would be medium.

11.5.45 The medium magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **moderate adverse** effects.

Recreational

Viewpoint 2.1: View northeast from the Thames Path close to the Rotherhithe Tunnel Air Shaft

11.5.46 Views from this location would be dominated by the temporary cofferdam projecting into the river, site hoardings along the western edge, construction plant, ongoing construction activity and traffic along the access route through the park. The removal of trees along the river frontage would also be highly visible. Therefore, the magnitude of change is considered to be high, affecting a valued view along the river.

11.5.47 The high magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **major adverse** effects.

Viewpoint 2.2: View southeast from close to the tennis courts in King Edward Memorial Park

11.5.48 View from this location towards the site would be affected by the background presence of construction activity and tall construction plant at the site and traffic along the construction access route. Other facilities would also be visible in the periphery of the view. However, the majority of construction activities would be partially screened by buildings and mature trees within the park, and the view would remain characterised by open space and tree planting. Therefore, the magnitude of change on this viewpoint would be low.

11.5.49 The low magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **minor adverse** effects.

Viewpoint 2.3: View southeast from the bowling green in King Edward Memorial Park; and Viewpoint 2.4: View south from the eastern side of King Edward Memorial Park

11.5.50 Views from these locations towards the site would be affected during construction. While the foreground of the views would remain characterised by the open space and existing trees within King Edward Memorial Park, the background would be interrupted by site hoardings, construction activity, construction plant and traffic along the construction access route. The use of climbing plants on the hoardings would preserve the green character of the park, but views of the river from these locations would be obscured. The view of the proposed development from viewpoint 2.4 is illustrated in Vol 21 Plate 11.5.1 below. A larger scale print of the photomontage, including the wider context and annotations, is provided in Vol 21 Figure 11.5.1 (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). The layout of the construction activities may change within the maximum extent of working area (see Construction phases – phase 2 (shaft construction) [see separate volume of figures – Section 1]).

Vol 21 Plate 11.5.1 Viewpoint 2.4 – illustrative construction phase photomontage

Date taken: 24 March 2011. 50mm lens.

11.5.51 Due to the changes in the background of the view reduced by the use of climbing plants along the hoarding, the magnitude of change is considered to be medium.

11.5.52 The medium magnitude of change, assessed alongside the high sensitivity of these receptors, would result in **moderate adverse** effects.

Viewpoint 2.5: View southwest from the Thames Path outside Free Trade Wharf

11.5.53 Views from this location towards the site would be affected during construction. The cofferdam projecting into the river would form a component of the view beyond the existing jetty structure opposite Free Trade Wharf. Construction activity, construction plant and road transport along the frontage of King Edward Memorial Park would also be visible in the middle ground of this view. Views of construction activity within the land based part of the site (including the welfare facilities) would be obscured by mature vegetation and the Free Trade Wharf building. Therefore, the magnitude of change is considered to be medium.

11.5.54 The medium magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **moderate adverse** effects.

Viewpoint 2.6: View west from the Thames Path at the entrance to Limehouse Basin

11.5.55 The background of the views from this location towards the site would be affected to a limited extent during construction. Construction activity, including the temporary cofferdam, tall construction plant and cranes would be visible in the background of the view, set in front of the green frontage of King Edward Memorial Park. Views of the site offices and welfare facilities in the western part of the park would be obscured by intervening buildings and mature trees. The majority of the panorama over the river would be unaffected. Therefore, the magnitude of change on this viewpoint would be low.

11.5.56 The low magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **minor adverse** effects.

Viewpoint 2.7: View north from the Thames Path outside the Old Salt Quay public house

11.5.57 The view from this location across the river would encompass the temporary cofferdam projecting into the river, construction plant, ongoing construction activity and traffic along the frontage of King Edward Memorial Park. The view would also be affected by the removal of mature trees along the river frontage. Views of the facilities in the western part of the park would be obscured by intervening buildings and mature trees. However, the majority of construction activity would be highly visible and set in front of the existing green frontage of King Edward Memorial Park. The majority of the view both along and directly across the river would be largely unaffected. Therefore, the magnitude of change is considered to be medium.

11.5.58 The medium magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **moderate adverse** effects.

Viewpoint 2.8: View northeast and west from the Thames Path in King’s Stairs Gardens

11.5.59 Oblique views from this location towards the King Edward Memorial Park Foreshore site would be affected to a limited extent during construction.

Distant views would be characterised by the temporary cofferdam projecting into the river, construction activity and tall construction plant.

11.5.60 The view towards the Chambers Wharf site from this viewpoint would also be affected to a limited extent, due to the background visibility of the temporary cofferdam projecting into the river, construction activity and cranes and continuous loading of barges. Views of the Chambers Wharf site would be partially screened by existing moorings along an intervening river jetty.

11.5.61 The majority of the wider panorama over the river would be largely unaffected. Therefore, the magnitude of change arising from both sites is considered to be low.

11.5.62 The low magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **minor adverse** effects.

Visual effects – sensitivity test for programme delay

11.5.63 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. 11.5.36 to 11.5.62). 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. 11.4.62 to 11.4.99.

11.6 Operational effects assessment

11.6.1 The following section describes the likely significant effects arising during the operational phase at the King Edward Memorial Park Foreshore site.

11.6.2 The 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, all surrounding townscape character areas and all viewpoints, adverse operational effects would be avoided by the commitment to a high quality design as detailed in the design principles summarised in para. 11.2.6. Furthermore, the elements of the design, including new tree planting, high quality structures and other improvements within King Edward Memorial Park, are considered to be an enhancement of the existing site. Where specific measures are of particular relevance to the effect on a receptor, these are described under each townscape character area and viewpoint.

11.6.4 Illustrative plans of the proposed development during operation are contained in a separate volume (see separate volume of figures – Section 1) 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 operational development would constitute a permanent improvement to the character of the site. The permanent works would result in a new extension of King Edward Memorial Park, projecting into the river beyond the existing river wall. The river wall surrounding the foreshore structure would be compatible with the visual character of existing adjacent river walls. The foreshore structure would include new planting and paving, extending the character of the park into the river corridor.

11.6.6 The 6-8m high ventilation columns serving the shaft would introduce new high quality built elements in the western half of the foreshore structure. The design intent for the ventilation columns (which would be the project signature design) is illustrated on the Ventilation columns design intent figure – type C (see separate volume of figures – Section 1). A further narrow 6m high ventilation column(s) serving the interception chamber would be located in the eastern section of the foreshore structure and a 1.2m high local control pillar(s) would be located along the northern edge of the new foreshore structure. The 3m high electrical and control kiosk would be located along the eastern boundary of the park, inland from the foreshore structure, and would incorporate a brown roof.

11.6.7 The land based area of the construction site would be redesigned as part of an improvement to the park, including:

a. a widened Thames Path accessed from Glamis Road

b. a new children's playground

c. a reconfigured area of sports pitches

11.6.8 The impacts on specific components of the site are described in Vol 21 Table 11.6.1 below.

Vol 21 Table 11.6.1 Townscape – impacts on baseline components in Year 1 of operation

ID	Component	Impacts
01	Boundary trees and shrub borders	Trees lost during construction would be replanted in line with a new landscape strategy for the park, designed to improve the character of the river frontage.
02	Boundary fencing and walls	These would be reinstated or redesigned in line with a new landscape strategy for the park, designed to improve the character of the river frontage.
03	Formal paths and steps	Where required, these would be reinstated. Elsewhere, level changes would be avoided in favour of creating fully accessible routes.

ID	Component	Impacts
04	Sports pitches	These would be reinstated and reconfigured as necessary.
05	Bandstand	This would be reinstated and incorporated into a landscape strategy for the park, designed to improve the character of the river frontage.
06	Memorial benches	These would be reinstated in line with a new landscape strategy for the park, designed to improve the character of the river frontage.
07	Children’s playground	This would be reinstated in line with a new landscape strategy for the park, designed to improve the character of the river frontage.
08	Mature parkland trees	Trees requiring removal during construction would be replanted in line with a new landscape strategy for the park, which would be designed to improve the character of the river frontage.
09	River wall and railings	A new river wall and railings would be installed in line with a new landscape strategy for the park, which would be designed to improve the character of the river frontage.
10	Existing seating area	No impacts during operation.

11.6.9 Given the localised improvements to the character of the park and the extension of the park onto the foreshore structure with a high quality design, the magnitude of change is considered to be medium.

11.6.10 The medium magnitude of change, assessed alongside the high sensitivity of the site, would result in **moderate beneficial** effects.

11.6.11 The assessment of specific effects on the setting of King Edward Memorial Park as a heritage asset is set out in Section 7 of this volume.

Townscape character areas assessment

11.6.12 This section describes effects arising from the proposed development in operation on townscape character areas surrounding the site. No assessment of townscape effects has been made for the following character areas, as the components of the operational scheme would not alter their setting:

a. Shadwell Residential North TCA

b. Narrow Street Conservation Area TCA

c. King’s Stairs Gardens TCA.

River Thames – East London Reach TCA

11.6.13 The proposed operational development would strengthen the connectivity between the river and King Edward Memorial Park by extending the park into the river. The setting of this reach of the river would be locally improved through the creation of a new area of high quality public realm including large species trees along the river frontage, behind a river wall clad with timber fenders. However, the change in setting would be broadly typical of the existing green frontage provided by King Edward Memorial Park, and the majority of the setting of this character area would remain unaffected. Therefore, the magnitude of change is considered to be low.

11.6.14 The low magnitude of change, assessed alongside the medium sensitivity of the character area, would result in **minor beneficial** effects.

Wapping Wall TCA

11.6.15 The proposed development would result in this character area being locally more closely linked with the river, through extending King Edward Memorial Park outwards. The immediate setting of King Edward Memorial Park would be improved due to the commitment to a high quality design (summarised in para. 11.2.6.) and the improvement of a number of components with the park, including the Thames Path. However, the majority of the wider character area would be largely unaffected by the proposed development. Therefore, the magnitude of change is considered to be low.

11.6.16 The low magnitude of change, assessed alongside the high sensitivity of the character area, would result in **minor beneficial** effects.

11.6.17 The assessment of specific effects on the setting of Wapping Wall Conservation Area as a heritage asset is set out in Section 7 of this volume.

Rotherhithe Street Residential TCA; and Rotherhithe Residential West TCA

11.6.18 The proposed development would improve part of the wider riverside setting of these character areas by strengthening the connectivity between the river and King Edward Memorial Park by extending the park into the river. The riverside setting would be locally improved through the creation of a new area of high quality public realm including large species trees along the river frontage, behind a river wall clad with timber fenders in keeping with the character of the surrounding townscape. However, the change in setting would be broadly typical of the existing green frontage provided by King Edward Memorial Park, and the majority of the riverside setting would remain unaffected. Therefore, the magnitude of change is considered to be low.

11.6.19 The low magnitude of change, assessed alongside the high and medium sensitivity of the character areas respectively, would result in **minor beneficial** effects.

Townscape – sensitivity test for programme delay

11.6.20 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 11.6.19). 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 11.4.60)

Visual assessment

11.6.21 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.

11.6.22 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 northeast from residences on Wapping High Street.

b. Viewpoint 1.4: View east from residences on Maynards Quay.

c. Viewpoint 2.6: View west from the Thames Path at the entrance to Limehouse Basin.

d. Viewpoint 2.8: View northeast from the Thames Path in King’s Stairs Gardens.

Residential

Viewpoint 1.1: View southwest from Free Trade Wharf on the eastern edge of King Edward Memorial Park; and Viewpoint 1.5: View northeast from residences on Trafalgar Court

11.6.23 Views from residences towards the site would be enhanced by the river wall around the foreshore structure, which would be designed to be in keeping with the character of the surrounding townscape, high quality ventilation columns, planting of large tree species and, from upper storeys, the high quality public realm. The new foreshore structure and ventilation columns would form distinctive components in the middle ground of the views. The view of the proposed development from Viewpoint 1.1 is illustrated in Vol 21 Plate 11.6.1 below. A larger scale print of the photomontage, including the wider context and annotations, is provided in Vol 21 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 21 Plate 11.6.1 Viewpoint 1.1 – illustrative operational phase photomontage

Date taken: 24 March 2011. 50mm lens.

11.6.24 The changes would generally be typical of the existing character of the views. Furthermore, the majority of the foreground of the views immediately in front of the residences and the majority of the views across the river would remain unaffected. Therefore, the magnitude of change is considered to be low.

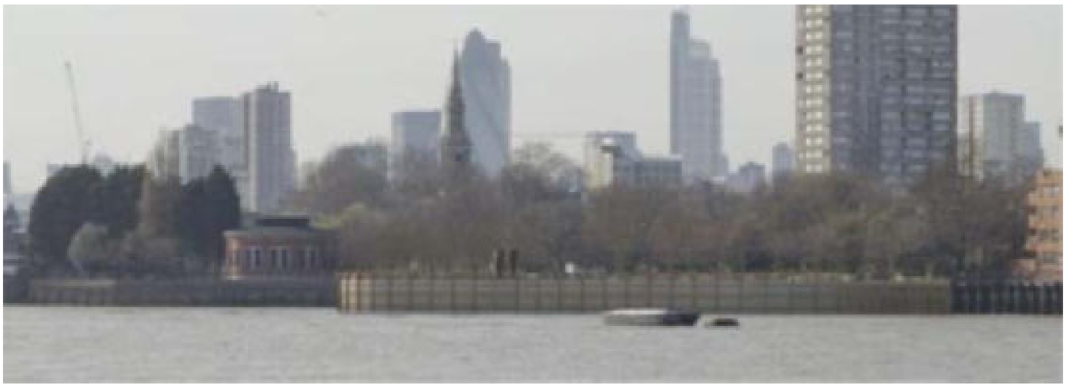
11.6.25 The low magnitude of change, assessed alongside the high sensitivity of these receptors, would result in **minor beneficial** effects during winter.

11.6.26 During summer, the visibility of the tree planting established as part of the scheme would be increased. However, the views of the majority of the foreshore structure and components of the proposed development would be unchanged. Therefore, the magnitude of change during summer would remain low, resulting in **minor beneficial** effects.

Viewpoint 1.2: View northwest from residences on Sovereign Crescent

11.6.27 Views from residences across the river towards the site would be enhanced to a limited extent by the design of the new river wall, in keeping with the surrounding townscape character, planting of large tree species and the high quality ventilation columns. The new foreshore structure and ventilation columns would form distinctive components in the view from the opposite side of the river. The view of the proposed development from this viewpoint is illustrated in Vol 21 Plate 11.6.2 below. A larger scale print of the photomontage, including the wider context and annotations, is provided in Vol 21 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 21 Plate 11.6.2 Viewpoint 1.2 – illustrative operational phase photomontage



Date taken: 24 March 2011. 50mm lens.

11.6.28 The changes would generally be typical of the existing character of the view. Furthermore, the majority of the view across the river would remain unaffected. Therefore, the magnitude of change is considered to be low.

11.6.29 The low magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **minor beneficial** effects during winter.

11.6.30 During summer, the visibility of the tree planting established as part of the scheme would be increased. However, the view of the majority of the foreshore structure and components of the proposed development would be unchanged. Therefore, the magnitude of change during summer would remain low, resulting in **minor beneficial** effects.

Recreational

Viewpoint 2.1: View northeast from the Thames Path close to the Rotherhithe Tunnel Air Shaft

11.6.31 Views from this location towards the site would be enhanced by the design of the new river wall around the new foreshore structure, in keeping with the surrounding townscape character, the high quality public realm and ventilation columns, and the planting of large tree species within the site. The new foreshore structure, area of new public realm and ventilation columns would form distinctive components in the foreground of the views. The view of the proposed development from this viewpoint is illustrated in Vol 21 Plate 11.6.3 below. A larger scale print of the photomontage, including the wider context and annotations, is provided in Vol 21 Figure 11.6.3 (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 21 Plate 11.6.3 Viewpoint 2.1 – illustrative operational phase photomontage

Date taken: 24 March 2011. 50mm lens.

11.6.32 The changes would generally be typical of the existing character of the view, although the park would be visibly extended into the river. Furthermore, existing elements of the view including memorial benches and the bandstand, would be reinstated. Therefore, the magnitude of change is considered to be medium.

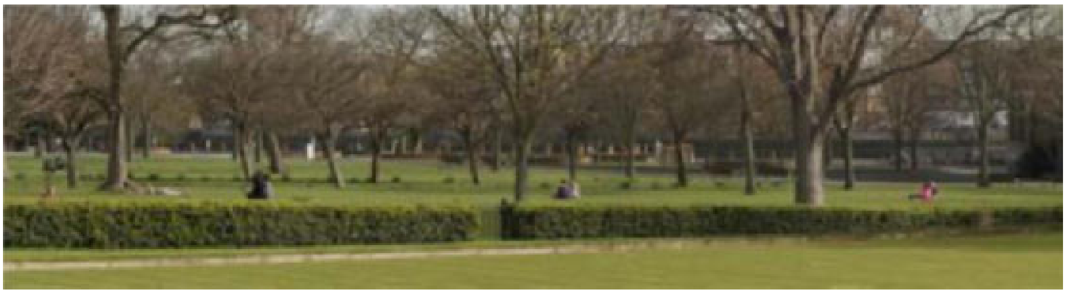
11.6.33 The medium magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **moderate beneficial** effects during winter.

11.6.34 During summer, the visibility of the tree planting established as part of the scheme would be increased. However, the views of the majority of the foreshore structure and components of the proposed development would be largely unchanged. Therefore, the magnitude of change during summer would remain medium, resulting in **moderate beneficial** effects.

Viewpoint 2.2: View southeast from close to the tennis courts in King Edward Memorial Park

11.6.35 Views from this location towards the site would be largely unchanged due to the components of the proposed development being located in the background of the view and obscured by intervening buildings and vegetation. The view of the proposed development from this viewpoint is illustrated in Vol 21 Plate 11.6.4 below. A larger scale print of the photomontage, including the wider context and annotations, is provided in Vol 21 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 21 Plate 11.6.4 Viewpoint 2.2 – illustrative operational phase photomontage



Date taken: 24 March 2011. 50mm lens.

11.6.36 Due to the limited visibility of the proposed development, the magnitude of change is considered to be negligible.

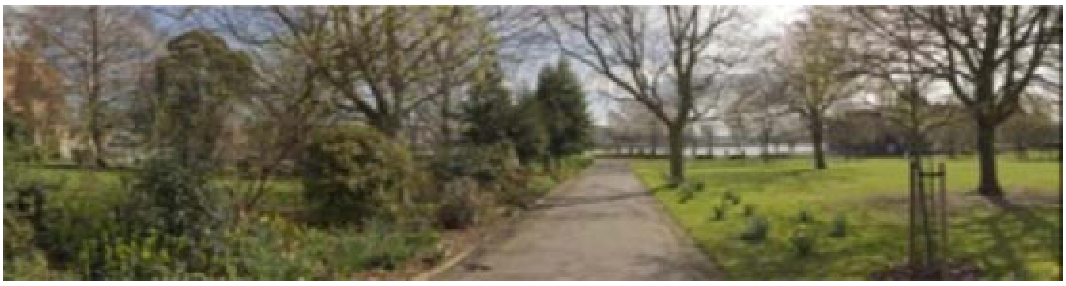
11.6.37 The negligible magnitude of change, assessed alongside the high sensitivity of the receptor, would result in a **negligible** effect during winter.

11.6.38 The assessment would be unchanged in summer.

Viewpoint 2.3: View southeast from the bowling green in King Edward Memorial Park; and Viewpoint 2.4: View south from the eastern side of King Edward Memorial Park

11.6.39 Views from these locations towards the site would be enhanced to a limited extent by the high quality design of the ventilation columns, although the structures would be partially screened by intervening planting within King Edward Memorial Park, and visibility of newly planted large tree species along the river frontage, extending the park into the river. The view of the proposed development from Viewpoint 2.4 is illustrated in Vol 21 Plate 11.6.5 below. A larger scale print of the photomontage, including the wider context and annotations, is provided in Vol 21 Figure 11.6.5 (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 21 Plate 11.6.5 Viewpoint 2.4 – illustrative operational phase photomontage



Date taken: 24 March 2011. 50mm lens.

11.6.40 Due to the limited visibility of some components of the proposed development, the magnitude of change is considered to be low.

11.6.41 The low magnitude of change, assessed alongside the high sensitivity of these receptors, would result in **minor beneficial** effects during winter.

11.6.42 During summer, the visibility of planting established as part of the scheme would be increased. However, the planting would remain characteristic of the wider views. Therefore, the magnitude of change during summer would remain low, resulting in **minor beneficial** effects.

Viewpoint 2.5: View southwest from the Thames Path outside Free Trade Wharf

11.6.43 Views this location would be enhanced to a limited extent by the design of the new river wall around the foreshore structure, in keeping with the surrounding townscape character, ventilation columns and tree planting. The new foreshore structure and ventilation columns would form components in the background of the view.

11.6.44 The changes would generally be typical of the existing character of the views. Furthermore, the foreground of the view immediately in front of Free Trade Wharf and wider views across the river would remain unaffected. Therefore, the magnitude of change is considered to be negligible.

11.6.45 The negligible magnitude of change, assessed alongside the high sensitivity of the receptor, would result in a **negligible** effect during winter.

11.6.46 During summer, the visibility of the tree planting established as part of the scheme would be increased. However, the views of the majority of the foreshore structure and components of the proposed development would be unchanged. Therefore, the magnitude of change during summer would remain negligible, resulting in a **negligible** effect.

Viewpoint 2.7: View north from the Thames Path outside the Old Salt Quay public house

11.6.47 Views from this location from the south, across the river towards the site would be enhanced to a limited extent by the design of the new river wall, in keeping with the surrounding townscape character, planting of large tree species and the high quality ventilation columns. The new foreshore structure and ventilation columns would form distinctive components in the view of the opposite side of the river. This is reflected in the photomontage shown in Vol 21 Figure 11.6.2 (see separate volume of figures).

11.6.48 The changes would generally be typical of the existing character of the view. Furthermore, the majority of the view across the river would remain unaffected. Therefore, the magnitude of change is considered to be low.

11.6.49 The low magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **minor beneficial** effects during winter.

11.6.50 During summer, the visibility of the tree planting established as part of the scheme would be increased. However, the view of the majority of the foreshore structure and components of the proposed development would be unchanged. Therefore, the magnitude of change during summer would remain low, resulting in **minor beneficial** effects.

Visual effects – sensitivity test for programme delay

11.6.51 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. 11.6.22 to 11.6.50). 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. 11.4.62 to 11.4.99.

Operational effects Year 15

11.6.52 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 King Edward Memorial Park.

11.6.53 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

11.6.54 With the exception of Viewpoints 1.1 and 1.5 (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

Residential

Viewpoint 1.1: View southwest from Free Trade Wharf on the eastern edge of King Edward Memorial Park; and Viewpoint 1.5: View northeast from residences on Trafalgar Court

11.6.55 In Year 15, the trees planted along the river frontage would have matured further, strengthening the green character of King Edward Memorial Park in the middle ground of the views, extending into the river. Therefore, the magnitude of change would be considered to be medium.

11.6.56 The medium magnitude of change, assessed alongside the high sensitivity of these receptors, would result in **moderate beneficial** effects.

11.6.57 The assessment described above 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

11.7.1 As detailed in the site development schedule (Vol 21 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 of the measures embedded in the proposed scheme and *CoCP* of relevance to the townscape and visual assessment are summarised in Section 11.2.

11.8.2 Effects on viewpoint 2.3 and 2.4 during construction could be reduced through undertaking advanced tree planting within King Edward Memorial Park along existing avenues and pathways. However, agreement to undertake advanced planting at this location has not been gained with the local authority and land owner.

11.8.3 No mitigation is required during operation as all effects are assessed to be negligible or beneficial. However, if the advanced tree planting were to be undertaken as described above, this would have semi-matured by Year 1 of operation, further enhancing the view from viewpoints 2.3 and 2.4, and introducing components that would also enhance the view from viewpoint 2.2

11.9 Residual effects assessment

Construction effects

11.9.1 Taking into account the mitigation measures described in Section 11.8, the assessment of construction effects would be altered for viewpoint 2.3 and viewpoint 2.4 (described below). The assessment of effects on all other receptors would remain unchanged.

Viewpoint 2.3: View southeast from the bowling green in King Edward Memorial Park; and Viewpoint 2.4: View south from the eastern side of King Edward Memorial Park

11.9.2 Advance planting within King Edward Memorial Park would be visible in the foreground of the view from these locations, further obscuring views of site hoardings, construction activity and construction plant. Therefore, the magnitude of change, taking into account the mitigation measures described in Section 11.8, the magnitude of change is considered to be low.

11.9.3 The low magnitude of change, assessed alongside the high sensitivity of these receptors, would result in **minor adverse** effects.

Operational effects

11.9.4 Taking into account the mitigation measures described in Section 11.8, the assessment of operational effects would be altered for viewpoint 2.2, 2.3 and viewpoint 2.4 (described below). The assessment of effects on all other receptors would remain unchanged.

Viewpoint 2.2: View southeast from close to the tennis courts in King Edward Memorial Park

11.9.5 Advance planting within King Edward Memorial Park would be visible in the middle ground of the view from this location, introducing new components into the view, improving the character of view across the park to a limited extent. Therefore, the magnitude of change is considered to be low.

11.9.6 The low magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **minor beneficial** effects during winter.

11.9.7 During summer, the visibility of planting established as part of the scheme would be increased. However, the planting would remain characteristic of the wider views. Therefore, the magnitude of change during summer would remain low, resulting in **minor beneficial** effects.

Viewpoint 2.3: View southeast from the bowling green in King Edward Memorial Park; and Viewpoint 2.4: View south from the eastern side of King Edward Memorial Park

11.9.8 Advance planting within King Edward Memorial Park would be visible in the foreground of the view from these locations, introducing further new components that would improve the character of the views over the park. The planting, which would be established prior to construction, would have semi-matured by Year 1 of operation, and would therefore noticeably improve the existing view in addition to the improvements at the main site. Therefore, the magnitude of change is considered to be medium.

11.9.9 The medium magnitude of change, assessed alongside the high sensitivity of these receptors, would result in **moderate beneficial** effects in winter.

11.9.10 During summer, the visibility of planting established as part of the scheme would be increased. However, the planting would remain characteristic of the wider views. Therefore, the magnitude of change during summer would remain medium, resulting in **moderate beneficial** effects.

11.10 Assessment summary

Vol 21 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 the partial removal of the river wall, removal of vegetation and street furniture, erection of site hoardings, construction access along the river frontage and construction activity.	Major adverse	No mitigation possible	Major adverse
River Thames – East London Reach TCA	Change to setting due to the presence of high levels of construction activity in front of the green frontage of King Edward Memorial Park Foreshore.	Moderate adverse	No mitigation possible	Moderate adverse
Wapping Wall TCA	Change to part of the areas riverside setting due to the presence of construction activity, site hoardings, the temporary cofferdam and road transport along the frontage of the park, partially reduced through the use of climbing plants on the hoardings.	Moderate adverse	No mitigation possible	Moderate adverse
Shadwell Residential North TCA	Change to part of the areas riverside setting due to the presence of tall construction plant and cranes.	Minor adverse	None	Minor adverse
Narrow Street Conservation Area TCA	No significant change in setting.	Negligible	None	Negligible
Rotherhithe Street Residential TCA	Change to part of the riverside setting due to the presence of the temporary cofferdam, construction plant, ongoing construction activity and road transport along the frontage of the park.	Moderate adverse	No mitigation possible	Moderate adverse

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Rotherhithe Residential West TCA	Change to wider riverside setting due to the presence of the temporary cofferdam, construction plant, ongoing construction activity and road transport along the frontage of the park.	Minor adverse	None	Minor adverse
King's Stairs Gardens TCA	Change to wider riverside setting due to the presence of the temporary cofferdam, construction plant, ongoing construction activity and road transport along the frontage of the park.	Minor adverse	None	Minor adverse

Vol 21 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 Free Trade Wharf on the eastern edge of King Edward Memorial Park	Visibility of the temporary cofferdam, construction activity, construction plant and site hoardings. Filtered visibility of welfare facilities	Major adverse	No mitigation possible	Major adverse
Viewpoint 1.2: View northwest from residences on Sovereign Crescent	Visibility of the temporary cofferdam, construction activity, construction plant and removal of trees.	Moderate adverse	No mitigation possible	Moderate adverse
Viewpoint 1.3: View northeast from residences on Wapping High Street	Oblique visibility of the temporary cofferdam, site hoardings, tall construction plant and cranes.	Minor adverse	None	Minor adverse
Viewpoint 1.4: View east from residences on Maynards Quay	Intermittent visibility of tall construction plant and cranes.	Negligible	None	Negligible
Viewpoint 1.5: View northeast from residences on Trafalgar Court	Visibility of the temporary cofferdam, construction activity, construction plant and	Moderate adverse	No mitigation	Moderate adverse

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
	site hoardings, partially screened by mature tree planting within the park.		possible	
Recreational				
Viewpoint 2.1: View northeast from the Thames Path close to the Rotherhithe Tunnel Air Shaft	Foreground visibility of the temporary cofferdam, site hoardings, construction plant, ongoing construction activity and traffic through the park.	Major adverse	No mitigation possible	Major adverse
Viewpoint 2.2: View southeast from close to the tennis courts in King Edward Memorial Park	Background visibility of construction activity, tall construction plant and welfare facilities, partially screened by intervening vegetation and buildings.	Minor adverse	None	Minor adverse
Viewpoint 2.3: View southeast from the bowling green in King Edward Memorial Park	Background visibility of site hoardings (covered by climbing plants), construction activity, construction plant and traffic.	Moderate adverse	Advance planting within the park	Minor adverse
Viewpoint 2.4: View south from the eastern side of King Edward Memorial Park	Background visibility of site hoardings (covered by climbing plants), construction activity, construction plant and traffic.	Moderate adverse	Advance planting within the park	Minor adverse
Viewpoint 2.5: View southwest from the Thames Path outside Free Trade Wharf	Visibility of the temporary cofferdam, construction activity, construction plant and traffic through the park.	Moderate adverse	No mitigation possible	Moderate adverse
Viewpoint 2.6: View west from the Thames Path at the entrance to Limehouse Basin	Background visibility of the temporary cofferdam, tall construction plant and cranes.	Minor adverse	None	Minor adverse
Viewpoint 2.7: View north from the	Visibility of the temporary cofferdam,	Moderate	No	Moderate

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Thames Path outside the Old Salt Quay public house	construction activity, construction plant and removal of trees.	adverse	mitigation possible	adverse
Viewpoint 2.8: View north-east from the Thames Path in King's Stairs Gardens	Oblique visibility of the site cofferdam, construction activity and construction plant at King Edward Memorial Park Foreshore and Chambers Wharf	Minor adverse	None	Minor adverse

Vol 21 Table 11.10.3 Townscape – summary of Year 1 and Year 15 operational assessment[ii]

Receptor[iii]	Effect	Significance of effect	Mitigation	Significance of residual effect
The site	Change in character through the introduction of new area of high quality public realm, high quality ventilation structures, a widened Thames Path, new children's playground and replacement planting.	Moderate beneficial	None	Moderate beneficial
River Thames – East London Reach TCA	Improvement to setting through the creation of a new area of public realm including large species of tree along the park's river frontage.	Minor beneficial	None	Minor beneficial
Wapping Wall TCA	Improvement to the local setting of part of this area through the creation of a high quality area of public realm and ventilation structures.	Minor beneficial	None	Minor beneficial
Rotherhithe Street Residential TCA	Improvement to wider riverside setting through the creation of a new area of high quality public realm	Minor beneficial	None	Minor beneficial

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[ii] Operational effects have been assessed to be the same in both Year 1 and Year 15 of operation

[iii] Townscape character areas not assessed during operation (refer to para. 11.6.12) are not included in the summary table

Receptor[iii]	Effect	Significance of effect	Mitigation	Significance of residual effect
	incorporating large species of tree along the river frontage.			
Rotherhithe Residential West TCA	Improvement to wider riverside setting through the creation of a new area of high quality public realm incorporating large species of tree along the river frontage.	Minor beneficial	None	Minor beneficial

Vol 21 Table 11.10.4 Visual – summary of Year 1 operational assessment

Receptor[iv]	Effect	Significance of effect	Mitigation	Significance of residual effect
Residential				
Viewpoint 1.1: View southwest from Free Trade Wharf on the eastern edge of King Edward Memorial Park	Visibility of the new river wall, ventilation columns, tree planting and, from upper storeys, high quality public realm.	Winter – Minor beneficial	Winter – None	Winter – Minor beneficial
		Summer – Minor beneficial	Summer – None	Summer – Minor beneficial
Viewpoint 1.2: View northwest from residences on Sovereign Crescent	Visibility of the new river wall, ventilation columns and tree planting.	Winter – Minor beneficial	Winter – None	Winter – Minor beneficial
		Summer – Minor beneficial	Summer – None	Summer – Minor beneficial
Viewpoint 1.5: View northeast from residences on Trafalgar	Visibility of the new river wall, ventilation columns,	Winter – Minor beneficial	Winter – None	Winter – Minor beneficial

[iv] Viewpoints not assessed during operation (refer to para. 11.6.22) are not included in the summary table

Receptor[iv]	Effect	Significance of effect	Mitigation	Significance of residual effect
Court	tree planting and, from upper storeys, high quality public realm.	Summer – Minor beneficial	Summer – None	Summer – Minor beneficial
Recreational				
Viewpoint 2.1: View northeast from the Thames Path close to the Rotherhithe Tunnel Air Shaft	Visibility of the new river wall, public realm, ventilation columns and tree planting.	Winter – Moderate beneficial	Winter – None	Winter – Moderate beneficial
		Summer – Moderate beneficial	Summer – None	Summer – Moderate beneficial
Viewpoint 2.2: View southeast from close to the tennis courts in King Edward Memorial Park	No significant effects.	Winter – Negligible	Advance planting within the park (proposed to mitigate construction effects)	Winter – Minor beneficial
		Summer – Negligible		Summer – Minor beneficial
Viewpoint 2.3: View southeast from the bowling green in King Edward Memorial Park	Filtered visibility of the ventilation columns and new tree planting.	Winter – Minor beneficial	Advance planting within the park (proposed to mitigate construction effects)	Winter – Moderate beneficial
		Summer – Minor beneficial		Summer – Moderate beneficial
Viewpoint 2.4: View south from the eastern side of King Edward Memorial Park	Filtered visibility of the ventilation columns and new tree planting.	Winter – Minor beneficial	Advance planting within the park (proposed to mitigate construction effects)	Winter – Moderate beneficial
		Summer – Minor beneficial		Summer – Moderate

Receptor[iv]	Effect	Significance of effect	Mitigation	Significance of residual effect
				beneficial
Viewpoint 2.5: View southwest from the Thames Path outside Free Trade Wharf	Background visibility the river wall, ventilation columns and tree planting	Winter – Negligible	Winter – None	Winter – Negligible
		Summer – Negligible	Summer – None	Summer – Negligible
Viewpoint 2.7: View north from the Thames Path outside the Old Salt Quay public house	Visibility of the new river wall, ventilation columns and tree planting in the middle ground of the view.	Winter – Minor beneficial	Winter – None	Winter – Minor beneficial
		Summer – Minor beneficial	Summer – None	Summer – Minor beneficial

Vol 21 Table 11.10.5 Visual – summary of Year 15 operational assessment

Receptor[v]	Effect	Significance of effect	Mitigation	Significance of residual effect
Residential				
Viewpoint 1.1: View southwest from Free Trade Wharf on the eastern edge of King Edward Memorial Park	Visibility of matured trees along the river frontage of King Edward Memorial Park.	Winter – Moderate beneficial	Winter – None	Winter – Moderate beneficial
Viewpoint 1.5: View northeast from residences on Trafalgar Court	Visibility of matured trees along the river frontage of King Edward Memorial Park.	Winter – Moderate beneficial	Winter – None	Winter – Moderate beneficial

[v] Only viewpoints where the assessment differs in Year 15 compared to Year 1 are included in the summary table

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] London Borough of Tower Hamlets. *LDF Core Strategy* (September 2010).

[3] London Borough of Tower Hamlets, *UDP Interim Planning Guidance* (October 2007).

[4] London Borough of Southwark. *LDF Core Strategy* (April 2011).

[5] London Borough of Tower Hamlets. *Wapping Wall Conservation Area Character Appraisal and Management Guidelines* (February 2007).

[6] London Borough of Tower Hamlets. *St Paul's Shadwell Conservation Area Character Appraisal and Management Guidelines* (March 2007).

[7] London Borough of Tower Hamlets. *Narrow Street Conservation Area Character Appraisal and Management Guidelines* (November 2009).

[8] 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: **6.2.21**

Volume 21: King Edward Memorial Park Foreshore site assessment

Section 12: Transport

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

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Environmental Statement

Volume 21: King Edward Memorial Park Foreshore 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 King Edward Memorial Park Foreshore 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 has the potential to affect the following transport elements:

a. pedestrian routes

b. cycle routes

c. bus routes and patronage

d. Docklands Light Railway, London Overground and National Rail services

e. river passenger services and river navigation

f. car parking

g. highway layout, operation and capacity.

12.1.3 The assessment considers effects on each of these elements during construction, as well as effects on specific receptors including residents, park users and users of nearby commercial properties.

12.1.4 The operation of the King Edward Memorial Park Foreshore 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 section 4.3 (Defra, 2012)[1]. Further details of these requirements can be found in Volume 2 Environmental assessment methodology 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 King Edward Memorial Park Foreshore 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 21 King Edward Memorial Park Foreshore site 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 of this volume 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 King Edward Memorial Park Foreshore site would be located on the river frontage of King Edward Memorial Park south of The Highway (A1203). Vehicle access to and from the site would take place from Glamis Road.

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 this site and other Thames Tideway Tunnel construction sites with construction routes along The Highway (A1203), pedestrian and cycle diversions in the vicinity and temporary restriction of car parking on Glamis Road.

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 21 Table 12.2.1.

Vol 21 Table 12.2.1 Transport - construction details

Description	Assumption
Assumed peak period of construction lorry movements	Site Year 1 of construction
Assumed average peak daily construction lorry vehicle movements (in peak month of Site Year 1 of construction)	82 movements per day (41 vehicle trips)
Assumed peak period of construction barge movements	Site Year 3 of construction
Assumed average peak daily construction barge movements (in peak month of Site Year 3 of construction)	4 movements per day (2 barge trips)
Typical types of lorry requiring access (comprising rigid-bodied, flatbed and articulated vehicles)	Excavation lorries Temporary construction material lorries Ready mix concrete lorries Plant and equipment lorries

Description	Assumption
	Steel reinforcement lorries Imported fill lorries Office/general delivery lorries Grout/materials 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 cofferdam fill (both import and export) and excavated material from the combined sewer overflow (CSO) drop shaft and other excavations would be transported 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 Vehicle movements would 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 London Borough (LB) of Tower Hamlets.

Construction traffic routing

12.2.7 The hoarded area of the King Edward Memorial Park Foreshore site would be accessed from Glamis Road, a local road that connects to The Highway (A1203) at a signalised junction. The Highway (A1203) forms part of the Transport for London Road Network (TLRN). The northern end of Glamis Road is included within the limits of land to be acquired or used (LLAU) (the full site boundary) to enable the junction improvement works.

12.2.8 The construction routing for all phases at the King Edward Memorial Park Foreshore site would use the TLRN, approaching the site from the direction of Commercial Road (A13) and Butcher Row to the northeast. Vehicles departing would return in the same direction. Vehicle access would be arranged on a ‘left in, right out’ basis. All vehicles would arrive at and depart from the site via the junction with Glamis Road / The Highway (A1203).

12.2.9 The main part of the construction site would be located on the foreshore of the River Thames. Vehicle access to and from the main part of the site would take place from Glamis Road via a new permanent vehicle route between Glamis Road and the site through the southern end of the sports pitch and King Edward Memorial Park.

12.2.10 The Access plan and Highway layout during construction plan (see separate volume of figures – Section 1) present the highway layout during construction.

12.2.11 Vol 21 Figure 12.2.1 (see separate volume of figures) shows the construction traffic routes for access to/from the King Edward Memorial

Parksite. Construction routes have been discussed with both Transport for London (TfL) and the Local Highway Authority (LHA), LB of Tower Hamlets for the purposes of the assessment.

Construction workers

12.2.12 The construction site is expected to require a maximum workforce of approximately 40 workers at any one time. The number and type of workers is shown in Vol 21 Table 12.2.2.

Vol 21 Table 12.2.2 Transport – maximum estimated construction worker numbers

Contractor		Client
Staff*	**Labour****	**Staff*****
08:00-18:00	**08:00-18:00**	**08:00-18:00**
15	20	5

** Contractor Staff – engineering and support staff brought in to project manage the engineering work and site.*
***Labour – those working on site doing engineering, construction and manual work.*
**** Client Staff – engineering and support staff managing the project and supervising the Contractor*

12.2.13 At the King Edward Memorial Park Foreshore site there would be no parking provided within the site boundary for workers. As parking on surrounding streets is also restricted, and measures to reduce car use would be incorporated into site-specific *Travel Plan* requirements (in accordance with the overall aims and objectives of the *Draft Project Framework Travel Plan* which accompanies the application), it is highly unlikely that workers would travel by car. It is therefore assumed that construction workers would access the site by other modes of transport, further details of which are provided in Vol 21 Table 12.5.1.

Code of Construction Practice

12.2.14 Measures incorporated into the *Code of construction practice (CoCP)*[i] Part A (Section 5) to reduce transport impacts 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, diversion or temporary closure 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

[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).

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.

12.2.15 In addition to the general measures within the *CoCP Part A* (Section 5) the following measures have been incorporated into the *CoCP Part B* (Section 5):

a. the site access would be only via Glamis Road from The Highway (A1203). Access to the site would be from the north with left turn into the site and right turn out

b. the security barrier would be positioned to allow a standard rigid tipper vehicle to be wholly off the road whilst awaiting barrier operation

c. a gated crossing would be provided in King Edward Memorial Park to enable the realigned Thames Path to cross the new access road. The gates would only be closed during vehicle movements. A traffic marshal would be deployed to ensure the safe movement of vehicles and public crossing

d. the new site access road to the east of the existing playground between the football pitch/maintenance area and the foreshore would be a single lane only with appropriate traffic control

e. areas of parking suspension would be confirmed with the LB of Tower Hamlets

f. adequate advance notice and signage would be provided for the diversion of the Thames Path.

12.2.16 The effective implementation of the *CoCP* Part A and Part B Section 5 measures is assumed within the assessment.

12.2.17 Based on current travel planning guidance including TfL's *Travel planning for new development in London* (TfL, 2011)[2] this development lies within the threshold for producing a Strategic Framework Travel Plan. A *Draft Project Framework Travel Plan*, which accompanies the application, has been prepared based on the TfL ATTrBuTE guidance (TfL, 2011)[3]. The *Draft Project Framework Travel Plan* addresses project-wide travel planning measures, including the need for a 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 King Edward Memorial Park Foreshore site

b. a mode split established for the King Edward Memorial Park Foreshore 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 responsibility for managing the *Travel plan* monitoring and action plans specifically for this site.

Other measures during construction

12.2.18 Embedded design measures which are not outlined in the *CoCP* but are of relevance to the transport assessment at the King Edward Memorial Park Foreshore site include the following:

a. relocation of the cycle advance area and stop line on Glamis Road on the northbound arm of the junction with The Highway (A1203)

b. adjustment of existing crossover on Glamis Way at proposed site access.

Operation

12.2.19 During operation, maintenance vehicles would enter the site from Glamis Road at the site access established for construction, as set out in the King Edward Memorial Park Foreshore design principles (see *Design Principles* report Section 4.17 in Vol 1 Appendix B). Access would be required for a light commercial vehicle on a three to six monthly maintenance schedule.

12.2.20 Additionally there would be more substantive maintenance visits at approximately ten year intervals requiring access to enable two mobile cranes and associated support vehicles to be brought to the site and which may require temporary restriction of 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 21 Table 12.3.1.

12.3.2 It is noted that it was reported in the *Scoping Report* (Thames Water, 2011)[4] 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 21 Table 12.3.1 Transport - stakeholder engagement

Organisation	Comment	Response
LB of Tower Hamlets, phase two consultation, February 2012	The plans showing the future access across the Park to the completed machinery and shaft at the foreshore are not very detailed, and concerns are that it will run parallel to the old route of the Council maintained footpath from Glamis Road to the existing listed shaft in the park leading down to the Rotherhithe Tunnel.	Further discussions will be necessary to agree the path's future status and management. This will be determined at a future date through a development consent order (DCO) requirement and in consultation with stakeholders.
LB of Tower Hamlets, phase two consultation, February 2012	On-street parking in Glamis Road up to the point of access would most likely need to be suspended.	Some on-street parking would need to be temporarily restricted on Glamis Road to ensure the construction vehicles have enough manoeuvring space to access the site. This is described in Section 12.5.
LB of Tower Hamlets, phase two consultation, February 2012	Physical changes to The Highway/Glamis Road junction and more traffic on the junction will prevent free-flow of traffic on Glamis Road.	The only change to the junction would be to relocate the stop line on the southern arm of Glamis Road. Junction modelling shows The Highway (A1203) arms are already over capacity, while delays would be slightly increased on Glamis Road only (see Section 12.5).
LB of Tower Hamlets, phase two consultation, February 2012	The Council is opposed to the selection of the King Edward Memorial Park Foreshore option as the preferred site.	The relative impacts of the site options relating to transport and traffic were taken into consideration in site selection.
LB of Tower Hamlets, phase two consultation, February 2012	Clarification on the number of lorry and barge movements is needed.	There would be approximately 41 two-way construction vehicle trips and two two-way barge trips at this site per day.
LB of Tower Hamlets, phase two consultation,	The interaction of construction traffic with existing traffic on The Highway will cause	Local modelling has been undertaken to demonstrate how the proposed flows would affect operation of

Organisation	Comment	Response
February 2012	congestion throughout the day. The need for lorries to make right turns from Glamis Road into the Highway would mean additional delays to traffic on The Highway are likely, particularly if vehicles are blocking traffic while they are queuing to turn.	this junction. This is reported in Section 12.5.
Transport for London, phase two consultation, February 2012	The impact of construction vehicles on the bus services and facilities on Glamis Road must be investigated.	The impacts on bus services have been considered in the assessment. Results are reported in Section 12.5.
Transport for London phase two consultation, February 2012	The possibility of achieving operational access by river should be investigated.	The operational access is infrequent and controlled. There are considerable logistic issues with undertaking access by river for routine and major inspection access. It is therefore assumed that maintenance access would be by road.
Transport for London, interim consultation, February 2012	Consider reconfiguration of Glamis Road arm of junction with The Highway so that construction vehicles left turning into Glamis Road do not conflict with vehicles queuing at the stop line.	The design relocates the southern arm stop line of Glamis Road further south to address this issue.
Transport for London, consultation workshop, June 2011	The impact of construction vehicles on the parking bays on Glamis Road must be investigated.	Impacts on the parking bays in Glamis Road have been considered in the assessment. Results are reported in Section 12.5.
Transport for London, consultation workshop, June 2011	Use of Limehouse Link and/or Blackwall Tunnel as HGV routes may not be possible due to height / weight restrictions. Use of A13 would be preferred route for HGVs.	The assessment is based on construction vehicles using the A13 as the principal construction route to/from the site instead of the Limehouse Link or Blackwall Tunnel.
LB of Tower Hamlets, scoping	Clarification is required of whether materials associated	Movement of material to and from construction sites

Organisation	Comment	Response
response, April 2011	with construction of connection tunnels and chambers will be included within the assessment of each construction site.	is assessed and this includes materials related to connection chambers and other near surface structures.
LB of Tower Hamlets, scoping response, April 2011	An appropriate computer based road traffic modelling package should be agreed with the LB of Tower Hamlets Highways team.	Agreement of a modelling methodology has been reached with TfL and LB of Tower Hamlets and the assessment has been undertaken using this methodology.

Baseline

12.3.3 The baseline methodology follows the methodology described in Vol 2 Section 12. 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 Section 12. 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 sites on the area surrounding the King Edward Memorial Park Foreshore site has been taken into account within the assessment of the peak year of construction at this site.

12.3.6 As indicated in the Development Schedule (see Vol 21 Appendix N) the two other developments identified within 1km of the King Edward Memorial Park Foreshore site (John Bell House and development on the land bounded by Schoolhouse Lane, Cable Street and Glasshouse Fields) would be complete and operational by Site Year 1 of construction and are therefore included in the construction base case. The TfL Highway Assignment Models (HAMs) 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* (GLA, 2011)[5]. As a result the assessment inherently takes into account a level of future growth and development across London. There are no construction cumulative effects requiring assessment.

Construction assessment area

12.3.7 The assessment area for the King Edward Memorial Park Foreshore site includes the proposed site access directly from Glamis Road and the signalised junction of Glamis Road with The Highway (A1203).

12.3.8 These roads and junctions have been assessed for highway, cycle and pedestrian impacts. The Thames Path has been included within the assessment as its current daytime route would need to be diverted around the proposed 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].

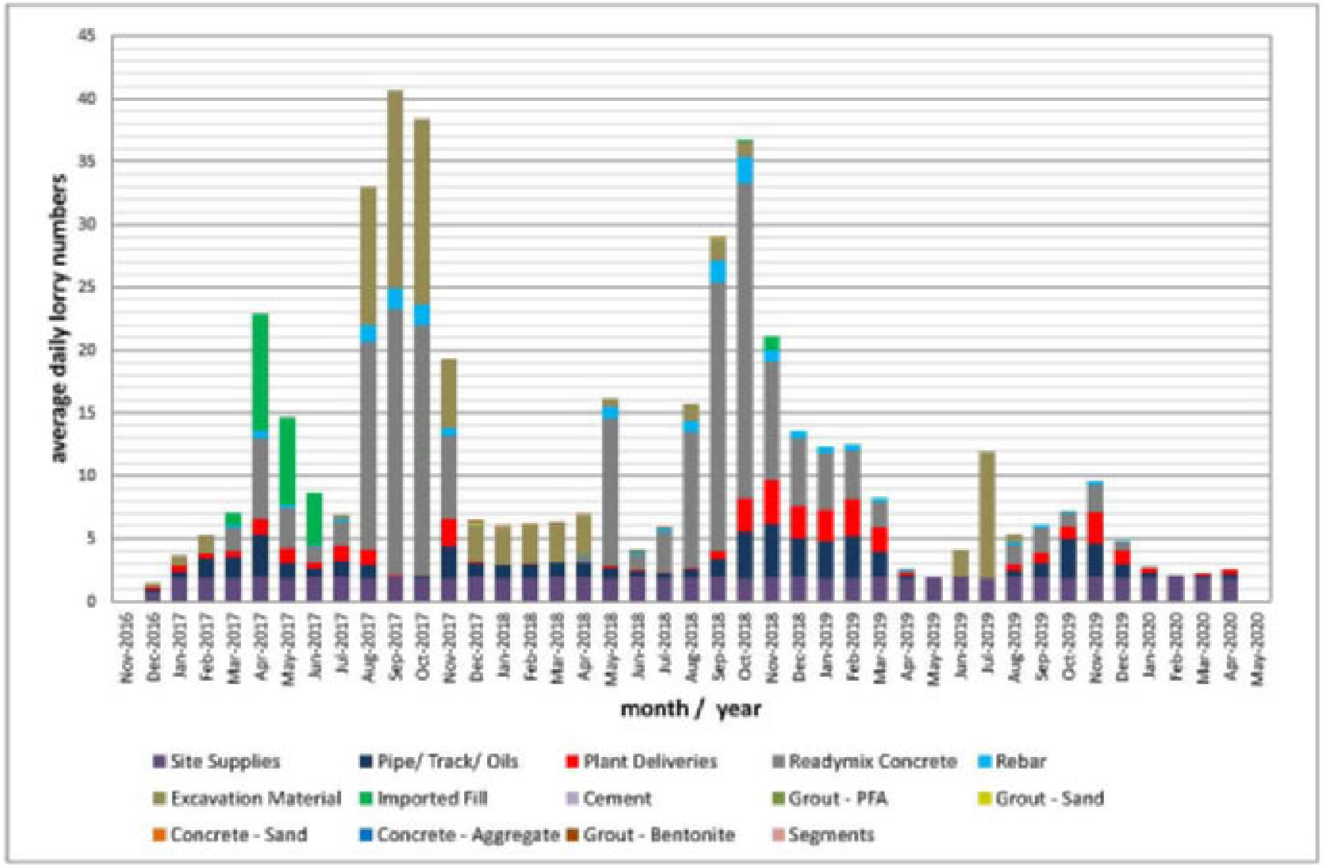
Construction assessment years

12.3.9 Site-specific peak construction assessment years have been identified for this site. The histograms in Vol 21 Plate 12.3.1 and Vol 21 Plate 12.3.2 show that the peak site-specific activity at the King Edward Memorial Park Foreshore site would occur in Site Year 1 of construction for construction road traffic and Site Year 3 for construction for construction river traffic (associated with the removal of cofferdam fill).

12.3.10 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.

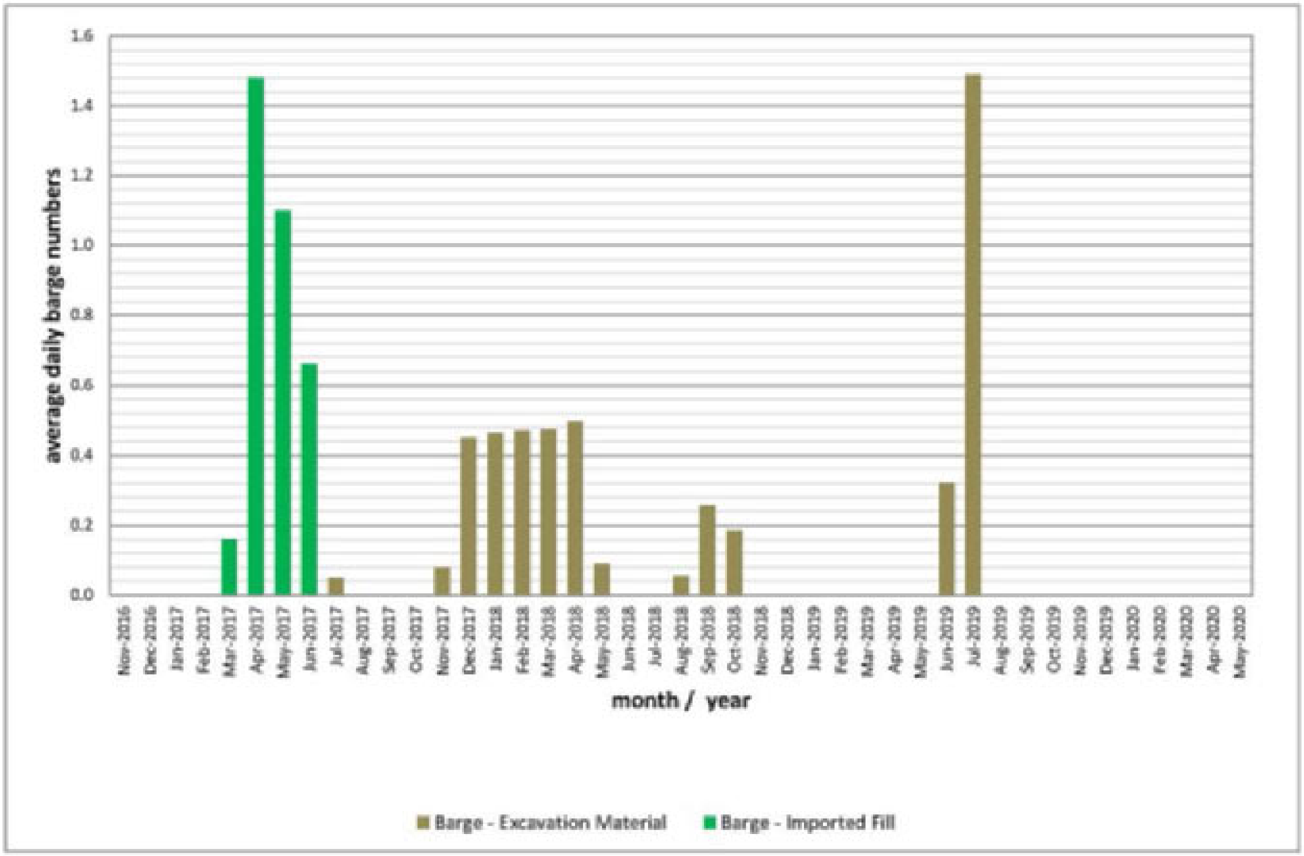
[ii] Distances derived from the Public Transport Accessibility Level (PTAL) methodology described in Vol 2 Section 12.

Vol 21 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 21 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

12.3.11 The assessment methodology for the operational phase follows that described in Vol 2 Section 12. There are no site-specific variations for undertaking the operational assessment of this site.

12.3.12 Once the Thames Tideway Tunnel is operational it is not anticipated that there would be any significant effects on the transport infrastructure and operation within the local area because maintenance trips to the operational site would be infrequent and short-term. However, the physical aspects of access to the site for maintenance have been considered in relation to:

a. car parking

b. highway layout and operation.

12.3.13 These elements are considered qualitatively (as described in Vol 2 Section 12) because the minimal effect on the highway network means that a quantitative assessment is not required. The scope of this analysis has been discussed with the LB of Tower Hamlets and TfL.

12.3.14 Also, given the local impact of the transport activity associated with the Thames Tideway Tunnel during the operational phase, only the localised transport effects around the King Edward Memorial Park Foreshore site are assessed. Other Thames Tideway Tunnel sites would not affect the area around the site in the operational phase and therefore they are not considered in this assessment.

12.3.15 With regard to other developments in the vicinity of the site (as detailed in Vol 21 Appendix N), the two developments would be complete and operational by Year 1 of operation. As a result these developments 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

12.3.16 The assessment area for the operational assessment remains the same as for the construction assessment as set out in paras. 12.3.7 and 12.3.8.

Operational assessment year

12.3.17 As outlined in Vol 2 Section 12 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.

12.3.18 As with construction, 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 (and hence opening year) be delayed by approximately one year.

Assumptions and limitations

12.3.19 The general assumptions and limitations associated with this assessment are presented in Vol 2 Section 12.

Assumptions

12.3.20 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 maintenance) to ensure the effective operation of the highway network and respond to changes in traffic conditions.

12.3.21 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 King Edward Memorial Park Foreshore site, it is assumed that there would be one hazardous load per fortnight generated by the site.

12.3.22 With regard to construction workers travelling to the site it is assumed that no construction workers would drive to the site, as set out in para. 12.5.3.

Limitations

12.3.23 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 on the foreshore adjacent to and south of King Edward Memorial Park in the LB of Tower Hamlets as shown in Vol 21 Figure 12.4.1 (see separate volume of figures).

12.4.3 There is an existing vehicular access in the south-west corner of the Park via Glamis Road which is used to access a maintenance storage area. There is also a vehicle access point at the north end of Glamis Road.

Pedestrian routes

12.4.4 The existing pedestrian network and facilities in the vicinity of the site are shown in Vol 21 Figure 12.4.2 (see separate volume of figures). The Thames Path provides a continuous east-west link for pedestrians along the north bank of the River Thames. The Thames Path routes through the Park along the riverside footway. The Park is closed at night and Thames Path users are diverted via The Highway (A1203) and Glamis Road.

12.4.5 There are a number of designated pedestrian paths within King Edward Memorial Park that link the entrance points and the riverside footway.

12.4.6 There are footways located on both sides of The Highway (A1203) and Glamis Road varying in width from 1.9m to 2.4m on Glamis Road and between 3.7m and 4.4m on The Highway (A1203). Pedestrian crossing facilities are incorporated into the signalised junction of The Highway

(A1203) with Glamis Road. The signal timings operate with an all-red pedestrian phase in each signal cycle which provides pedestrians with a period of safe crossing by stopping all traffic.

12.4.7 There is also a signalised pedestrian crossing with a staggered pedestrian refuge approximately 200m walking distance east of The Highway (A1203) / Glamis Road signalised junction.

Cycle facilities and routes

12.4.8 The existing cycle network and facilities in the vicinity of the site are shown in Vol 21 Figure 12.4.2 (see separate volume of figures).

12.4.9 A designated London Cycle Route runs north and south along Glamis Road and then continues east and west along Cable Street. The crossroads junction formed by Glamis Road and The Highway (A1203) has advanced cycle stop line facilities on the Glamis Road arms.

12.4.10 London Cycle Routes 1 and 4 are also within close proximity of the King Edward Memorial Park Foreshore site.

12.4.11 The closest Cycle Superhighway to the site is CS3 which routes between Tower Gateway and Barking. CS3 routes along Cable Street which is approximately 270m walking distance to the north of the site access on Glamis Road.

12.4.12 Two cycle stands are located within the southern footway of Wapping Road at the Wapping Rail Station approximately 650m walking distance to the southwest of the site.

12.4.13 The closest cycle hire docking station is located on Garnet Street (Shadwell) approximately 620m walking distance or under eight minutes walking time to the east of the site which accommodates 23 bicycles.

Public Transport Accessibility Level

12.4.14 The Public Transport Accessibility Level (PTAL) of the site has been calculated using TfL's approved PTAL methodology (TfL, 2010)[6] 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).

12.4.15 Using this methodology the site has a PTAL rating of 3, rated as 'moderate' (with 1a being the lowest accessibility and 6b being the highest accessibility).

12.4.16 Vol 21 Figure 12.4.3 (see separate volume of figures) shows the public transport network around the King Edward Memorial Park Foreshore site.

Bus routes

12.4.17 As shown in Vol 21 Figure 12.4.3 (see separate volume of figures) a total of seven daytime bus routes and two night bus routes operate within a 640m walking distance of the site.

12.4.18 These bus routes operate from the following bus stops:

a. King Edward Memorial Park bus stop on Glamis Road, 80m north of the hoarded area of the site, northbound and southbound.

b. Cable Street bus stop on Glamis Road, 180m north of the hoarded area of the site, southbound only

c. Exmouth Estate bus stop on Commercial Road (A13), 680m north of the hoarded area of the site, westbound only

12.4.19 These routes would also serve other stops further from the site as shown on Vol 21 Figure 12.4.3 (see separate volume of figures).

12.4.20 On average there are 91 daytime bus services in total per hour in the AM peak and 88 bus services in total per hour in the PM peak within a 640m walking distance of the site.

12.4.21 There are approximately 44 night-time bus services per hour Monday to Friday between 00:00 and 06:00 and a total of 51 night-time bus services per hour on Saturdays between 00:00 and 06:00 within a 640m walking distance of the site.

Docklands Light Railway

12.4.22 As shown on Vol 21 Figure 12.4.3 (see separate volume of figures), Shadwell Docklands Light Railway (DLR) station is located approximately 700m walking distance or nine minutes walking time to the northwest of the site.

12.4.23 Limehouse DLR station, which serves the same DLR route as Shadwell station, is located approximately 1km walking distance or 12 minutes walking time to the northeast of the site.

12.4.24 DLR trains from Shadwell and Limehouse travel east to Woolwich Arsenal and Beckton and west to Tower Gateway and Bank. The frequency of the DLR trains from Shadwell and Limehouse is approximately every two to three minutes providing an average of 25 services per hour in each direction.

12.4.25 On average there are 50 DLR services in total during each of the AM and PM peak hours within a 960m walking distance of the site.

London Overground

12.4.26 The closest London Overground station to the site is Wapping rail station located approximately 650m walking distance to the southwest of the site. Shadwell station also provides access to London Overground services. These services operate southwards to West Croydon and Crystal Palace and northwards to Highbury and Islington offering connections to National Rail, London Underground and other London Overground services.

12.4.27 In the AM peak hour there are approximately 26 services (12 southbound and 14 northbound) on the London Overground from Wapping and Shadwell. In the PM peak hour there are approximately 26 services (13 southbound and 13 northbound).

National Rail

12.4.28 The nearest National Rail station to the site is at Limehouse, 1km walking distance or 12 minutes walking time to the northeast. Limehouse station provides c2c services to Fenchurch Street, Shoeburyness, Tilbury, Grays and Laindon with approximately 15 westbound and five eastbound services calling at Limehouse in the AM peak hour and five westbound and 14 eastbound services in the PM peak hour.

River passenger services

12.4.29 There are no operational wharves, jetties or piers in the immediate vicinity of the King Edward Memorial Park Foreshore site. The nearest river passenger services stop at the Hilton Pier which is approximately 1.5km downstream on the south bank of the River Thames. On the north bank, the nearest river passenger services stop is at the Canary Wharf and St Katharine's piers which are located approximately 2km east and 2.2km west of King Edward Memorial Park site respectively.

12.4.30 Services at Canary Wharf pier operate between Woolwich Arsenal to the east and Embankment to the west. Services at St Katherine's pier operate between Greenwich to the east and Westminster to the west. Both services operate at 20 minute intervals during peak periods.

River navigation and access

12.4.31 An analysis has been made of the typical volume of river vessel traffic passing the King Edward Memorial Park Foreshore site, based on published river passenger service timetables and estimates of freight traffic based on discussions with operators.

12.4.32 It is estimated that the peak hour for river vessel traffic passing this site is between 16:00 and 17:00, Monday to Friday. During this hour it is estimated that approximately 33 vessels typically pass the site. This figure is not constant as freight vessel transit patterns are influenced by the rising and falling tide. Therefore, such a peak will only occur every ten to 12 days when the tide is at its highest[7].

12.4.33 It should be noted that the Shadwell Basin Outdoor Activity Centre moors a number of sailing dinghies to a pontoon in the River Thames within close proximity of the proposed King Edward Memorial Park Foreshore site. These are used by club members for sailing on the River Thames.

Parking

12.4.34 Vol 21 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

12.4.35 There are seven on-street car parking bays on the western side of Glamis Road which are subject to a Controlled Parking Zone (CPZ).

12.4.36 There are 31 shared use and four resident on-street car parking bays on the adjacent Wapping Wall which are subject to a CPZ.

12.4.37 There are approximately 19 on-street car parking bays on The Highway (A1203), which are subject to a CPZ.

12.4.38 There are also two parking bays each for permit holders or pay and display use and motorcycles on Monza Street which is approximately 300m walking distance southwest of the site access. These bays are subject to a CPZ.

12.4.39 There are no blue badge parking bays within close proximity to the site.

12.4.40 The current level of use of these bays shows a high demand of approximately 75% at all times.

Existing off-street/private car parking

12.4.41 The Tobacco Dock multi-storey car park is located approximately 1km to the west of the site at Wapping Lane, Poplar. It is open 24 hours from Monday to Sunday and has a capacity of 580 car parking spaces.

Coach parking

12.4.42 There is a coach parking bay for a single coach situated on Glamis Road which is operational between 08.30 and 17.30 with a maximum stay of four hours permitted.

Car clubs

12.4.43 The closest car club parking space to the site is operated by Zipcar and is approximately 300m walking distance to the east on Heckford Street where space for one car is provided.

12.4.44 A further car club parking space is operated by Hertz On Demand and is approximately 550m walking distance to the southwest on Wapping Wall.

12.4.45 Two car club bays are available on Wapping High Street 600m walking distance to the southwest of the site, which are operated by City Car Club.

Servicing and deliveries

12.4.46 There are no designated on-street loading bays in the vicinity of the site.

Taxis

12.4.47 There are no taxi ranks within a 640m walking distance of the site.

Highway network and operation

12.4.48 Glamis Road is subject to a 20mph speed limit. There is a 7.5 tonne weight restriction on Glamis Road on the bridge over Shadwell Basin south of the site access. There are also traffic calming measures in the form of speed cushions in place on Glamis Road.

12.4.49 The Highway (A1203) forms part of the TLRN. It is subject to a 30mph speed limit and provides two lanes of traffic in each direction. During off-peak hours, parking is permitted in designated bays at the kerbside along it which effectively reduces it to single lane operation in each direction at these locations. The Highway (A1203) is suitable for HGVs and long vehicles.

12.4.50 The junction between The Highway (A1203) and Glamis Road is a four arm signalised crossroads. The Highway (A1203) has two lanes on entry and exit to the junction while Glamis Road has one entry and one exit lane on each of its arms.

12.4.51 Approximately 800m east of the site The Highway (A1203) forms a three arm signalised junction with Butcher Row. East of this junction the A1203 becomes the Limehouse Link.

Data from third party sources

Description of data

12.4.52 Data in relation to accidents over a five year period have been sourced from TfL.

Accident analysis

12.4.53 Data in relation to accidents over a five year period have been sourced from TfL.

12.4.54 A total of one fatal accident, 15 serious accidents and 49 slight accidents occurred in the King Edward Memorial Park Foreshore site assessment area over the five-year period of accident data analysed.

12.4.55 The one fatal accident that occurred happened at the junction of The Highway (A1203) and Glamis Road. The accident involved a motorcyclist travelling on the wrong side of an island and hitting a turning Light Goods Vehicle (LGV).

12.4.56 The majority of the serious accidents occurred on The Highway (A1203) at or near its junctions with Glamis Road, Dellow Street and King David Lane.

12.4.57 Of all of the accidents, one involved a light goods vehicle (LGV) and none involved medium or heavy goods vehicles (MGV/HGVs).

12.4.58 None of the accidents recorded within the five years of data were attributed to road geometry.

Survey data

Description of surveys

12.4.59 Baseline survey data were collected in May, July and August/September 2011 to establish the existing transport movements and usage of parking in the area. Volume 21 Figure 12.4.5 (see separate volume of figures) shows the survey locations in the vicinity of the site.

12.4.60 As part of the 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, saturation flows, degree of saturation and traffic signal timings. Parking surveys were undertaken to establish the usage of permit parking in addition to coach parking and motorcycle bays. Further surveys were conducted in August/September 2011 to establish the summer usage of the Thames Path.

Results of the surveys

12.4.61 The surveys inform the analysis of the baseline situation in the area surrounding the site.

Pedestrians and cyclists

12.4.62 Pedestrian surveys around the site during the AM and PM peak hours indicate that there is a relatively balanced flow of pedestrians during the AM peak hour along the riverside footway within the Park with approximately 65 pedestrian movements in each direction. During the PM peak hour the flow is lower with approximately 52 southwestbound pedestrians and 34 northeastbound pedestrians on the same footway.

12.4.63 There is a balanced flow of pedestrians crossing The Highway (A1203) from Brodlove Lane during the AM peak hour of approximately 11 and 16 pedestrians in northbound and southbound directions respectively. During the PM peak hour the flow is approximately 13 northbound movements and four southbound movements.

12.4.64 Cycle flow surveys indicates that the Thames Path is relatively well used by cyclists but that flows on NCN routes are not substantial during either peak hour. This may reflect the presence of route Cycle Superhighway Route 3 (CS3) located 300m walking distance to the north on Cable Street which provides an alternative east-west cycle route.

Traffic flows

12.4.65 The ATC data has been analysed to identify the existing traffic flows along Glamis Road and The Highway (A1203). Weekday flows are used as this is when the greatest impacts from the project are likely to be experienced.

12.4.66 The weekday ATC data for Glamis Road shows that between 08:00 – 09:00 there are approximately 359 two-way vehicle movements. The busiest 15 minute peak period in this period occurred after 08:45 with approximately 26 northbound vehicles and approximately 77 southbound vehicles.

12.4.67 For the period between 17:00 – 18:00 there are approximately 269 two-way vehicle movements. The busiest 15 minute peak period in this period occurred after 17:45 with approximately 42 northbound vehicles and approximately 28 southbound vehicles.

12.4.68 The AM peak period for the western direction flow of The Highway (A1203) is the busiest hour with a maximum of approximately 503 vehicles travelling westbound every 15 minutes and approximately 423 vehicles travelling eastbound during the same period. The PM peak period for the eastern direction flow of The Highway (A1203) is the busiest hour with a maximum of approximately 551 vehicles travelling eastbound every 15 minutes and approximately 446 vehicles travelling westbound during the same period. The traffic flows for the busiest period (weekday AM peak hour) within the area are shown in Vol 21 Figure 12.4.6 and Vol 21 Figure 12.4.7 (see separate volume of figures).

Parking

12.4.69 The results of the surveys indicate that the on-street parking in the vicinity of the site is moderately well used but that there is spare capacity available on both weekdays and at weekends during the peak and off-peak periods.

Local highway modelling

12.4.70 To establish the existing capacity on the local highway network a scope was discussed with TfL and the LB of Tower Hamlets to model the signalised Glamis Road / The Highway (A1203) junction using LinSig software. The baseline model incorporated the current traffic and transport conditions within the vicinity of the site and followed the methodology outlined in Vol 2 Section 12.

12.4.71 The weekday AM and PM baseline model flows for Glamis Road and The Highway (A1203) were compared against observed queue lengths for the peak periods using junction survey data to validate both models to ensure reasonable representation of existing conditions.

12.4.72 Vol 21 Table 12.4.1 shows the modelling outputs which demonstrate that the Glamis Road / The Highway (A1203) junction is currently operating above its theoretical capacity in the weekday AM and PM models. The validated model indicates that the AM peak hour is the busiest period with a peak flow of 987 PCUs on the eastern arm of The Highway (A1203). In this period the majority of arms operate below 90% of capacity, with the exception of The Highway (A1203) eastern arm which operates above capacity, with maximum queues of approximately 35 vehicle lengths.

12.4.73 The delay to vehicles is most significant during the PM peak hour on the Glamis Road approach on its southern arm, which currently indicates an average of 107 seconds of delay per PCU.

Vol 21 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 (PCU)	DoS	MMQ (PCU)	Delay (seconds per PCU)	Flow (PCU)	DoS	MMQ (PCU)	Delay (seconds per PCU)
Glamis Road (N)	Left / right / ahead	92	45%	3	65	92	40%	3	61
The Highway (E)	Left / ahead	987	93%	35	41	864	89%	28	39
	Right / ahead	987	93%	35	41	864	91%	29	41
Glamis Road (S)	Left / right / ahead	93	46%	3	68	202	88%	10	107
The Highway (W)	Left / ahead	756	61%	16	16	941	82%	27	28
	Right / ahead	756	57%	15	15	940	77%	25	25
		PRC		Total delay (PCU hours)		PRC		Total delay (PCU hours)	
Overall junction performance		-3.6%		33		-0.9%		40	

Notes: 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

12.4.74 The receptors and their sensitivities in the vicinity of the King Edward Memorial Park Foreshore site are summarised in the table below (Vol 21 Table 12.4.2). The transport receptor sensitivity is defined as high, medium or low using the criteria detailed in Vol 2 Section 12.

12.4.75 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.

12.4.76 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 21 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[iii]) using the Thames Path and the local highway network	Construction Operation	High sensitivity to pedestrian and cycle diversions leading to journey time changes.
Private vehicle users (including taxis) in the area using the local highways. Users of car parking on Glamis Road	Construction Operation	Low sensitivity to increases in HGV traffic. Medium sensitivity to change in parking capacity.
Emergency vehicles travelling on Glamis	Construction	High sensitivity to journey time delays due to time

[iii] 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
Road / The Highway (A1203)	Operation	constraints on journey purposes.
Marine emergency services	Construction	High sensitivity to changes in vessel movements / moorings.
Bus users (passengers) travelling along Glamis Road and Commercial Road (A13) / Cable Street west and north of the site respectively.	Construction Operation	Low sensitivity to journey time delays as a result of increases to traffic flows.
River vessel operators including river passenger services	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 due to distance from the site and low numbers of construction workers.
Free Trade Wharf residents, northeast of the site. Shadwell Pierhead residents, south of the new site access	Construction	High sensitivity to pedestrian and cycle diversions and changes in traffic flow, resulting in increases to journey times.
Users of recreational spaces at King Edward Memorial Park, adjacent to site.	Construction Operation	High sensitivity to pedestrian and cycle diversions and changes to traffic flow, resulting in increases to journey times. Vulnerable pedestrian groups are

Receptors (relating to all identified transport effects)	Phase at which receptor is sensitive to identified impacts	Value/sensitivity and justification
		likely to be present (children, mobility impaired users).
Pupils, parents and staff at Pier Head Preparatory (Montessori) School, south of the new site access. Users of Shadwell Basin Outdoor Activity Centre, 5m south of the hoarding. Users of the Shadwell Centre, on The Highway (A1203) northeast of the site. Patrons of Prospect of Whitby public house, 145m southwest of the site.	Construction	High sensitivity to pedestrian and cycle diversions and changes in traffic flow, resulting in increases to journey times

Construction base case

12.4.77 As described in Section 12.3 the construction assessment year for transport effects in relation to this site is Site Year 1 of construction in relation to construction road traffic and Site Year 3 of construction in relation to construction river traffic.

12.4.78 There are no known proposals to change the cycle or pedestrian network by Site Year 1 of construction and it is assumed that the network will operate as indicated in the baseline situation.

12.4.79 In terms of the public transport network, at the time of undertaking the assessment there were no plans to change DLR services on the route through Shadwell. It is envisaged that DLR, London Overground and National Rail patronage will increase by Site Year 1 of construction.

12.4.80 In order to ensure that the busiest base case scenario is used in the assessment, the capacity for National Rail, Overground and DLR 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 Section 12.

12.4.81 There are no known current proposals to alter river passenger services or river navigation patterns from the current baseline conditions and therefore the construction base case in Site Year 3 of construction would remain similar to the baseline position.

12.4.82 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 King Edward Memorial Park Foreshore site in Site Year 1 of construction without the Thames Tideway Tunnel project. The construction base case traffic flows (derived from the survey data) at the junction of The Highway (A1203) and Glamis Road providing input to the LinSig model are shown on Vol 21 Figure 12.4.6 and Vol 21 Figure 12.4.7 (see separate volume of figures).

12.4.83 The key findings from the construction base case LinSig model for King Edward Memorial Park Foreshore site indicate that there will be an increase in queue lengths and changes to average delays at the junction of The Highway (A1203) and Glamis Road in the construction base case compared to baseline conditions.

12.4.84 Results also indicate that the local network would operate above capacity in the AM and PM peaks when taking into account the construction base case traffic flows.

12.4.85 With regard to the identification of additional receptors associated with the other developments included in the base case, there are one developments within 250m of the site. This is therefore included as an additional receptor as detailed in Vol 21 Table 12.4.3 below on the basis that impacts could be experienced by residents and visitors using the footways and local highway network in the vicinity of the site.

Vol 21 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
New residents and visitors to John Bell House development on King David Lane, 150m northwest of the site.	Construction	Low sensitivity to pedestrian and cycle diversions and changes in traffic flow due to distance from the site.

Operational base case

12.4.86 The operational assessment year for transport is Year 1 of operation.

12.4.87 As explained in para. 12.3.12 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 indicated in the construction base case.

12.4.88 The operational base case takes account of the two developments described in the Development Schedule (Vol 21 Appendix N). Given the infrequent and short-term nature of maintenance activity and the distance of the developments from the site it is not however necessary to consider them as receptors in the transport assessment of operational effects.

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 King Edward Memorial Park Foreshore site, Site Year 1 of construction for construction road traffic and Site Year 3 for construction river traffic.

12.5.2 The anticipated mode split of worker trips (covering all types of construction worker as set out in Vol 21 Table 12.2.2) for the King Edwards Memorial Park Foreshore site is detailed in Vol 21 Table 12.5.1 and has been generated based on 2001 Census data for journeys to workplaces within the vicinity of King Edward Memorial Park[iv]. This shows that the predominant mode of travel for construction workers would be public transport.

12.5.3 At this site there would be no parking provided within the site boundary for workers. As parking on surrounding streets is also restricted, and measures to reduce car use would be incorporated into site-specific *Travel plan* requirements, it is highly unlikely that workers would travel by car. The Census mode shares have therefore been adjusted in Vol 21 Table 12.5.1 to reflect increased levels of non-car use by workers at this site. This forms the basis of the assessment.

Vol 21 Table 12.5.1 Transport – mode split

Mode	Percentage of trips to site	Equivalent number of worker trips (based on 40 worker trips)	
		AM peak hour (07:00-8:00)	PM peak hour (18:00-19:00)
Bus	8%	3	3
National Rail	42%	17	17
Underground	0%	0	0
DLR	34%	14	14
Car driver	<1%*	0	0
Car passenger	<1%*	0	0
Cycle	3%	1	1
Walk	10%	4	4

[iv] Based on 2001 Census as this type of data had not been released from the 2011 Census at the time of assessment.

Mode	Percentage of trips to site	Equivalent number of worker trips (based on 40 worker trips)	
		AM peak hour (07:00-8:00)	PM peak hour (18:00-19:00)
River	0%	0	0
Other (taxi/motorcycle)	3%	1	1
Total	**100%**	**40**	**40**

** Assumed to be zero for the purposes of the assessment*

Pedestrian routes

12.5.4 As a result of the construction phase at the King Edward Memorial Park Foreshore site, as detailed in Section 12.2, changes would be made to the pedestrian network. The Construction phase layout phase 1-3 plans (see separate volume of figures – Section 1) show the changes to the pedestrian footways during construction.

12.5.5 The existing Thames Path runs adjacent to the riverside footway of King Edward Memorial Park and would require diversion as a result of the proposed construction works. This would be necessary throughout the construction works and therefore the diversion would be away from the foreshore west around the northern hoarding of the site, and through the western part of the Park to Glamis Road. Alternatively pedestrians would be able to cross the access road at a designated gated crossing point supervised by a traffic marshal to use the existing access road to get to Glamis Road.

12.5.6 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 by foot. As a result the 40 worker trips generated by the site have been added to the construction base case pedestrian flows during the AM and PM peak hours.

12.5.7 Taking into consideration the pedestrian diversions and increase in worker trips the greatest effect would be on the pedestrian routes through King Edward Memorial Park and on Glamis Road to which pedestrians would be diverted from the riverside footway of the foreshore during construction activity.

12.5.8 In determining the magnitude of impacts on pedestrian routes the relevant impact criteria with respect to the assessment of pedestrian routes are pedestrian delay, pedestrian amenity and accidents and safety (as set out in Vol 2 Section 12).

12.5.9 It is anticipated that the pedestrian diversions during construction at the King Edward Memorial Park Foreshore site would result in a journey time increase of approximately two minutes 20 seconds due to the extension of the journey by 180m and based on a walking speed of 1.3m/sec. This would result in a medium adverse impact on pedestrian delay for those using the Thames Path and riverside footway within King Edward

Memorial Park. The impact on other pedestrian movements in the area would be lower.

12.5.10 With regards to pedestrian amenity and accidents and safety the diversion of the Thames Path would not result in pedestrians having to make any additional road crossings although it would be necessary to cross the site access within the Park for those who want to access Glamis Road via the existing access road (rather than via the northern diversion). Pedestrian flows would be approximately 130 people per hour. Pedestrian routes close to the site would require protection to segregate pedestrians and construction vehicle movements. The impact magnitude would therefore be classified as low adverse for both pedestrian amenity and accidents and safety using the criteria set out in Vol 2 Section 12.

Cycle facilities and routes

12.5.11 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 Section 12).

12.5.12 Cyclists using the Thames Path would experience an additional delay to journey time as a result of the construction works at the King Edward Memorial Park Foreshore site due to the diversion that would be in place during construction. The effect on journey times would be an increase of a maximum of 40 seconds over that in the construction base case based on a cycling speed of 16km/h. This represents a negligible impact.

12.5.13 Cyclists using the adjacent highway network may experience a slight increase in journey times. This is described in the highway network and operation section (para. 12.5.46) and would amount to a maximum of 13 seconds additional delay on the offside lane of the eastern arm of The Highway (A1203) at its junction with Glamis Road. This represents a negligible impact.

12.5.14 With regard to accidents and safety; while cyclists would not be required to make any additional road crossings along the NCN Route 1, cyclists using the Thames Path would have to cross the site access road on the diversionary route. This would be gated and supervised by a traffic marshal to minimise conflict with construction vehicles. There would be an increase in construction traffic flow of less than ten HGV movements per hour at the site detailed in Vol 21 Table 12.2.1. Overall this represents a low adverse impact on accidents and safety for cyclists.

Bus routes and patronage

12.5.15 Bus services operate immediately past the site on Glamis Road. However, the additional construction vehicles serving the site would not directly affect bus infrastructure along Glamis Road or in the wider area. The effect on journey times is detailed under the highway assessment (paras. 12.5.46) and would be an increase of a maximum of approximately 13 seconds on the offside lane of the eastern arm of The Highway (A1203) at its junction with Glamis Road in the PM peak hour. This represents a negligible impact.

12.5.16 It is expected that approximately three additional two-way worker trips would be made by bus during the AM and PM peak hours. Based on a service of 91 and 88 buses within a 640m walking distance during the AM and PM peak hours respectively this is equivalent to less than one additional passenger per bus. This represents a negligible impact on bus patronage.

DLR and patronage

12.5.17 It is expected that there would be approximately 14 worker journeys made using DLR services in the AM and PM peak hours.

12.5.18 DLR provides 50 services per hour at Shadwell station. The additional worker journeys therefore represent less than one person per train service on this network.

12.5.19 Based on the quantitative assessment of patronage and the impact criteria on rail patronage in Vol 2 Section 12 this would result in a negligible impact on DLR patronage.

London Overground and National Rail and patronage

12.5.20 The mode split in Vol 21 Table 12.5.1 is based on 2001 Census data and was collected before the introduction of London Overground services. As most overground sites are used to serve national rail, the numbers for the overground mode split have therefore been based on rail numbers and were then combined with the rail site in the vicinity of the King Edward Memorial Park Foreshore site.

12.5.21 It is expected that there would be approximately 17 worker journeys made using London Overground or National Rail services in the AM and PM peak hours.

12.5.22 National Rail provides about 20 services per hour from Limehouse station and there would be a further 26 National Rail services per hour at Wapping rail station. The additional worker journeys therefore represent less than one per train service on these networks, which represents a negligible impact on National Rail and London Overground patronage.

River passenger services and patronage

12.5.23 There are no river passenger services in the immediate vicinity of the King Edward Memorial Park site and therefore it is not expected that the transport of construction materials by river would directly affect services.

12.5.24 It is not anticipated that construction workers would use river services to access the construction site. There would therefore be a negligible impact on river passenger service patronage.

River navigation and access

12.5.25 This section addresses the effects on river navigation and access in the vicinity of the King Edward Memorial Park Foreshore site. The wider effects of transporting construction materials by river from a number of sites within the project are dealt with in Vol 3 Section 12.

12.5.26 During construction it is intended that the cofferdam fill (import and export), drop shaft excavated and ‘other’ material (export) would be transported by barge. For assessment it is taken as 90% of these materials are by river to take into account periods where river transport is unavailable or the material is unsuitable. The peak number of barge movements would occur within Site Year 3 of construction and would be an average of four barge movements a day.

12.5.27 Barges would be hauled by tugs. which typically haul two barges at a time where possible. The number of transit movements required on the river may therefore be lower than the number of individual barge movements.

12.5.28 Due to the low number of barges arriving at the site and based on the impact criteria outlined in Vol 2 Section 12, it is anticipated that the impact on river navigation in the vicinity of the site as a result of the barge movements at the King Edward Memorial Park Foreshore site would be negligible.

12.5.29 It is noted that a separate *Navigational Issues and Preliminary Risk Assessment* which accompanies the application, has been undertaken for the temporary construction works and barges to be used at the King Edward Memorial Park Foreshore site.

Parking

12.5.30 The site would be accessed at one location on Glamis Road. To accommodate the movement of construction vehicles into and out of the site access it would be necessary to temporarily restrict approximately 15m of on-street car parking from the western side of Glamis Road opposite the site access. The car parking would not be reprovided in the immediate vicinity of the site as there is no physical capacity to do so and there is sufficient spare parking capacity on the surrounding roads to accommodate displaced parking demand (see para. 12.4.69).

12.5.31 In determining the magnitude of impacts the relevant criterion is vehicle parking and loading changes (as set out in Vol 2 Section 12).

12.5.32 The removal of 15m of on-street car parking from Glamis Road is judged to be a low adverse impact as there would be sufficient spare capacity elsewhere in the vicinity of the site to accommodate displaced parking demand.

12.5.33 There are no loading bays within the vicinity of this site.

12.5.34 Parking for five essential construction site operations and contractor activity operation vehicles would be provided on site but no construction worker parking would be provided. As parking on surrounding streets is restricted and measures to reduce car use would be incorporated into site-specific *Travel plan* requirements, there would be no impact on local parking from construction workers.

Highway network and operation

12.5.35 The Highway layout during construction plans (see separate volume of figures – Section 1) show the highway layout during the construction works at the King Edward Memorial Park Foreshore site. The site is on the southern side of King Edward Memorial Park and would be accessed from Glamis Road. The highway layout during construction vehicle swept path analysis (see King Edward Memorial Park Foreshore *Transport Assessment* Figures) demonstrate that the construction vehicles would be able to safely enter and leave the site.

12.5.36 The Thames Tideway Tunnel project proposes to relocate the stop line and advanced cycle stop line on the Glamis Road arm of the Glamis Road / The Highway (A1203) signalised junction to allow larger construction vehicles to make the left-turn movement from The Highway (A1203) on to Glamis Road without overrunning the nearside kerb.

12.5.37 A gated access for the left-turn in / right-turn out movement at the site access would be provided. The existing access would be widened to accommodate HGVs and dropped kerbs and tactile paving would be provided.

12.5.38 Construction lorry movements would be limited to standard working hours (08:00 to 18:00 Monday to Friday and 08:00 to 13:00 Saturday). In exceptional circumstances 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 Tower Hamlets.

12.5.39 Vol 21 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. The assessment is 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 Plans* which are required as part of the *CoCP* Part A Section 5.

Vol 21 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%*	82	0	8	8	0
Other construction vehicle movements**	36	0	4	4	0
Worker vehicle movements***	nominal	0	0	0	0
Total	**118**	**0**	**12**	**12**	**0**

** The assessment is 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 less than 1% of workers driving, on the basis that there would be no worker parking on site; on-street parking in the area is restricted; and Travel Plan measures would discourage workers from driving. In practical terms, this would be close to zero.*

12.5.40 To ensure the assessment of the highway network is robust it has been based on a combination of the peak hour of movements for construction lorries and other construction vehicles between 07:00 and 09:00 and 17:00 and 19:00. These have been combined and applied to the peak hour to take into account the highest number of movements generated by the site.

12.5.41 An average peak flow of 118 vehicle movements a day is expected during the months of greatest activity during Site Year 1 of construction at this site. At other times in the construction period vehicle flows would be lower than this average peak figure.

12.5.42 The relevant 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 Section 12).

12.5.43 It is anticipated that in the vicinity of the site there would be an additional eight two-way HGV movements per hour as a result of the construction at the King Edward Memorial Park Foreshore site. There would be no construction traffic from other Thames Tideway Tunnel sites using The Highway (A1203) or Glamis Road. Taking this into account together with the location of the site access on Glamis Road, which is not part of the strategic road network, the impact on accidents and safety would be low adverse.

12.5.44 It is assessed that potentially, one hazardous load every fortnight would be generated by this site and this equates to a low adverse impact in accordance with the criteria set out in Vol 2 Section 12.

12.5.45 The local LinSig model has been used to apply the construction traffic demands 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 model) are shown on Vol 21 Figure 12.4.6 and Vol 21 Figure 12.4.7 (see separate volume of figures).

12.5.46 A summary of the construction assessment results for the weekday AM and PM peak hours is presented in Vol 21 Table 12.5.3 and Vol 21 Table 12.5.4, respectively. The construction base case scenario shows that the local highway will be operating above capacity without the Thames Tideway Tunnel proposals. The results indicate that the construction at the King Edward Memorial Park Foreshore site would result in a slight reduction in capacity along The Highway (A1203) in the PM peak hour and a slight increase to delay on this part of the network. The maximum increase in delay on any arm of the junction would be seven seconds per PCU in the AM peak hour, and 13 seconds per PCU during the PM peak hour. In both cases this increase would occur on eastbound carriageway of The Highway (A1203). This would result in a negligible impact on road network delay, based on the impact criteria identified in Vol 2 Section 12.

Vol 21 Table 12.5.3 Transport – construction LinSig model output (AM peak hour)

Approach	Arm	Flow (PCU)	Weekday								
			AM peak hour (08:00-09:00)								
			DoS			MMQ (PCU)			Delay (seconds per PCU)		
			Base case	Devt case	Change	Base case	Devt case	Change	Base case	Devt case	Change
Glamis Road (N)	Left / ahead / right	103	50%	50%	-	4	4	-	67	67	-
The Highway (E)	Left / ahead	1102	104%	104%	-	67	69	+2	122	129	+7
	Right / ahead	1102	104%	104%	-	67	69	+2	123	130	+7
Glamis Road (S)	Ahead / aight / left	113	51%	56%	+5%	4	4	-	70	72	+2
The Highway (W)	Left / ahead	840	68%	68%	-	19	19	-	18	18	-
	Ahead / right	840	63%	63%	-	18	18	-	17	17	-
			PRC						Total delay (PCU hours)		
Overall junction performance			-15.1%	-15.7%	-0.6%				87	92	+3

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 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. 12.3.20.

Vol 21 Table 12.5.4 Transport – construction LinSig model outputs (PM peak hour)

Approach	Arm	Flow (PCU)	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
Glamis Road (N)	Left / ahead / right	102	47%	44%	-3%	4	4	-	64	62	-2
The Highway (E)	Left / ahead	965	97%	99%	+2%	40	45	+5	60	73	+13
	Right / ahead	965	100%	101%	+1%	46	50	+4	83	90	+7
Glamis Road (S)	Ahead / right / left	235	104%	102%	-2%	18	17	-1	225	201	-24
The Highway (W)	Left / ahead	1046	90%	92%	+2%	35	36	+1	36	39	+3
	Ahead / right	1046	84%	85%	+1%	30	31	+1	28	30	+2
			PRC						Total delay (PCU hours)		
Overall junction capacity			-15.6%	-13.8%	+1.8%				73	79	+6

Notes: 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 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. 12.3.20.

Significance of effects

12.5.47 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 21 Table 12.5.5.

12.5.48 Vol 21 Table 12.5.5 sets out the effects on each receptor in the vicinity of the site.

Vol 21 Table 12.5.5 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 local highway network.	Minor adverse effect on pedestrians Minor adverse effect on cyclists	**Pedestrians:** • High sensitivity • Medium adverse impact on pedestrian delay • Low adverse impact on pedestrian amenity and accidents and safety • Due to impacts being of low adverse and medium adverse magnitude, equates to minor adverse effect. **Cyclists:** • High sensitivity • Negligible impact on cycle delay. • Low adverse impact on accidents and safety. • Due to impacts being of negligible and low adverse magnitude, equates to minor adverse effect.
Private vehicle users (including taxis) in the area using the local highways. Users of car parking on the local highway network.	Minor adverse effect on highway users Minor adverse effect on parking users	**Highway users:** • Low sensitivity • Negligible impact on road delay. • Low adverse impact on accidents and safety and from hazardous loads. • Due to negligible and, low adverse magnitudes, and the sensitivity of the receptor, this equates to a minor adverse effect. **Parking users:** • Medium sensitivity • Low adverse impact on on-street

Receptors (relating to all identified transport effects)	Significance of effect	Justification (receptor sensitivity and impacts)
		parking • Due to low adverse impact magnitude, equates to minor adverse effect.
Emergency vehicles travelling on Glamis Road/ The Highway (A1203).	Minor adverse effect	• High sensitivity • Negligible impact on road delay. • Low adverse impact on accidents and safety and from hazardous loads. • Due to negligible and, low adverse magnitudes, and the sensitivity of the receptor, this equates to a minor adverse effect.
Marine emergency services.	Negligible effect	• High sensitivity • Negligible impact from barge movements • Due to negligible impact, equates to negligible effect.
Bus users (passengers) travelling along Glamis Road and Commercial Road / Cable Street (A13) west and north of the site respectively.	Negligible effect	• Low sensitivity • Negligible impact on road network delay and patronage • Due to negligible impacts, equates to negligible effect.
River vessel operators including river passenger services.	Negligible effect	• Medium sensitivity • Negligible impact from barge movements • Due to negligible impact, equates to negligible effect.
Leisure users of the River Thames.	Negligible effect	• Medium sensitivity • Negligible impact from barge movements • Due to negligible impact, 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 patronage. • Due to negligible impact, equates to negligible effect.
Free Trade Wharf residents. Shadwell Pierhead residents. Pupils, parents and staff and of Pier Head Preparatory (Montessori) School. Users of Shadwell Basin Outdoor Activity Centre. Users of the Shadwell Centre, on The Highway (A1203). Patrons of Prospect of Whitby public house Retail/commercial receptor.	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 • Medium adverse impact on pedestrian delay • Low adverse impact on pedestrian amenity and accidents and safety • Equates to minor adverse effect. **Cyclists:** • Negligible impact on cycle delay. • Low adverse impact on accidents and safety. • Equates to minor adverse effect. **Highway users:** • Low sensitivity • Negligible impact on road delay. • Low adverse impact on accidents and safety and from hazardous loads. • Equates to a minor adverse effect. **Parking users:** • Medium sensitivity • Low adverse impact on on-street parking • Equates to minor adverse effect.
Users of recreational spaces at King Edward Memorial Park.	Minor adverse effect	• High sensitivity • Medium adverse impact on pedestrian delay • Low adverse impact on pedestrian amenity and accidents and safety • Negligible impact on cycle delay • Equates to minor adverse effect.

Receptors (relating to all identified transport effects)	Significance of effect	Justification (receptor sensitivity and impacts)
New residents and visitors to John Bell House development on King David Lane.	Negligible effect on pedestrians	**Pedestrians:** • Low sensitivity • Medium adverse impact on pedestrian delay • Low adverse impact on pedestrian amenity and accidents and safety • Considering low receptor sensitivity and distance from site, equates to negligible effect.
	Negligible effect on cyclists	**Cyclists:** • Negligible impact on cycle delay. • Low adverse impact on accidents and safety. • Considering low receptor sensitivity and distance from site, equates to negligible effect.
	Minor adverse effect on highway users	**Highway users:** • Low sensitivity • Negligible impact on road delay. • Low adverse impact on accidents and safety and from hazardous loads. • Equates to a minor adverse effect.

Sensitivity test for programme delay

12.5.49 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.

12.5.50 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 route 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 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 King Edward Memorial Park Foreshore 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 Development Schedule (see Vol 21 Appendix N), there would be no new receptors requiring assessment as a result of a one year delay.

12.6 Operational effects assessment

12.6.1 This section summarises the findings of the assessment undertaken for Year 1 of operation at the King Edward Memorial Park Foreshore 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 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 Section 12.2. This assessment approach has been discussed with the LB of Tower Hamlets and TfL.

12.6.4 The operational assessment has taken into consideration those elements that would be affected when maintenance visits are made to the site.

Parking

12.6.5 When cranes are required to service the site some car parking bays on Glamis Road would have to be temporarily restricted to ensure the vehicles have sufficient space to manoeuvre into the site. This temporary restriction would be on an infrequent basis and would occur approximately every ten years.

12.6.6 Based on the impact magnitude criteria outlined in Vol 2 Section 12 the temporary restriction of the car 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 the King Edward Memorial Park Foreshore site for which parking restrictions would be required and the sensitivity of the receptor it is anticipated that there would be a **negligible** effect on car parking.

Highway layout and operation

12.6.8 The site would be accessed via Glamis Road during the operational phase via the new access established for the construction phase. The permanent Highway layout plans (see separate volume of figures – Section 1) shows 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 flatbed vehicles to access the site.

12.6.10 During ten-yearly inspections an area to locate two large cranes within the site 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; a 11.36m mobile crane, 10m articulated vehicle and 10.7m articulated vehicle. The permanent highway layout vehicle swept path analysis plan (see King Edward Memorial Park Foreshore *Transport Assessment* Figures) demonstrates that the maintenance vehicles would be able to safely enter and leave the site

12.6.11 When cranes are required to service the site some car parking bays on Glamis Road would have to be temporarily restricted to ensure the vehicles have sufficient space to manoeuvre into the site. This temporary restriction would be on an infrequent basis and would occur approximately every ten years.

12.6.12 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.

12.6.13 In accordance with the criteria outlined in Vol 2 Section 12 during the routine inspections of the operational site it is anticipated that there would be a negligible impact on road network delay.

12.6.14 Taking into consideration the various sensitivities of the receptors affected during the operational phase (pedestrians, cyclists, private vehicle users, emergency vehicles, bus users and recreational users of the Park) this would result in a **negligible** effect on highway layout and operation.

Sensitivity test for programme delay

12.6.15 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 Development Schedule (see Vol 21 Appendix N) the two other developments identified within 1km of the King Edward Memorial Park Foreshore site would be complete and operational by Site Year 1 of construction. These are therefore already included in the base case. This means that there are no specific cumulative effects to assess, although it is noted that the TfL Highway Assignment Models (HAMs) have been developed using GLA employment and population forecasts, which are based on the employment and housing projections set out in the *London Plan*. As a result the assessment inherently takes into account a level of future growth and development across London.

12.7.2 Therefore the effects on transport would 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

12.7.3 As indicated in the Development Schedule (see Vol 21 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. 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* (see Vol 1 Appendix A) and the *Draft Project Framework Travel Plan* which accompanies the application . 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 21 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 the local highway network	• Loss of footway along Thames Path • Pedestrian diversion route along Thames Path • Increased journey time for cyclists and pedestrians along Thames Path	Minor adverse effect on pedestrians Minor adverse effect on cyclists	None	Minor adverse effect on pedestrians Minor adverse effect on cyclists
Private vehicle users (including taxis) in the area using the local highways Users of car parking on the local highway network	• Movement of large construction vehicles • Highway layout changes including highway layout modifications • Temporary restriction of 15m of parking	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 Glamis Road/ The Highway (A1203) Private vehicle users (including taxis) in the area using the local highways	• Movement of large construction vehicles • Highway layout changes including highway layout modifications	Minor adverse effect	None	Minor adverse effect

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
	• Delay to journey time			
Marine emergency services	• Additional barge movements on the River Thames	Negligible effect	None	Negligible effect
Bus users (passengers) travelling along Glamis Road and Commercial Road (A13)/Cable Street west and north of the site respectively	• Movement of large construction vehicles • Highway layout changes including highway layout modifications • Delay to journey time. • Additional patronage from construction workers	Negligible effect	None	Negligible effect
River vessel operators including river passenger services	• 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
Public transport users using rail or river services within the area	• Some additional patronage from construction workers.	Negligible effect	None	Negligible effect
Free Trade Wharf residents Shadwell Pierhead residents	• Movement of large construction vehicles	Minor adverse effect on pedestrians Minor adverse effect	None	Minor adverse effect on pedestrians Minor adverse effect on

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Pupils, parents and staff of Pier Head Preparatory (Montessori) School Users of The Shadwell Centre, on The Highway (A1203) to the northeast of the site. Users of Shadwell Basin Outdoor Activity Centre Patrons on the Prospect of Whitby public house, Retail/commercial receptor	• Pedestrian and cyclist diversion route • Highway layout changes including highway layout modifications • Delay to journey time.	on cyclists Minor adverse effect on highway users Minor adverse effect on parking users		cyclists Minor adverse effect on highway users Minor adverse effect on parking users
Users of recreational spaces at King Edward Memorial Park adjacent to site	• Pedestrian and cyclist diversion route • Delay to journey time.	Minor adverse effect	None	Minor adverse effect
New residents and visitors at John Bell House development on King David Lane	• Movement of large construction vehicles • Pedestrian and cyclist diversion route • Highway layout changes including highway layout modifications • Delay to journey time	Negligible effect on pedestrians Negligible effect on cyclists Minor adverse effect on highway users	None	Negligible effect on pedestrians Negligible effect on cyclists Minor adverse effect on highway users

Vol 21 Table 12.10.2 Transport – summary of operational assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Pedestrians and cyclists (including sensitive pedestrians) using the Thames Path and the local highway network	• Occasional delay to pedestrians and cyclists accessing the Thames Path and the local highway network	Negligible effect	None	Negligible effect
Private vehicle users (including taxis) in the area using the local highways. Users of car parking on Glamis Road	• Occasional restriction of on-street parking spaces adjacent to site access on Glamis Road during maintenance	Negligible effect	None	Negligible effect
Emergency vehicles travelling on Glamis Road.	• Occasional maintenance trips resulting in some temporary, short-term road network delay	Negligible effect	None	Negligible effect
Bus users (passengers) travelling along Glamis Road and The Highway, Commercial Road (A1203) and Cable Street west and north of the site respectively	• Occasional delay to buses when large maintenance vehicles accessing site	Negligible effect	None	Negligible effect
Users of recreational spaces at King Edward Memorial Park adjacent to site	• Occasional delay to pedestrians accessing foreshore and pedestrian amenity	Negligible effect	None	Negligible effect

References

[1] Defra, *National Policy Statement for Waste Water* (2012)

[2] TfL, *Travel Planning for new development in London,* Transport for London (2011)

[3] Transport for London, *Assessment Tool for Travel Plan Building Testing and Evaluation (ATTrBuTE)*, 2011. http://www.attrbute.org.uk/

[4] Thames Water. *EIA Scoping Report (2011).* Available at: http://www.thamestunnelconsultation.co.uk/document-library/catalogue-view/?c=4-eia-scoping-report

[5] Greater London Authority, *London Plan*, July 2011.

[6] Transport for London, *Transport Assessment Best Practice Guidance*, April 2010.

[7] 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.

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.21**

Volume 21: King Edward Memorial Park Foreshore site assessment

Section 13: Water resources - groundwater

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

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Creating a cleaner, healthier River Thames

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Thames Tideway Tunnel

Environmental Statement

Volume 21: King Edward Memorial Park Foreshore 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 finding of the assessment of the likely significant effects of the proposed development on groundwater at the King Edward Memorial Park Foreshore site.

13.1.2 The proposed development has the potential to affect groundwater due to:

a. dewatering of aquifer units

b. use of grout/ground treatment to control ingress of water

c. creation of pathways for pollution

d. obstruction to groundwater flows

e. seepages into and out of the CSO drop shaft during operation.

13.1.3 This groundwater assessment should be read in conjunction with supporting Volume 21 Appendix K (K.1 – K.9) and the land quality assessment (Vol 21 Section 8 Land quality).

13.1.4 The site has a covering of low permeability material, the London Clay Formation and the upper part of the Lambeth Group, overlying the Chalk, a principal aquifer [i]. There are few existing abstractions from the Chalk around the King Edward Memorial Park Foreshore site, in part due to the number of potentially polluting activities which may already have reduced the value/sensitivity of certain receptors in this part of east London.

13.1.5 Dewatering would be required at this site, but it would be internal to the diaphragm walls[ii].

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 Section 13.3).

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[i] Principal aquifer – a geological stratum that exhibits high inter-granular and /or fracture permeability (was previously referred to as a major aquifer)

[ii] Diaphragm wall – a sub-surface barrier installed around construction works to support the required excavation and which amongst other things helps to control inflows of groundwater typically formed of reinforced concrete. This barrier would extend down by up 8m below the base of the shaft invert, for structural reasons and to increase the length of the flow path and hence reduce the amount of groundwater inflows

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 (Volume 21 King Edward Memorial Park Foreshore Figures).

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 King Edward Memorial Park Foreshore site, relevant to groundwater, would include:

a. A permanent cofferdam and infill structure within the existing foreshore

b. A drop shaft of approximately 20m internal diameter (ID) and approximately 60m deep, (based on 45.21mATD [iii] from an assumed ground level of 105.5mATD, excluding an approximately 5m thick base slab, constructed within the permanent cofferdam in the foreshore.

c. An interception chamber for the existing combined sewer overflow (CSO) from the North East Storm Relief sewer, constructed within the permanent cofferdam.

d. A connection culvert and associated chambers from the interception chamber to the drop shaft constructed within the permanent cofferdam.

e. A storm overflow chamber constructed within the permanent cofferdam

f. A temporary cofferdam in the foreshore to enable construction of the above elements

13.2.3 The proposed methods of construction for these elements of the King Edward Memorial Park Foreshore site are described in Section 3 of this volume and summarised in Vol 21 Table 0.1. Approximate duration of construction and depths are also contained in Vol 21 Table 0.1 below.

[iii] 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.

Vol 21 Table 0.1 Groundwater – methods of construction

Design element	Method of construction	Construction periods (years)*	Construction depth (mbgl)**
CSO drop shaft	Diaphragm walls[iv] with internal dewatering and fissure grouting[v]	<1	Deep (around 60)
Reception/launch of TBM	Reception/launch of TBM would involve dewatering and ground treatment of the lower aquifer	<1	Deep
Interception chamber and connection culvert	Secant or sheet piles[vi] with ground treatment	<1	Deep (around 13)

** The site would be used for construction purposes for up to 4 years*
*** In terms of construction depth - deep (means >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 dewatering from excavations to prevent silty water from entering watercourses, surface water drains and onto roads as per Environment Agency (EA) guidelines (EA, 2011a)[2]. The contractor would have plans and equipment in place to deal with emergency situations as well as ensuring that staff are appropriately trained.

[iv] Diaphragm wall - a sub-surface structure installed to support the required excavation and to cut off potential inflows of groundwater typically formed of reinforced concrete. This barrier would extend down by up 8m below the base of the shaft invert for structural reasons and to increase the length of the flow path and hence reduce the amount of groundwater inflows.

[v] Grouting - a thin, coarse mortar injected into various voids and narrow cavities, such as rock fissures, or to fill them and consolidate the adjoining objects into a solid mass and to eliminate water flow.

[vi] Sheet or secant pile wall - a sub-surface structure to support the required excavation and in order to control inflows of shallow groundwater. Sheet piles typically formed of steel. Secant piles typically formed of intersecting concrete or overlapping shafts of concrete.

b. A precautionary approach, involving targeted risk-based audits and checks by monitoring water quality, would be applied to licensed abstractions 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. The use of any materials for ground treatment would be agreed with the EA prior to use.

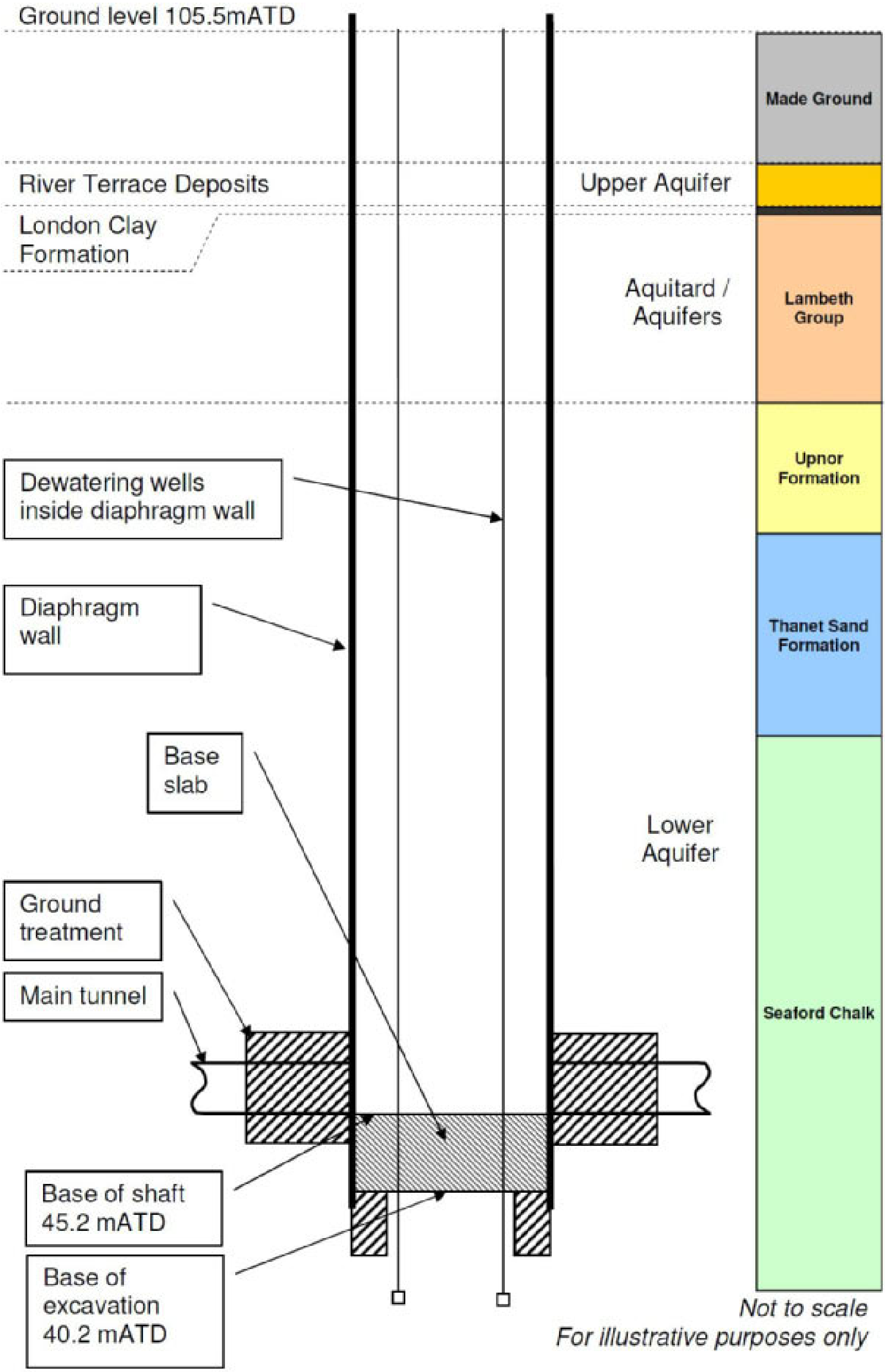
e. At the end of construction where temporary support does not form part of the operational structure it would be removed, piped through or cut down to avoid the build up of groundwater on the upstream side of underground structures.

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 CSO drop shaft means that it would extend into the Seaford Chalk (lower aquifer) (see Vol 21 Table 13.4.1 and Vol 21 Appendix K.1), which is expected to contain substantial quantities of groundwater. The drop shaft would be constructed using diaphragm walling techniques (see Vol 21 Plate 0.1) installed to a depth suitable to reduce the flow of water into the CSO drop shaft, below the base of the drop shaft. This would reduce the amount of pumping required from within the diaphragm wall. There would be no pumping external to the diaphragm wall (internal dewatering would be undertaken). This approach should ensure any movement of known groundwater contamination beneath the site (see Section 13.4) is minimised during pumping. Pumping would be required during construction of CSO drop shaft for approximately 12 months and for the break in / out of the drop shaft for the tunnel boring machine (TBM) *en-route* to Abbey Mills.

Vol 21 Plate 0.1 Groundwater – Schematic of a diaphragm wall internally dewatered



13.2.7 The water levels in the Chalk outside the diaphragm wall would be drawn down by only a few metres, due to the barrier effects. An estimate of the average amount of dewatering which would be needed at the King Edward Memorial Park Foreshore site would be less than 200m^3/d. The pumped groundwater would be discharged directly to the river, following any necessary treatment and subject to EA approval.

13.2.8 Ground treatment, including fissure grouting, would be required within the Chalk immediately below the base of the shaft and to facilitate TBM break in / out of the drop shaft. In addition, grouting may be required in the Laminated Beds of the Lambeth Group at the toe of the existing river wall prior to excavation beneath this level in order to construct the interception chambers (see para 13.2.9). The amount of grouting required would depend on the ground conditions encountered. As with other sites, it is assumed, for the purposes of the assessment, that grout blocks around the full circumference of the shaft would be approximately 5m high with a width of 1.5m. For the TBM, for the purposes of the assessment, it is assumed that ground treatment on either side of the shaft would have dimensions of approximately 15m by 15m and extending 15m from the shaft into the surrounding Chalk.

13.2.9 The CSO connections, interception chamber and connection culvert would be constructed using steel bar reinforced cast *in-situ* concrete culverts and chambers. To prevent inundation from the tidal Thames, local support to the toe of the existing river wall, in the form of secant or sheet piles and ground treatment, may be required where the excavation is required to extend below this level. The site would extend partly into the tidal Thames and this part of the site would be protected from inundation by the temporary cofferdam. Both the temporary and permanent cofferdams would be constructed from sheet pile walls. It is assumed that the toe level of the sheet piles would be approximately 2m below the base of the London Clay and finishing in the Upper Mottled Beds of the Lambeth Formation at approximately 93.2mATD. Water entering through the cofferdam would be pumped back to the river following any required treatment. The temporary sheet piles in the river would be removed at the end of the construction period.

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 Environmental assessment methodology documents the overall engagement which has been undertaken in preparing the *Environmental Statement*. There have been no site-specific comments relevant to the King Edward Memorial Park Foreshore site for the assessment of groundwater.

Baseline

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

13.3.3 The baseline describes receptors within a 1km radius of the CSO sites during both construction and operation.

13.3.4 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 of wider regional significance and are assessed in the project-wide assessment (see Vol 3).

Construction

13.3.5 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.

13.3.6 The assessment year applied to the construction assessment is Site Year 1 of construction. In this year, dewatering would first take place at the King Edward Memorial Park Foreshore site. The baseline is not anticipated to change substantially between 2011 and Site Year 1 and so baseline data from 2011 have formed the basis for the construction assessment.

13.3.7 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. The developments considered as part of the base case are detailed in Vol 21 Table 13.3.1. 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.

Vol 21 Table 13.3.1 Groundwater – construction assessment

Development	Component or receptor relevant to groundwater	Construction base case	Cumulative effect assessment
John Bell House, King David Lane	Basement*	✓	✗
Former land bounded by Schoolhouse Lane, Cable Street and Glasshouse Fields, London E1	Basement*	✓	✗

** Relevant to the upper aquifer*
Symbols ✓ applies ✗ does not apply

13.3.8 Section 13.5 details the likely significant effects arising from the construction at the King Edward Memorial Park Foreshore site. Other Thames Tideway Tunnel project sites which could give rise to additional effects on groundwater resources are Kirtling Street and Blackfriars Bridge

Foreshore sites. These Thames Tideway Tunnel project sites are therefore included in the assessment of the impact of dewatering on the lower aquifer and licensed abstractions at the King Edward Memorial Park Foreshore site, following the methodology set out in Vol 2 Section 12.

Operation

13.3.9 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 the King Edward Memorial Park Foreshore site.

13.3.10 The assessment year applied to the operational assessment is Year 1 of operation. The baseline is not anticipated to vary significantly by the start of the operational phase; and therefore, baseline data from 2011 have formed the basis for the operational assessment. In addition, information on proposed development schemes likely to have been completed before commencement of the operation of the Thames Tideway Tunnel project has formed part of the operational base case.

13.3.11 The developments considered as part of the operational base case are included in Vol 21 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.

Vol 21 Table 13.3.2 Groundwater – operation assessment

Development	Component or receptor relevant to groundwater	Operational base case	Cumulative effect assessment
John Bell House, King David Lane	Basement*	✓	✗
Former land bounded by Schoolhouse Lane, Cable Street and Glasshouse Fields, London E1	Basement*	✓	✗

** Relevant to the upper aquifer*
Symbols ✓ applies ✗ does not apply

13.3.12 Section 13.6 details the likely significant effects arising from the operation at the King Edward Memorial Park Foreshore 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 the King Edward Memorial Park Foreshore site during the operational phase and so no other Thames Tideway Tunnel project sites are considered in this assessment.

Assumptions and limitations

Assumptions

13.3.13 The construction assumptions relevant to the site are presented in Section 13.2.

13.3.14 The assessment of dewatering in Section 13.5 is based on a quantitative assessment of dewatering on the lower aquifer using the best available hydraulic property information from the EA's London Basin groundwater model. The hydraulic properties for the Chalk obtained from this model, were an average transmissivity value of approximately $90m^2/d$ (EA and ESI, 2010)[3] and a storativity[vii] value of approximately 1×10^{-4} at the King Edward Memorial Park Foreshore site (see Vol 2 Section 13).

13.3.15 The amount of pumping required from within the diaphragm wall at the King Edward Memorial Park Foreshore site is assumed to be less than $200m^3/d$.

13.3.16 The assessment of obstruction effects in Sections 13.5 and 13.6 is based on estimated hydraulic gradient[viii] of 0.004 in the upper aquifer across the site.

13.3.17 The regional groundwater flow direction in the Chalk is based on the EA groundwater contour map (EA, 2011b)[4] and this indicates flow towards the northwest.

13.3.18 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).

13.3.19 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 indicative only.

13.3.20 For the purposes of this assessment, deep refers to greater than 10m below ground level (bgl) and shallow refers to less than 10m bgl.

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 21 Appendix K.2).

13.3.22 Groundwater level data available for this assessment is limited, with monitoring data available from one borehole within the upper aquifer and one borehole within the lower aquifer. This has meant that hydraulic gradients could only be estimated across the site. 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.

[vii] Storativity – the volume of water released for a unit change in water level (in a confined aquifer).

[viii] Hydraulic gradient – the slope of the water table which drives groundwater movement.

13.3.23 Groundwater quality data available at this site is also limited.

13.3.24 Despite the limitations identified above, the assessment which uses the best available information is considered robust.

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 21 Appendix K.1 – K.9.

Current baseline

Hydrogeology

13.4.3 The CSO drop shaft would pass through Made Ground, River Terrace Deposits, London Clay, Lambeth Group, Thanet Sands and Seaford Chalk. The superficial and solid geology in the vicinity of the site, as published by the British Geological Survey (BGS, 2009)[5], is shown in Vol 21 Figure 13.4.1 and Vol 21 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[ix]. The Upnor Formation, Thanet Sands and the Chalk form the lower aquifer and are classified by the EA as a principal aquifer. The presence of the London Clay Formation and the Lambeth Group is expected to separate hydraulically the upper and lower aquifers at the King Edward Memorial Park Foreshore site.

13.4.5 The depths and thicknesses of the geological layers have been determined by reference to a number of ground investigation boreholes located up to 260m from the King Edward Memorial Park Foreshore site and on one foreshore borehole immediately adjacent to the site. These boreholes are SR1031, SR1033A. SR1033H, PR1034A, SR1034A and SR2029 and the locations of boreholes around the site are shown in Vol 21 Figure 13.4.1 (see separate volume of figures). The depths and thicknesses of geological layers encountered are summarised in Vol 21 Table 13.4.1.

Vol 21 Table 13.4.1 Groundwater - anticipated ground conditions/ hydrogeology

Formation/ Group	Top elevation* (mATD)	Depth (m)	Thickness (m)	Hydrogeology
River Terrace Deposits	98.0	0.0	2.5	Upper aquifer

[ix] Secondary aquifer – either a geological stratum that exhibits high inter-granular and/or fracture permeability (was previously referred to as a minor aquifer)

Formation/ Group	Top elevation* (mATD)	Depth (m)	Thickness (m)	Hydrogeology
London Clay				Aquiclude[x]
A2	95.5	2.5	0.3	
Lambeth Group				Aquitard[xi]/ aquifer
UMB	95.2	2.8	3.2	
LtB	92.0	6.0	1.4	
Sand Unit	90.6	7.4	1.0	
LtB/LSB	89.6	8.4	3.0	
LMB	86.5	11.4	2.2	
Upn (Gv)	84.3	13.7	1.6	Lower aquifer
UPN	82.6	15.3	5.8	
Thanet Sand	76.8	21.2	11.6	
Seaford Chalk	65.1	32.8	Not proven	

** Based on an assumed ground level of 105.50mATD and top elevation of over-water boreholes is approximately 7m below assumed ground level*
UMB–Upper Mottled Beds; LtB–Laminated Beds; LSB-Lower Shelly Beds; LMB-Lower Mottled Beds; UPN (Gv)-Upnor Formation(Gravel); UPN-Upnor Formation.

Groundwater level monitoring

13.4.6 Groundwater level monitoring has been undertaken at a number of 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.

13.4.7 The information on groundwater levels for this assessment has been collected from the three off site ground investigation boreholes (SR1031, SR1033A. SR1033H, PR1034A, SR1034A and SR2029 inclusive) located within 100m from the King Edward Memorial Park Foreshore site. The locations are shown in Vol 21 Figure 13.4.3 (see separate volume of figures). These boreholes have response zones[xii] in the River Terrace Deposits, Thanet Sands and Seaford Chalk and are monitoring groundwater levels in both the upper and lower aquifers. Vol 21 Table 13.4.2 summarises the minimum, average and maximum water levels at the six ground investigation boreholes.

---

[x] 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).

[xi] 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).

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

Vol 21 Table 13.4.2 Groundwater – recorded water levels

Monitoring borehole ID	Formation	Average over period of record (mATD)	Minimum (mATD)	Maximum (mATD)
SR1034A	River Terrace Deposits	102.41	102.04	102.89
SR1033A*	Thanet Sands	75.37	75.00	76.13
PR1034A**	Seaford Chalk	75.94	75.52	76.61
TQ37/276	Seaford Chalk	83.96	80.74	90.17

** SR1034A (L) records similar piezometric levels in the Thanet Sands*
*** SR1031 and SR1034H record similar piezometric levels in the Seaford Chalk*

13.4.8 The recorded water levels in the River Terrace Deposits at SR1034A are consistently above the top of the formation, indicating that confined[xiii] conditions at this site by the overlying Made Ground.

13.4.9 The recorded water levels (piezometric head[xiv]) recorded in the Thanet Sand remained below the top of the formation and shows a downward trend, suggesting that water levels are being drawn down by nearby pumping.

13.4.10 The piezometric levels in the Seaford Chalk remain above the top of the formation, indicating confined conditions in the Chalk at the site. There are very similar measured responses in the Thanet Sands and Chalk, indicating that these units are in hydraulic continuity. Further detail on water level monitoring is provided in Vol 21 Appendix K.3

13.4.11 The nearest EA groundwater level monitoring borehole is called Rotherhithe (London Underground), station number TQ37/276, located at approximately 1km to the southwest of the King Edward Memorial Park Foreshore site (see Vol 21 Figure13.4.4 in separate volume of figures). The average, minimum and maximum recorded levels from this borehole are also shown in Vol 21 Table 13.4.2

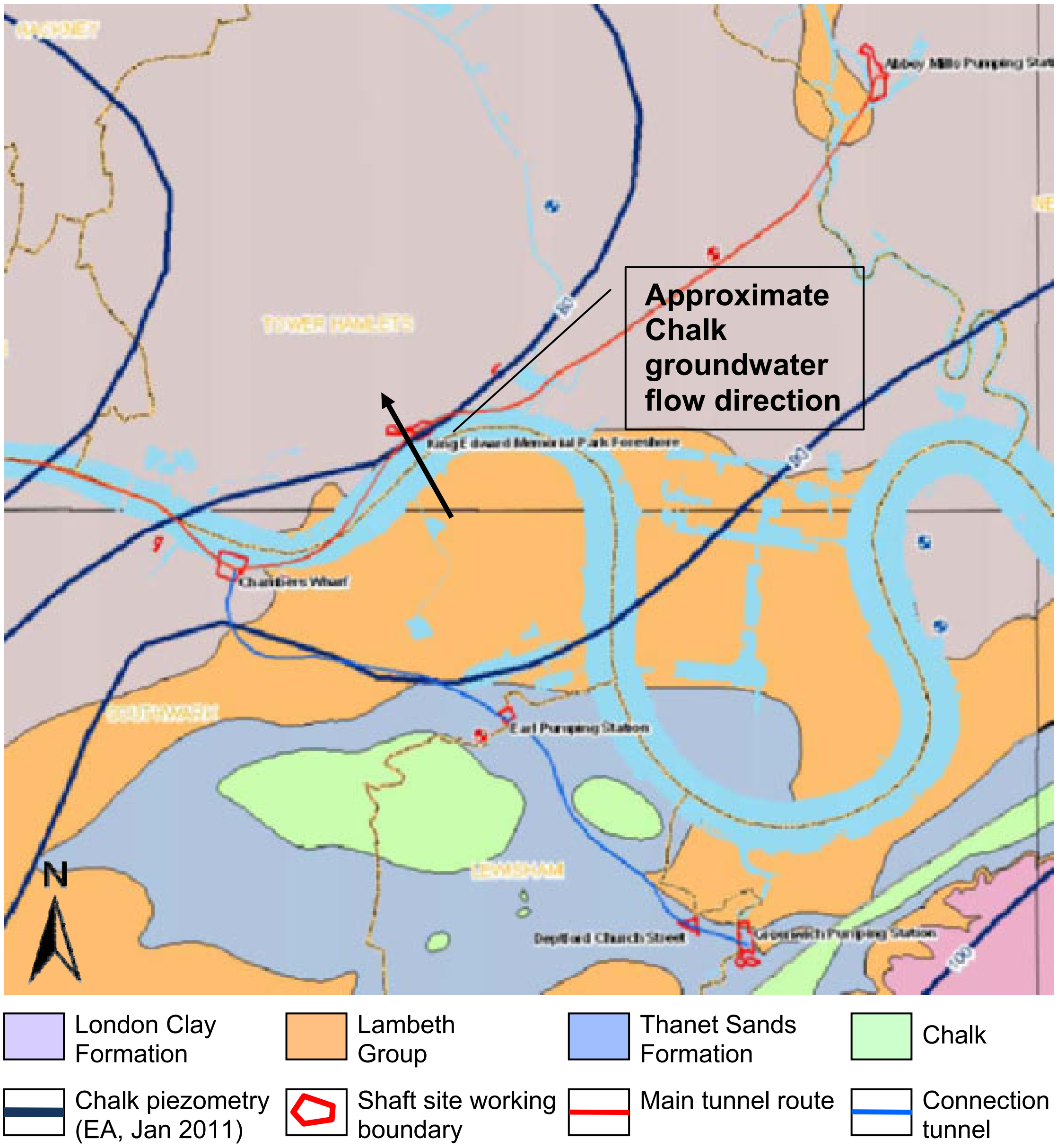
13.4.12 The EA produces an annual regional groundwater contour map (piezometry) of the Chalk, showing a snap-shot of groundwater flows in time (EA, 2011b)[6]. The January 2011 map indicates that the regional direction of groundwater flow (perpendicular to the groundwater contours) at this point in time was northwest in the Chalk around the King Edward Memorial Park Foreshore site (see Vol 21 Plate 13.4.1).

13.4.13 In the absence of further monitoring boreholes within the upper aquifer, it is not possible to accurately determine the direction of groundwater flow within this waterbody; however it is likely to be from southeast to northwest and this has been assumed in this assessment.

[xiii] 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.

[xiv] Piezometric head – the level or pressure head to which confined groundwater would rise to in a piezometer if it is open to the atmosphere.

Vol 21 Plate 13.4.1 Groundwater – Chalk groundwater level contour map



** Extract from Vol 21 Figure 13.4.2 (see separate volume of figures)*

Licensed abstractions

13.4.14 There are no licensed abstraction sources from the upper or lower aquifers located within a radius of 1km around the King Edward Memorial Park Foreshore site. The nearest abstraction source is 28/39/42/0048, located at just over a kilometre to the south, which abstracts for amenity purposes from the Chalk.

13.4.15 There are no licensed abstractions from the River Terrace Deposits or known unlicensed abstractions within 1km of the King Edward Memorial Park Foreshore site.

Groundwater source protection zones

13.4.16 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 modelled SPZ for a Chalk source (lower aquifer) lies approximately 3.2km to the northeast. This is not in the direction of the expected ground flow direction beneath the site, which is towards the northwest.

Environmental designations

13.4.17 There are no designations relevant to groundwater within 1km of the site.

Groundwater quality and land quality

13.4.18 Historical land use mapping reviewed as part of the land quality assessment identified various potentially contaminative land uses in close proximity to the King Edward Memorial Park Foreshore site (see Vol 21 Appendix K.7).

13.4.19 The baseline groundwater quality data obtained from boreholes SR1033H, SR1033A, PR1034A, SR1034A, SR1031, SR1030, SR1029, SA1038 and SA1029A (located up to 1km of the King Edward Memorial Park Foreshore site and shown in Vol 21 Figure 13.4.1 in separate volume of figures) show exceedances of the UK drinking water standards or relevant Environmental Quality Standards (EQS) pertaining to both brackish conditions (in the upper and lower aquifers), as indicated by the elevated concentrations of chloride, conductivity and sodium. The occurrence of brackish conditions here is to be expected given the location within and adjacent to the tidal Thames.

13.4.20 The data also shows exceedances with respect to hydrocarbon contamination in the upper aquifer (at SR1034A located at 105m from the site) and lower aquifer (at PR1034A located at 94m from the site and at SR1031 located at 260m from the site). Specifically the presence of aromatics (C6-7), Benzo(a)pyrene and Benzo(g,h,i)perylene have been detected. Further details are included in Vol 21 Appendix K.7).

13.4.21 The land quality data from the ground investigation boreholes used in the groundwater quality assessment show no exceedances of the human health screening values (EA, 2009)[7] (soil guideline values designed to be protective of human health) within the River Terrace Deposits or lower aquifer. Further detail is provided in the land quality assessment (see Vol 21 Appendix F).

Groundwater flood risk

13.4.22 There are no reported incidences of groundwater flooding in the vicinity of the site, based on information from the London Borough of Tower Hamlets Strategic Flood Risk Assessment (SFRA) (Capita Symonds, 2012)[8].

Groundwater receptors

13.4.23 Groundwater receptors which could be affected during construction or operation are summarised in Vol 21 Table 13.4.3 below. Both the upper and lower aquifers have been assessed as receptors as both would be penetrated by the CSO drop shaft at the King Edward Memorial Park Foreshore site. There is one abstraction source from the Chalk, at just over 1km radius from the site and which have also been assessed for the construction phase.

Vol 21 Table 13.4.3 Groundwater - receptors

Receptor	Construction	Operation	Comment
Groundwater Body – Upper Aquifer	✓	✓	Penetrated by CSO drop shaft, interception chambers & culverts
Groundwater Body – Lower Aquifer	✓	✓	CSO drop shaft and base slab extend into lower aquifer
Licensed abstractions – lower aquifer	✓	×	One licensed abstraction at just over 1km of site (28/39/42/0048)
Licensed abstractions - upper aquifer	×	×	No licensed abstractions within 1km of site
Unlicensed abstractions	×	×	None known
Planned developments	×	×	No planned licensed abstractions or Ground Source Heat Pumps (GSHP's)

** Symbols ✓ applies × does not apply*

Receptor sensitivity

13.4.24 The upper aquifer is classified by the EA as a secondary A aquifer and is allocated a medium value in terms of quantity in this assessment. The upper aquifer has known brackish water quality and hydrocarbon contamination. Therefore it is categorised as being of low value with regard to quality close to the tidal Thames.

13.4.25 The lower aquifer is a principal aquifer as classified by the EA and so is categorised as being of high value with regard to quantity (resource). Given that the baseline groundwater quality data suggests brackish conditions and there is known contamination locally, the lower aquifer is categorised as being of medium value with regard to quality.

13.4.26 A summary of receptor sensitivities used in the assessments that follow are included in Vol 21 Table 13.4.4.

Vol 21 Table 13.4.4 Groundwater – receptor value/ sensitivity

Receptor	Value/sensitivity
Groundwater quality	
Upper Aquifer	Low value; secondary A aquifer but brackish conditions.
Lower Aquifer	Medium value; principal aquifer but brackish conditions and contamination.
Groundwater quantity (resources)	
Upper Aquifer	Medium value; secondary A aquifer.
Lower Aquifer	High value; principal aquifer.
Licensed Chalk abstraction 28/39/42/0048 (2 boreholes)	Medium value; industrial source, used for amenity purposes

Construction base case

13.4.27 The construction base case in Site Year 1 is as per the current baseline and also includes any developments that are likely to be complete and partially or fully operational during construction at the King Edward Memorial Park Foreshore site, and would have the potential to lead to a change to groundwater in the upper and lower aquifers.

13.4.28 The basements associated with other developments identified in Vol 21 Table 13.3.1 could cause some disruption to groundwater flow in the upper aquifer. Any substantive changes from the baseline conditions prior to construction would be detected by monitoring of groundwater levels.

13.4.29 None of the proposed developments identified in Vol 21 Table 13.3.1 would impact on the lower aquifer and it can be concluded that there would be no change to the base case in Site Year 1 of construction.

Operational base case

13.4.30 The operational base case is as per the construction base case. Therefore it can be concluded that there would be no change to the base case in Year 1 of operation in terms of groundwater flow in both upper and lower aquifers.

13.5 Construction effects assessment

Construction impacts

Dewatering of aquifers

13.5.1 No dewatering from the upper aquifer is anticipated as the diaphragm wall used to construct the CSO drop shaft would extend down into the London Clay Formation. There are no licensed abstraction sources within the upper aquifer located within 1km of the site. The magnitude of impact on the upper aquifer is assessed to be negligible.

13.5.2 For the construction of the Thames Tideway Tunnel project as a whole, groundwater levels in the lower aquifer would have to be lowered by dewatering to allow construction of CSO drop shafts, connection culverts and below ground chambers. The impact of this project-wide dewatering is discussed in detail in Vol 3 Section 10. Impacts have been quantified by modelling (see Vol 3 Section 10 Appendix K.2) and the effects, where they are of relevance to the King Edward Memorial Park Foreshore site, are included in this assessment.

13.5.3 The design at the King Edward Memorial Park Foreshore site uses diaphragm walls that hydraulically isolate the inside of the CSO drop shaft from the surrounding ground. The amount of dewatering which would be needed at this site is estimated at less than $200m^3/d$ and would be pumped from within the diaphragm walls ("internal dewatering"). Any drawdown within the shaft would be isolated from water levels outside the diaphragm wall and it is anticipated that these levels would only be lowered by a few centimetres (based on experience from the Lee Tunnel project [WJ Groundwater, 2012])[9].

13.5.4 Details of the groundwater modelling undertaken to inform the assessment of likely significant effects at the King Edward Memorial Park Foreshore site are included in Vol 3 Appendix K.2. The draft groundwater level monitoring (Vol 3 Appendix K.1) already reflects the pumping from local abstraction source located to the south (see para 13.4.14).

13.5.5 In addition to the limited dewatering at the King Edward Memorial Park Foreshore site CSO drop shaft described above, there would also be drawdown (lowering of groundwater levels) on the lower aquifer as a result of project-wide dewatering. The full details of the effect on the one licensee, which is located over a kilometre from the site, are set out in the modelling report (Vol 3 Section 10 Appendix K.2). For this licensee the impact of drawdown is assessed by comparing it to the maximum available drawdown (MAAD)[xv] at the licensee's borehole(s).

a. In the case of licence number 28/39/42/0048, there are two boreholes, A and B. Modelling has predicted a maximum drawdown of around 2m at borehole A, this less than the MAAD of 7m. The magnitude of impact at borehole A is assessed to be negligible.

b. In the case of licence number 28/39/42/0048 borehole B, modelling has predicted a maximum drawdown of around 2m, which does not exceed the MAAD of 16m. The modelled drawdown has predicted that water levels would stay at least 14m above the pump. The magnitude of impact at borehole B is assessed to be negligible.

[xv] Maximum available drawdown – is defined as the difference between the pumped water level and depth of the pump or difference between the pumped water level and the top of the Thanet Sand (which is designed to prevent oxidation and the mobilisation of natural pollutants); which ever is least of these two values is applied with this assessment.

Groundwater quality

13.5.6 The baseline groundwater quality baseline data from the nearby ground investigation boreholes shows exceedances in the River Terrace Deposits, Upnor Formation, Thanet Sands and the Seaford Chalk for hydrocarbons and indicators of brackish conditions (chloride and sodium). The brackish conditions are to be anticipated in a location close to the tidal Thames. There are also indications from the land quality assessment (see Vol 21 Appendix F) that the potentially contaminative uses may have taken place locally.

13.5.7 The CSO drop shaft construction may create a pathway for groundwater movement between the shaft and the ground, where an effective seal is not in place. However, the diaphragm walls would seal out the upper aquifer and any water encountered would be pumped out and disposed of appropriately, following the measures identified within the *CoCP* (and detailed in Section 13.2). Given the preceding approach, the magnitude of the impact on the upper aquifer is assessed to be low.

13.5.8 In addition, there is the potential for poor quality groundwater to migrate and to further degrade groundwater quality in the lower aquifer. The nearest licensed abstraction is at 1km from the site and is located up hydraulic gradient of the site, and therefore not considered to be at direct risk. In addition, any dewatering of the lower aquifer would be internal to the diaphragm walls and that any groundwater encountered would be pumped out and disposed of appropriately, following the measures identified within the *CoCP* (and detailed in Section 13.2). The magnitude of the impact on the lower aquifer is assessed to be negligible.

13.5.9 No ground treatment is anticipated to be required within the upper aquifer; and the magnitude of the impact on the upper aquifer is assessed to be negligible.

13.5.10 Ground treatment is anticipated to be required within the lower aquifer. The hydraulic properties information (see Vol 3 Appendix K.2) for the area indicates a medium transmissivity value. The amount of treatment would depend on the depth of diaphragm wall and the ground conditions encountered. There is the potential for grout contaminated groundwater (characterised by excess turbidity) to migrate and impact on groundwater quality in the lower aquifer. However, given that internal dewatering would limit the potential movement of grout contaminated groundwater, the impact on groundwater quality within the lower aquifer has been assessed to be negligible.

13.5.11 The EA aims to manage groundwater abstractions to keep groundwater levels above the top of the Thanet Sands. The lowering of water groundwater levels below the top of the Thanet Sands may lead to deterioration in water quality within the lower aquifer although the recorded groundwater levels at PR1034A are below the top of the formation already. Project-wide dewatering within the lower aquifer would draw water levels down at the King Edward Memorial Foreshore site by an estimated 2m and this level of drawdown is not anticipated to result in any substantial changes in groundwater quality. The magnitude of this project-wide impact on groundwater quality has been anticipated to be negligible and has been dealt with further in Vol 3 Section 10.

Physical obstruction

13.5.12 The construction of underground structures may disrupt groundwater flow and alter groundwater levels in both the upper and lower aquifers.

13.5.13 The methodology for assessing the impact of all below ground activities upon the groundwater levels in the upper aquifer is described in Vol 2 Appendix K.2. It is estimated that the groundwater level would rise during the construction phase at the King Edward Memorial Park Foreshore site by approximately 0.3m, based on an estimated hydraulic gradient of 0.004.

13.5.14 Based on the limited available data, groundwater levels in the upper aquifer (River Terrace Deposits) can reach 102.9mATD, this is approximately 2.6m below the existing ground surface at the King Edward Memorial Park Foreshore site of 105.5mATD (see Vol 21 Table 13.4.1). However these water levels are confined and under pressure (piezometric head). Therefore the small predicted rise in water levels (0.3m) on the southeast side of the King Edward Memorial Park Foreshore site would result in increased pressure within the River Terrace Deposits rather than actual increased water levels (see explanation in Vol 2 Appendix K.2). The impact on the upper aquifer is assessed to be negligible.

13.5.15 The presence of the drop shaft in the lower aquifer may form a physical obstruction to local groundwater flow around the shaft. The impact of this change is reduced because none of the abstraction points are located in a down hydraulic gradient direction. The impact on the lower aquifer is assessed to be negligible.

Construction effects

13.5.16 By combining the impacts identified above with the receptor value in Vol 21 Table 13.4.4, 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

13.5.17 No dewatering of the upper aquifer is anticipated to be required. This negligible impact on a medium value receptor, the upper aquifer with regard to quantity, would result in a **negligible** effect.

13.5.18 The effects from dewatering of the lower aquifer are expected to be between minor adverse and negligible depending on the receptor considered.

a. Lower aquifer is classified as a high value receptor in terms of groundwater resources. A negligible impact on this high value receptor would result in a **minor adverse** effect.

b. Licence number 28/39/42/0048 (borehole A) is licensed for use for industrial, commercial and public services including amenity purposes and is classified as being of medium value. A negligible impact on this medium value receptor would result in a **negligible** effect.

c. Licence number 28/39/42/0048 (borehole B) is also used for amenity purposes and is classified as being of medium value. A negligible impact on this medium value receptor would result in a **negligible** effect.

Groundwater quality

13.5.19 The baseline groundwater quality data show exceedances in the upper aquifer with respect to hydrocarbons in close proximity to the King Edward Memorial Park Foreshore site. However, the use of the diaphragm wall construction technique would limit any movement of contaminated groundwater should it be encountered. A low impact on a receptor of low value, the upper aquifer with regard to quality, would result in a **negligible** effect.

13.5.20 No grouting is anticipated to be required within the upper aquifer. This negligible impact on groundwater quality on a low value receptor, the upper aquifer to quality, would result in a **negligible** effect.

13.5.21 The baseline groundwater quality data also shows exceedances in the lower aquifer with respect to hydrocarbons in close proximity to the site. However, the use of the diaphragm wall construction technique would limit any movement of contaminated groundwater should it be encountered. This negligible impact on a receptor of medium value, the lower aquifer with regard to quality, would result in a **negligible** effect.

13.5.22 Grouting is anticipated to be required within the lower aquifer. This **negligible** impact on a receptor of medium value, the lower aquifer with regards to quality, would result in a **negligible** effect.

13.5.23 The drawing down on water further into the Thanet Sand may lead to a deterioration in groundwater quality in the lower aquifer. A negligible impact on a receptor of medium value would result in an overall **negligible** effect.

Physical obstruction

13.5.24 The physical impact of all below ground activities upon the local groundwater levels in the upper aquifer is considered negligible. This negligible impact on a medium value receptor (upper aquifer with regards to quantity), would result in an overall **negligible** effect.

13.5.25 The physical impact of the drop shaft upon the lower aquifer as a result of obstruction can be considered negligible given the extent and thickness of the lower aquifer and the distance to the nearest licensed abstraction source. This negligible impact on a high value receptor (lower aquifer with regards to quantity) would result in an overall **minor adverse** effect.

13.6 Operational effects assessment

Operational impacts

Physical obstruction

13.6.1 The presence of the operational CSO drop shaft, the connection culvert and other chambers in the upper aquifer may disrupt local groundwater flow and alter groundwater levels.

13.6.2 The method for assessing the impact upon the groundwater levels in the upper aquifer is described in Vol 2 Appendix K.2. It is estimated that the groundwater rise during the operational phase at King Edward Memorial Park Foreshore site would be less than 0.1m, based on an assumed hydraulic gradient of 0.004.

13.6.3 Groundwater levels in the upper aquifer can reach 102.9mATD, which is approximately 2.6m below the existing ground surface at the King Edward Memorial Park Foreshore site. The small predicted rise in water levels (less than 0.1m) on the southeast (upstream) side of the structure would be a negligible impact.

13.6.4 The main tunnel shaft would extend down approximately 44m into the lower aquifer and with an external diameter of approximately 26m. The physical impact of the drop shaft upon the lower aquifer as a result of physical obstruction can be considered negligible given the areal extent and thickness of the lower aquifer and the distance to the nearest licensed abstraction source.

Seepage into CSO drop shaft

13.6.5 An estimate of the theoretical seepage volumes into the drop shaft at the King Edward Memorial Park Foreshore site is included in Vol 2 Appendix K.3. The estimated loss of water from the upper aquifer into the drop shaft is 57m^3/annum (Table K.4) and the magnitude of impact is assessed as negligible for the upper aquifer.

13.6.6 The estimated loss of water resources from the lower aquifer is 1011m^3/annum which is considered to be a negligible impact.

Seepage from CSO drop shaft

13.6.7 An estimate of the seepage volumes from the CSO drop shaft at the King Edward Memorial Park site is included in Vol 2 Appendix K.3. The shaft would be full for only approximately 3% of the year, or 11 days per year (Vol 3 Section 10). The estimated volume of seepage from the shaft into the upper aquifer is 1.7m^3/annum (Table K.5). The higher heads outside the CSO drop shaft means that any risk of seepage from the CSO drop shaft into the upper aquifer would be further reduced. The magnitude of impact is assessed as negligible for the upper aquifer.

13.6.8 The estimated volume of seepage from the drop shaft into the lower aquifer is 30m^3/annum (Table K.5). The magnitude of impact is assessed as negligible for the lower aquifer.

No other operational impacts are envisaged.

Operational effects

13.6.9 By combining the receptor value (Vol 21 Table 13.4.4) 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

13.6.10 Altering groundwater levels on the southeast side of the shaft would be a negligible impact on a medium value receptor (upper aquifer) would lead to a **negligible** effect. The same impact on a high value receptor (lower aquifer) would lead to a **minor adverse** effect.

Seepage into CSO drop shaft

13.6.11 Seepage into the shaft has been determined as a negligible impact, which on a medium value aquifer (the upper aquifer with regard to quantity) would lead to a **negligible** effect. The same impact on a high value receptor (the lower aquifer with regard to quantity) would lead to a **minor adverse** effect.

Seepage from CSO drop shaft

13.6.12 Seepage from the shaft has been determined as a negligible impact on a low value receptor (the upper aquifer with regard to quality) which would lead to a **negligible** effect. The same impact on a medium value receptor (the lower aquifer with regard to quality) would lead to a **negligible** effect.

13.7 Cumulative effects assessment

Construction effects

13.7.1 No cumulative construction effects assessment is required as no development schemes are likely to be under construction during construction at the King Edward Memorial Park Foreshore site. Therefore, the effects on groundwater during construction would remain as described in Section 13.5.

Operational effects

13.7.2 No cumulative operational effects assessment is required as the development schemes identified already form part of the base case prior to the operational phase of the Thames Tideway Tunnel project. Therefore, the effects on groundwater during operation would remain as described in Section 13.6.

13.8 Mitigation

13.8.1 The Thames Tideway Tunnel project includes a number of environmental design measures as described in Section 13.2 and various measures incorporated in the *CoCP* as set out in para. 13.2.4.

13.8.2 No significant effects are identified in the construction assessment and no mitigation is required.

13.8.3 Similarly, no significant effects are identified in the operational assessment and no mitigation is required.

13.8.4 The potential for movement of contamination at the King Edward Memorial Park Foreshore site by project-wide dewatering is discussed in Vol 3 Section 10.

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 21 Table 13.10.1 Groundwater - construction assessment summary

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Upper aquifer (licensed abstractions)	Lowering of groundwater levels	Negligible	None	Negligible
Lower aquifer (licensed Chalk abstractions)	Lowering of groundwater levels	Lower aquifer – minor adverse 28/39/42/0048 (Borehole A) – Negligible 28/39/42/0048 (Borehole B) – Negligible	None	Minor adverse or Negligible
Upper aquifer (groundwater quality)	Deterioration in groundwater quality caused by creation of a pathway	Negligible	None	Negligible
	Deterioration in water quality from grouting	Negligible	None	Negligible
Lower aquifer (groundwater quality)	Deterioration in groundwater quality caused by creation of a pathway	Negligible	None	Negligible
	Deterioration in water quality	Negligible	None	Negligible

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
	from grouting			
	Deterioration from drawing down water levels	Negligible	None	Negligible
Upper aquifer	Change in groundwater storage as a result of physical obstruction	Negligible	None	Negligible
Lower aquifer	Change in groundwater storage as a result of physical obstruction	Minor adverse	None	Minor adverse

Vol 21 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
Lower aquifer	Change in groundwater levels as a result of physical obstruction	Minor adverse	None	Minor adverse
Upper aquifer	Seepage into drop shaft affecting groundwater resources	Negligible	None	Negligible
Lower aquifer	Seepage into shaft affecting groundwater resources	Minor adverse	None	Minor adverse
Upper aquifer	Deterioration in water quality in the upper aquifer from seepage out of drop shaft	Negligible	None	Negligible

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Lower aquifer	Deterioration in water quality in the lower aquifer from seepage out of drop shaft	Negligible	None	Negligible

References

[1] Defra. *National Policy Statement for Waste Water* (2012)

[2] Environment Agency. *Introducing pollution prevention: PPG 1 – EA Consultation* (2011a).

[3] Environment Agency and ESI. *London Basin Aquifer Conceptual Model*. ESI Report Reference 60121R1 (June 2010).

[4] Environment Agency. *Groundwater level contours for the Chalk aquifer* (2011b).

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

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Thames Tideway Tunnel
Thames Water Utilities Limited

Thames Water

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.21**

Volume 21: King Edward Memorial Park Foreshore site assessment

Section 14: Water resources - surface water

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

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Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

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Thames Tideway Tunnel

Environmental Statement

Volume 21: King Edward Memorial Park Foreshore 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 King Edward Memorial Park Foreshore 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 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:

a. construction activities

b. operation of the main tunnel.

14.1.3 The assessment of construction and operational 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 and operation

d. identification of mitigation measures and the residual effects both during construction and operation.

14.1.4 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.

14.1.5 This assessment covers the effects of the proposed development at the King Edward Memorial Park Foreshore site and in particular in relation to the interception of the North East Storm Relief combined sewer overflow (CSO). It is however important to recognise that whilst the reduction in spills from the North East Storm Relief CSO would be important to water quality in the immediate area of the CSO, the overall water quality benefits in any part of tidal Thames would accrue as a result of the project as a whole, rather than a single part of it. The catchment-wide effects on the tidal Thames, particularly in relation to the water quality improvements anticipated from the proposed Thames Tideway Tunnel project, are assessed separately and presented in Volume 3 Project-wide effects assessment.

14.1.6 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Volume 21 King Edward Memorial Park Foreshore 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 King Edward Memorial Park Foreshore site is partly located within the tidal Thames channel, which means that some of the proposed working area would be within the river bed. A temporary cofferdam would be constructed in the foreshore to enable construction of the permanent works site (see construction plans, separate volume of figures – Section 1).

14.2.3 Barges would be used to import the majority of the cofferdam fill, although it is assumed that other imported materials would be brought in by road. Barges would also be used to export the majority of the excavations from the CSO drop shaft. In order to facilitate the use of barges, campsheds would be constructed adjacent to the cofferdam.

14.2.4 A CSO drop shaft would be constructed at the site. Based on the geology at the site, the construction of the base of the CSO drop shaft and associated infrastructure would require dewatering and or ground treatment. However, internal dewatering of the shaft and associated works is proposed to limit the volume of dewatering required. Disposal of dewatering effluent can have an impact on surface water. See Section 13 of this volume for further details on the dewatering requirements.

14.2.5 The construction of in-river structures and in particular the temporary cofferdam and campsheds would affect the river regime with the potential that localised increases in flow velocity cause scour of the river bed and foreshore, or deposition of sediments. The scour could occur around the face of the cofferdam (abutment scour) or across the channel width (contraction scour). Any potential scour development during construction would be monitored and if relevant trigger levels are reached, appropriate protection measures would be provided. Further details are provided in the *Scour and Accretion Monitoring and Mitigation Plan for Temporary Works in the Foreshore* (see Vol 3 Appendix L.4).

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 are no site specific measures incorporated in the *CoCP* Part B (Section 8) relevant to the surface water assessment.

Operation

14.2.11 The operation of the main tunnel would enable the interception of combined sewage generated during storms which would otherwise discharge to the tidal Thames at King Edward Memorial Park foreshore site from the North East Storm Relief CSO. There would therefore be a reduction in the frequency, duration and volume of spills from this CSO.

14.2.12 The construction of the new permanent structure in the river would affect the river regime with the potential that localised increases in flow velocity cause scour of the river bed and foreshore, or deposition of sediments. Scour protection for the new permanent works would be provided and this would be located within the parameter plan for the site. The approach to scour on third party structures, contraction scour and accretion during the operational phase would be a reactive approach with mitigation measures only provided if required. Further details of the approach are provided in the *Engineering Design Statement*.

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[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).

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) (EA, 2009)[3] and is outlined in Volume 2 Environmental assessment methodology Section 14. A WFD assessment for the project as a whole is presented in Vol 3 Project-wide Section 14.

Engagement

14.3.2 Vol 2 documents the overall engagement which has been undertaken in preparing the *Environmental Statement*. Vol 2 Section 14 of this volume summarises the engagement that has been undertaken for the surface water assessment and the consultation responses relevant to surface water.

14.3.3 There are no site-specific engagement comments relevant to the surface water assessment at the King Edward Memorial Park Foreshore site.

Baseline

14.3.4 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

14.3.5 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.

14.3.6 The assessment year for construction effects is Site Year 1 (2016) 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.

14.3.7 The Lee Tunnel and the sewage treatment 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. Both the construction base case and the operational base case would t be the water quality in the tidal

Thames with the Lee Tunnel and sewage treatment works upgrades in place.

14.3.8 The construction base case has considered the developments that are scheduled to be complete and in operation by Site Year 1 (see Vol 21 Appendix N). The developments in Vol 21 Appendix N would not result in additional surface water receptors (ie, waterbodies) and are considered unlikely to result in changes in water quality as these developments are remote from the tidal Thames. The base case would therefore not change from that outlined above.

14.3.9 No developments have been identified that would be under construction during Site Year 1, therefore a cumulative effects assessment has not been undertaken (Section 14.7).

14.3.10 The assessment area for the effects of construction activities at the King Edward Memorial Park Foreshore site would be limited to two sections of the river, namely the Thames Middle (incorporating Deptford Creek) and Regent's Canal waterbodies listed below in Vol 21 Table 14.4.1.

14.3.11 Section 14.5 details the likely significant effects arising from the construction at the King Edward Memorial Park Foreshore 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.

Operation

14.3.12 The assessment methodology for the operation phase follows that described in Vol 2 Section 14. There are no site-specific variations for undertaking the operational assessment of this site.

14.3.13 The assessment year for operation effects is Year 1 of operation. As with the construction assessment, the operational assessment also relies on modelled water quality data which uses population projections for 2021. In addition, the influence of climate change on the proposed development has been assessed in 2080.

14.3.14 As noted above, the operational base case would be the water quality in the tidal Thames with the Lee Tunnel and sewage works upgrades in place. The operational base case has considered the developments that are scheduled to be complete and in operation by Year 1 of operation (presented in Vol 21 Appendix N). The developments in Vol 21 Appendix N would not result in additional surface water receptors and are considered unlikely to result in changes in water quality as these developments are remote from the tidal Thames. The base case would therefore not change from that outlined above.

14.3.15 No developments have been identified that would be under construction during Year 1 of operation, therefore a cumulative effects assessment has not been undertaken (see Section 14.7).

14.3.16 The operational assessment uses the same assessment area identified above for the construction assessment.

14.3.17 Section 14.6 details the likely significant effects arising from the operation at the King Edward Memorial Park Foreshore site.

Assumptions and limitations

14.3.18 The assumptions and limitations associated with this assessment are presented in Vol 2 Section 14. Based on the geology at the site, it is assumed that the construction of the base of the CSO drop shaft and associated infrastructure would require dewatering and or ground treatment. 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 (EA, 2009)[4] (RBMP), which are either adjacent to the site or downstream of the site and therefore have the potential to be affected by the proposed development[ii], is included in Vol 21 Table 14.4.1 below.

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].

[ii] The EA has provided advice on CSO excursion areas, which states that CSOs below Tower Bridge will only impact the Thames Middle waterbody and those upriver of Tower Bridge will impact both the Thames Upper and Thames Middle waterbodies.

Vol 21 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 Middle GB530603911402	Heavily modified	Moderate potential	Fail	Moderate potential	Fail	Good
Regents Canal, lower section GB70610510	Artificial	Moderate potential	Does not require assessment	Moderate potential	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 Middle (which stretches from Battersea Bridge to Mucking Flats) is considered to be a high value waterbody as although its 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. In addition, the tidal Thames is a valuable water resource, habitat, and source of amenity, recreation, and transport route throughout London.

14.4.5 The Regents Canal is within the vicinity of the site and could therefore be affected by the proposed construction. However, lock gates in the Limehouse Basin at the confluence of the Regents Canal and the tidal Thames prevent water movement for the majority of the time. They are only opened intermittently for the passage of individual boats for four hours either side of high tide. It is therefore considered that there is no pathway for impacts from the site to affect the Regents Canal and it is not considered further within this assessment.

14.4.6 Sediment levels within the tidal Thames are estimated to currently reach a peak of 4,000kg/s in the lower tidal Thames estuary, or more than 40,000t of sediment a day during spring tides (HR Wallingford, 2006)[8].

14.4.7 There are no licensed surface water abstractions within 1km of the King Edward Memorial Park Foreshore site.

14.4.8 The King Edward Memorial Park Foreshore site lies between the EA's spot sample sites at London Bridge and Greenwich, approximately 3km downstream of London Bridge and approximately 5km upstream of Greenwich, as shown on Vol 21 Figure 14.4.1 (see separate volume of figures). Summary data from these monitoring points, which gives 90 percentile values for ammonium (concentration that is exceeded 10% of the time) and 10% percentile values for dissolved oxygen (DO) (concentration exceeded 90% of the time) for spot sample results collected between 2005 and 2009 is presented below in Vol 21 Table 14.4.2.

Vol 21 Table 14.4.2 Surface water – London Bridge and Greenwich spot samples

EA spot sample site	DO (mg/l) (10%)	Ammonium (mg/l) (90%)
Thames at London Bridge	4.81	10.92
Thames at Greenwich	3.59	10.22

14.4.9 Classification of DO standards for transitional waters under the WFD is dependent on the salinity levels. The above 10 percentile values would place the Thames Middle waterbody within the good or moderate potential range, dependent on the associated salinity values.

14.4.10 The discharge from the North East Storm Relief CSO has the effect of depleting DO in the tidal Thames as a result of the biological breakdown of organic matter in the discharges. This causes both a localised (at the King

Edward Memorial Park Foreshore site) and a more widespread effect along the tidal Thames of rapidly dropping DO levels. Vol 3 Section 14 details half-tide plots displaying the changes in DO levels along the tidal Thames.

14.4.11 Historical mapping has identified no contaminative uses on site at King Edward Memorial Park and it is considered that there are no existing viable off site sources of contamination which could have caused significant contamination within the site boundary. However, historic shallow contamination of foreshore sediments has been identified in the operational area. Superficial sediment samples from the foreshore were analysed for a suite of metal, polycyclic aromatic hydrocarbon (PAH) contaminants and the results were compared against the Threshold Effect Levels (TEL) and Probable Effect Levels (PEL). An assessment of potential on-site contamination is provided within Section 8 of this volume.

Current CSO operation

14.4.12 The current operation of the North East Storm Relief CSO has been characterised using catchment model of the sewer system (see Vol 3 for further details of catchment modelling), and the annual average duration, frequency and volume of spill has been defined as follows:

a. the CSO spills on average 31 times in the Typical Year[iii]

b. the CSO spills for a total duration of 286 hours in the Typical Year

c. the spill volume from the CSO is approximately 782,000m^3 in the Typical Year, representing 2% of the total volume discharged to the tidal Thames in the Typical Year from all CSOs.

14.4.13 Using the same model, the annual polluting loading of biochemical oxygen demand (BOD), ammonia and total Kjeldahl nitrogen (TKN) (the sum of organic nitrogen, ammonia [NH_3), and ammonium [NH_4^{+})) of spills from the North East Storm Relief CSO has been defined as follows:

a. the CSO discharges 55,000kg of BOD in the Typical Year

b. the CSO discharges 1,900kg of ammonia in the Typical Year

c. the CSO discharges 8,100kg of TKN in the Typical Year.

14.4.14 Each discharge increases the risk of exposure to pathogens for river users who come into contact with the water. An assessment of health impacts upon recreational users of the tidal Thames was conducted and reported by the Health Protection Agency in 2007 (Lane, C, Surman-Lee, S, Sellwood, J and Lee, JV , 2007)[9]. The study concluded that risk of infection can remain for two to four days following a spill as the water

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iii Typical Year: single year which is most representative of an observed typical year of rainfall with the dataset. The 1979-1980 'water year' defined as the 12 month period ending on the 30th September 1980 containing the sewage moves back and forward with the tide[iv]. The same study also noted that analysis of the illness events reported against discharges on the tidal Thames shows that 77% of cases related to rowing activities undertaken within three days of a CSO spill.

14.4.15 Assuming the average 31 spills per annum from the North East Storm Relief CSO occur on separate days, there could be up to a maximum of 124 days per year where recreational users are at risk of exposure to pathogens in the vicinity of the outfall as a result of the North East Storm Relief CSO spills alone (Lane, C, Surman-Lee, S, Sellwood, J and Lee, JV, 2007)[10].

14.4.16 The operation of the North East Storm Relief CSO results in the discharge of sewage litter along with the discharge of effluent. It has been estimated by the *Thames Tunnel Strategic Study (TTSS)* (Thames Water , 2005)[11] that overflows from all the CSOs along the tidal Thames introduce approximately 10,000t of sewage derived solid material to the tidal Thames annually. Catchment modelling of the current CSO operation has defined the average volume of discharge from the North East Storm Relief CSO and assuming litter tonnages are proportional to discharge volumes, this would indicate that approximately 200t of sewage derived litter is discharged from the North East Storm Relief CSO in the Typical Year. An assessment of the amenity effects of the sewage litter is given in Vol 3 Section 10 Socio-economics.

Construction base case

14.4.17 As explained in Section 14.3, both the construction base case and the operational base case would be the water quality in the tidal Thames with the Lee Tunnel and sewage treatment works upgrades in place (further details are provided below under operational base case).

14.4.18 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.

Operational base case

14.4.19 As noted above, the operational base case would be the same as the construction base case and would include water quality improvement achieved by the Lee Tunnel and the sewage treatment works upgrades

14.4.20 The base case in Year 1 of operation taking into account the schemes described in Section 14.3 would not change since no new sensitive receptors would be introduced.

14.4.21 Catchment modelling results of the base case have demonstrated that by Year 1 of operation (assessed using 2021 modelled assumptions), the frequency, duration and volume of spills from the North East Storm Relief

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[iv] The EA has provided advice on CSO excursion areas, which states that CSOs below Tower Bridge will only impact the Thames Middle waterbody and those upriver of Tower Bridge will impact both the Thames Upper and Thames Middle waterbodies.

CSO would have increased (as a result of increased population) beyond the current baseline as follows:

a. the CSO would spill 32 times in the Typical Year (one more than the current baseline)

b. the CSO would spill for 307 hours in the Typical Year (21 hours more than the current baseline)

c. the spill volume from the CSO would be approximately 848,000m^3 in the Typical Year (66,000m^3 more than the current baseline).

14.4.22 The same catchment modelling has demonstrated that by the operational assessment year, the annual polluting loading of BOD, ammonia and TKN would have increased (as a result of increased population) beyond the current baseline as follows:

a. the CSO would discharge 73,200kg of BOD in the Typical Year (18,200kg more than the current baseline)

b. the CSO would discharge 2,600kg of ammonia in the Typical Year (700kg more than the current baseline)

c. the CSO would discharge 10,800kg of TKN in the Typical Year (2,700kg more than the current baseline).

14.4.23 Following on from the interpretation of the current baseline as per para. 14.4.15 the number of risk days for river users being exposed to pathogens during the operational base case year (taking into account 2021 modelled assumptions) would be a maximum of 128 days in the Typical Year as a result of spills from the North East Storm Relief CSO alone.

14.4.24 Similarly, the tonnage of sewage derived litter discharged from the North East Storm Relief CSO can be expected to increase by approximately 8%, from approximately 200t to approximately 214t in the Typical Year.

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 and permanent works at the King Edward Memorial Park Foreshore site, construction of a cofferdam within the river channel would be required as described in Section 3 of this volume. The channel would be more constricted than at present and together with the new profile of the structure, this would be likely to lead to changes in flows (velocities, directions) and lead to changes in scour and deposition of sediments.

Release of sediments from piling and scour

14.5.3 Minor 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[v]. The proportion of this estimate that would originate from the King Edward Memorial Park Foreshore site is approximately 75t.

14.5.4 It is also possible that the temporary cofferdam 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 (see Section 14.2). Any potential scour development during construction would be monitored and protection measures provided if set trigger levels are reached.

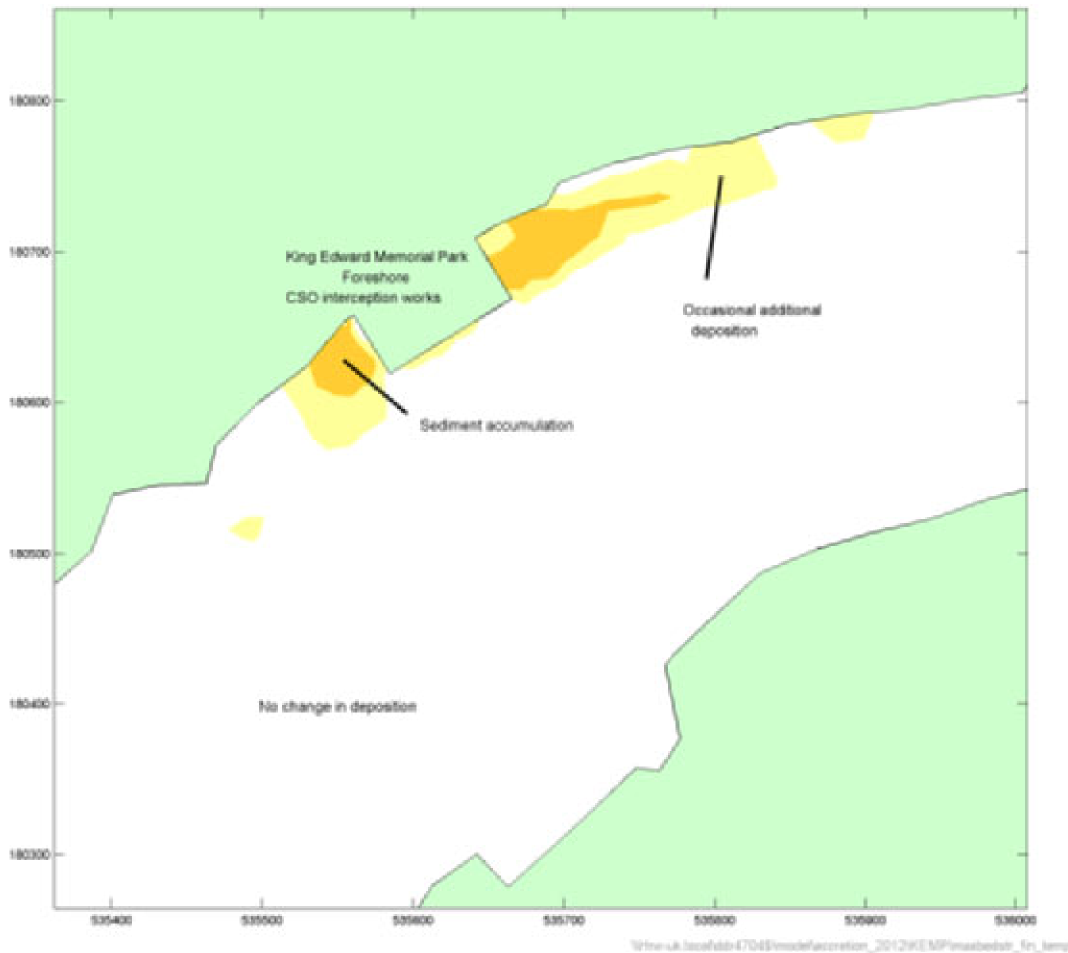
14.5.5 The tidal Thames is a high sediment environment and levels already present within the tidal Thames are estimated to be a peak of 4,000kg/s in the lower tidal Thames estuary or more than 40,000t of sediment passing the site four times a day during spring tides (HR Wallingford, 2006)[12]. In this context, the volumes produced by the construction works from 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.

Deposition

14.5.6 The temporary cofferdam would be likely to lead to changes in flows (velocities, directions) and cause changes in deposition of sediments around the King Edward Memorial Park Foreshore site. These sediments could be those generated by the project itself but would also include sediments occurring naturally in the water column. Modelling carried out (Vol 3 Appendix L.3) has predicted the extent of this deposition, as shown below in Vol 21 Plate 14.5.1.

[v] An assessment of the potential sediment losses anticipated from construction activities within the foreshore is provided in the *Habitats regulation assessment.*

Vol 21 Plate 14.5.1 Surface water – prediction deposition around temporary works at the King Edward Memorial Park site foreshore site



14.5.7 Most deposition is likely to be localised and occur in newly created areas of slack water (as shown above in Vol 21 Plate 14.5.1) but may be remobilised by spring tides (for deposition during neap tides) or by large fluvial flows (for deposition during seasonal low fluvial flows). The overall impact on channel morphology would be negligible.

14.5.8 Impacts on channel morphology from deposition can have an effect on ecological receptors, by changing habitat availability. This effect is assessed in Section 5 Ecology – aquatic.

Pumping and pollution during cofferdam construction

14.5.9 The main pathways for surface water quality impacts during construction at the King Edward Memorial Park Foreshore site are as a result of the requirement for a cofferdam to be constructed in the river channel for both the main construction work and to house the permanent structures once construction is complete.

14.5.10 The cofferdam would be constructed by driving sheetpiles into the river bed, which would be sealed and the water pumped out into the river channel. As the works would be in the channel, there would be a direct pathway for pollutants to be discharged to the river during the construction of the cofferdam which could impact on water quality in this location of the tidal Thames. The adoption of appropriate drainage and pollution control measures as included in the *CoCP* (see para. 14.2.6) should remove the impact pathway.

14.5.11 Before being released to the river, the water to be pumped from behind the cofferdam would be subject to settlement using a lagoon/pond, silt trap or other suitable method (see *CoCP* Part A Section 8) to ensure excessive levels of potentially contaminated suspended solids are not discharged to the tidal Thames. It is considered that via the proposed management of pumping out water from the cofferdam area, the pollution pathway is removed and therefore no impact is anticipated from this source and this is not considered further in the assessment.

Foreshore and contamination within the river channel

14.5.12 Shallow contamination of foreshore sediments has been identified in the operational area. 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.

14.5.13 Any additional sediments input to the river as a result of construction processes would be minimal in comparison to the already high background levels (see para. 14.4.6) and any mobilised contaminants would be expected to be rapidly diluted and their potential impact on water quality attenuated. Sediments mobilised by the construction works (including piling for the cofferdam walls) 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 a natural action of erosion and deposition, as well as by other dredging operations and river users.

14.5.14 Therefore, there is considered to be no impact from this source and this is not considered further within this assessment.

Surface water drainage

14.5.15 Once constructed, the cofferdam area and the shaft construction work within it would be protected from flooding to ensure the construction activity is not affected by high water levels. This would require the cofferdam walls to be raised to at least the existing flood defence level. Surface water from rainfall on the CSO drop shaft construction area may need to be pumped periodically to ensure the working activities are not affected by ponding of rainwater, if drainage of surface water by gravity is not possible.

14.5.16 The construction of the working area and drainage of surface water from it could therefore create a direct pathway to the river for contaminated runoff, high suspended solids and other pollution from the site. 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 therefore not considered further within this assessment.

Debris accumulation

14.5.17 The temporary cofferdam at the King Edward Memorial Park Foreshore site may cause an area of slack 'dead' water. Floating debris, oils and other pollutants could build up in the area if the flow of the river is unable to clear the accumulation due to the shelter provided by the King Edward Memorial Park Foreshore site working area.

Dewatering

14.5.18 Based on the geology at the site, the shaft would require dewatering and or ground treatment. However, internal dewatering of diaphragm wall is proposed, which would limit the amount of dewatering required. See Section 13 of this volume for further details on the dewatering requirements. Settlement of suspended solids within the dewatering would minimise the levels of contaminants within the effluent, which tend to be associated with particulates, but additional treatment of the dewatering effluent, or remediation of groundwater, may be required.

14.5.19 It is therefore considered that there is no pollution pathway and hence no impact from dewatering. This is therefore not considered further within the assessment.

Construction effects

14.5.20 The potential surface water impacts identified above as a result of construction at the King Edward Memorial Park Foreshore site have been assessed for their likely effects on WFD objective compliance, compliance with other legislation and effects on other users of the surface waters. The surface water receptors are identified in Vol 21 Table 14.4.1.

14.5.21 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.

14.5.22 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

14.5.23 The presence of the construction cofferdam in the channel would impact on the morphology of the tidal Thames in this location, altering it from its current state.

14.5.24 At the end of the construction, part of the riverbed would be reinstated following the removal of the temporary structures. This is due to the natural circulation of sediments within the estuary and the accumulation of silt and estuarine mud that is likely to occur (see Vol 3 Appendix C4). 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**.

14.5.25 Impacts on channel morphology can have an effect on ecological receptors, by changing habitat availability. This effect is assessed in Section 5 of this volume.

Debris accumulation

14.5.26 The change in flow regime of the tidal Thames due to cofferdam construction may result in an area of slack 'dead' water around the construction area, where floating debris, oils and other pollutants could build up and reduce the amenity value of the river for recreational users.

14.5.27 A change in appearance and aesthetic quality of the Tidal Thames in the near vicinity of the site is likely, but it would not prevent or limit recreational use of the tidal Thames in this location. There are no abstractions or discharges that could be affected by this change in debris accumulation, which would also not affect compliance with the WFD or other legislation as it is not assessed under this legislation. Therefore, the effect is considered to be **minor adverse**.

14.6 Operational effects assessment

14.6.1 This section presents the operational impacts that could occur at the site. The second part of the section identifies any effects that may occur and the likely significance of these effects.

Operational impacts

Reduction in North East Storm Relief CSO spills

14.6.2 Catchment modelling of the operational development case,(with the operational Thames Tideway Tunnel project) predicts that by Year 1 of operation, the frequency, duration and volume of spills from the North East Storm Relief CSO would substantially decrease (as a result of the capture of combined sewage overflows flow into the tunnel) as follows:

a. the CSO would spill on average four times per year (28 times less than the operational base case)

b. the CSO would spill for an average duration of 32 hours (275 hours less than the operational base case)

c. the spill volume from the CSO would be approximately 85,000m^3 per year (763,000m^3 less than the operational base case).

14.6.3 The frequency, duration and volume of spill at the King Edward Memorial Park Foreshore site would therefore be reduced by approximately 90% as a result of the operation of the Thames Tideway Tunnel project.

14.6.4 Given the reductions in spills, the number of days in which river users would be exposed to pathogens in Year 1 of operation as a result of spills from the King Edward Memorial Park CSO would be a maximum of 16 days in the Typical Year (a reduction of up to 112 days of risk of exposure).

14.6.5 Similarly, the tonnage of sewage derived litter from the CSO can be expected to reduce by approximately 90%, from approximately 216t to approximately 21t, in the Typical Year.

14.6.6 The reduction in polluting load that would be discharged from the CSO with the project in place would be as follows:

a. the CSO would discharge 7,600kg of BOD in the Typical Year (65,600kg less than the operational base case)

b. the CSO would discharge 300kg of ammonia in the Typical Year (2,300kg less than the operational base case)

c. the CSO would discharge 1,100kg of TKN in the Typical Year (9,700kg less than the operational base case).

14.6.7 Catchment modelling of the 2080 development case (to account for the effects of climate change and predicted increases to population) predicts that by 2080 with the operational Thames Tideway Tunnel project, the frequency, duration and volume of the North East Storm Relief CSO would be the following:

a. the CSO would spill on average five times per year (once more than the Year 1 of operation development case)

b. the CSO would spill for an average duration of 44 hours (12 hours more than the Site Year 1 of operation development case)

c. the spill volume from the CSO would be approximately 133,000m^3 per year (48,000m^3 more than the Year 1 of operation development case).

14.6.8 In summary, the model predicts that in the 2080 development case scenario the North East Storm Relief CSO at King Edward Memorial Park Foreshore site would increase in spill frequency, total spill duration and volume. These changes in spill frequency, duration and volume would be due to the impact of climate change, which is expected to lead to fewer, but more intense rainfall events during winter and drier summers.

14.6.9 Climate change is also predicted to increase average water temperatures, which combined with changes to rainfall patterns could affect water quality in the tidal Thames. As these water quality changes would be realised across the tidal Thames they have been assessed in Vol 3 Section 14 and climate change is not considered further within the assessment.

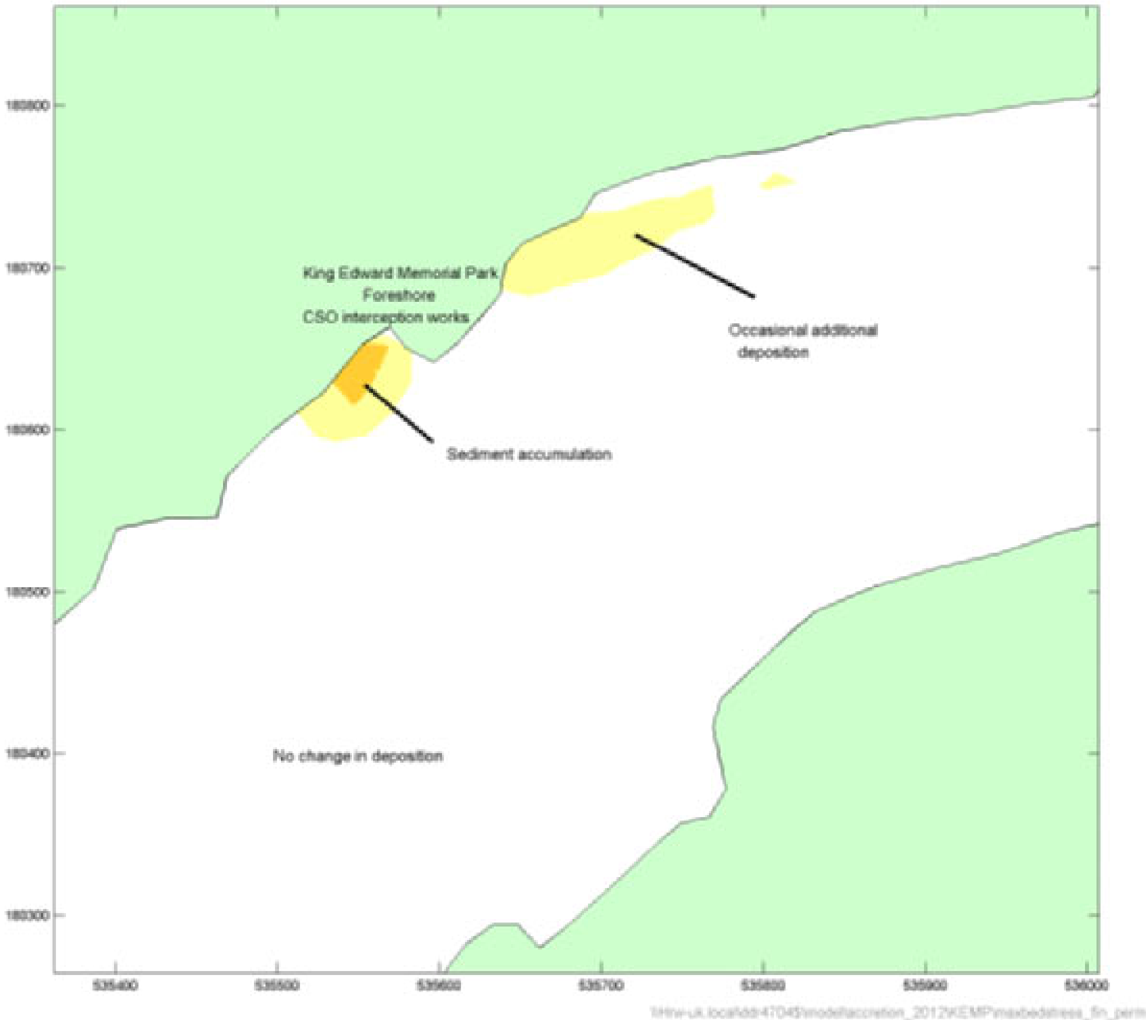
Permanent land take and morphological changes

14.6.10 In order to accommodate the permanent works at the King Edward Memorial Park Foreshore site, construction of a permanent structure within the river channel would be required, as described in Section 3 Proposed development. The permanent structure could 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. The approach to scour protection for the permanent works is described in the *Engineering Design Statement* as described in Section 14.2 and scour is not considered further with the assessment.

Deposition

14.6.11 The permanent works cofferdam would be likely to lead to changes in flows (velocities, directions) and cause changes in deposition of sediments around the King Edward Memorial Park foreshore site. These sediments could be those generated by the project itself but would also include sediments occurring naturally in the water column. Modelling carried out (Vol 3 Appendix L.3) has predicted the extent of this deposition, as shown below in Vol 21 Plate 14.5.1.

Vol 21 Plate 14.6.1 Surface water – prediction deposition around permanent works at the King Edward Memorial Park foreshore site foreshore site



14.6.12 Most deposition would be localised (as shown above in Vol 21 Plate 14.6.1) but may be remobilised by spring tides (for deposition during neap tides) or by large fluvial flows (for deposition during seasonal low fluvial flows) the impact on channel morphology would be negligible.

14.6.13 Impacts on channel morphology from deposition can have an effect on ecological receptors, by changing habitat availability. This effect is assessed in Section 5 of this volume.

Operational effects

Reduction in North East Storm Relief CSO spills

14.6.14 The reduction in spills from the North East Storm Relief CSO would represent an important contribution towards

a. meeting the requirements of the Urban Waste Water Treatment Directive[13] (UWWTD) in relation to the North East Storm Relief CSO.

b. meeting the required TTSS DO standards

c. moving the tidal Thames towards its target status under the WFD both locally and throughout the tidal Thames.

14.6.15 Therefore, the reduction in spills would result in a **major beneficial** effect, most notably in the context of the UWWTD. It should be noted that, as explained in Section 14.1, the water quality in the vicinity of the King Edward Memorial Park Foreshore site also depends on the project-wide improvements, as documented in Vol 3 Section 14.

14.6.16 The associated reduction in exposure to pathogens would greatly improve the conditions for recreational users of the tidal Thames around King Edward Memorial Park, allowing the tidal Thames in this location to be used more frequently with a reduced risk of exposure. This is considered to be a **moderate beneficial** effect.

14.6.17 The reduction in sewage litter discharge would also improve the aesthetic quality of the tidal Thames locally, improving conditions for recreational users. This is considered to be a **moderate beneficial** effect. As explained in Section 14.4, an assessment of the amenity effects of the sewage litter is given in Vol 3 Section 10 Socio-economics.

Permanent land take and morphological changes

14.6.18 The permanent structures proposed in the tidal Thames have been designed and engineered to minimise the impediment of flow and although some changes to flows are likely, the changes are unlikely to lead to further substantive deterioration of the morphological condition of the channel which is already modified by flood defences and channel dredging. In addition, the changes in flow are unlikely to lead to an area of slack 'dead' water around the permanent structures. The WFD objectives are not considered to be affected by this change, and hence the effect is considered to be **minor adverse**.

14.6.19 Impacts on channel morphology can also have an effect on ecological receptors, by changing habitat availability. This effect is assessed in Section 5 of this volume.

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 associated with the Lee Tunnel and sewage treatment 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 As explained in Section 14.3, no developments have been identified that would be under construction during Site Year 1 of construction or operation, therefore a cumulative effects assessment has not been undertaken. No significant cumulative effects have therefore been identified for the construction or operational phases at this site. The effects on surface water would therefore remain as described in Section 14.5 and Section 14.6 above.

14.8 Mitigation

14.8.1 No significant adverse effects have been identified and therefore 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.

Operational effects

14.9.2 As no mitigation measures are proposed, the residual operational effects remain as described in Section 14.6. All residual effects are presented in Section 14.10.

14.10 Assessment summary

Vol 21 Table 14.10.1 Surface water – construction assessment summary

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Thames Middle	Temporary changes to channel morphology (cofferdam and associated scour protection construction)	Minor adverse	None	Minor adverse
Thames Middle	Changes in aesthetic quality due to debris accumulation in slack water between structures	Minor adverse	None	Minor adverse

Vol 21 Table 14.10.2 Surface water – operational assessment summary

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Thames Middle	Compliance with UWWTD and WFD. Improved water quality in the vicinity of the North East Storm Relief CSO by reduced pollutant loading and not reduction of dissolved oxygen levels due to reduced spill frequency, duration and volume from the North East Storm Relief CSO	Major beneficial	None	Major beneficial
Thames Middle	Risk of exposure days to pathogens would be reduced to a maximum of 16 days in the Typical Year (a reduction of up to 112 days of risk of exposure)	Moderate beneficial	None	Moderate beneficial
Thames Middle	Sewage derived litter discharge at North East Storm Relief CSO would be reduced by approximately 90% improving the aesthetic quality of the river locally	Moderate beneficial	None	Moderate beneficial
Thames Middle	Change in channel morphology caused by permanent foreshore/in-channel structures	Minor adverse	See Volume 21 section 5 Aquatic ecology	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

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[4] Environment Agency. *River Basin Management Plan, Thames River Basin District* (2009)

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[9] Lane, C, Surman-Lee, S, Sellwood, J and Lee, JV. *The Thames Recreational Users Study Final Report.* (2007)

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[11] Thames Water. *Thames Tideway Strategic Study* (February 2005)

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.21**

Volume 21: King Edward Memorial Park Foreshore site assessment

Section 15: Water resources - flood risk

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

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Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

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Thames Tideway Tunnel

Environmental Statement

Volume 21: King Edward Memorial Park Foreshore 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 King Edward Memorial Park Foreshore site, which includes:

a. a qualitative appraisal of the flood risk posed to the site

b. the potential impact of the development on flood risk on and off the site

c. an appraisal of the scope of possible measures to reduce the flood risk to acceptable levels.

15.1.2 The FRA methodology was informed by the National Policy Statement (NPS) for Waste Water (Defra, 2012)[1] and is provided in Volume 2 Environmental assessment methodology.

15.1.3 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 21 King Edward Memorial Park Foreshore Figures).

15.1.4 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 elements of the proposed development relevant 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.

15.1.5 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 is presented in Section 13 Water resources – groundwater. The assessment of effects on surface water is presented in Section 14 Water resources – surface water.

15.1.6 A project-wide FRA has been undertaken and is presented in Volume 3 Project-wide assessment.

Regulatory context

15.1.7 The NPS seeks to ensure that where the development of new wastewater 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.

15.1.8 A review of planning policy relevant to the proposed development is provided in Vol 21 Appendix M.1.

NPS Sequential and Exception Tests

15.1.9 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 wastewater infrastructure projects can be located in Flood Zone 3 subject to the Exception Test.

15.1.10 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.

15.1.11 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).

15.1.12 The overall project is considered to pass the Sequential Test, as detailed in Vol 3. The project-wide Exception Test is also detailed in Vol 3.

15.1.13 The proposed development at the King Edward Memorial Park Foreshore site 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.

15.1.14 The proposed development would not be located on previously developed land. However, as explained in Vol 3 Section 15 no reasonably alternative sites on developable previously developed land were identified during the sites selection process and as such the proposed development at the King Edward Memorial Park Foreshore site would satisfy part b) of the Exception Test.

15.1.15 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. The elements of the proposed development relevant to flood risk are set out below.

Construction

15.2.2 The construction elements of the proposed development relevant to flood risk include:

a. A temporary cofferdam would be constructed within the tidal foreshore to the same height as the existing flood defence. This would provide the necessary working area for construction.

b. A campshed would be constructed along the south/southeast side of the cofferdam to allow barge mooring and the loading and unloading of material.

c. The North East Storm Relief combined sewer overflow (CSO) and the Cole Stairs CSO would be maintained to the same capacity throughout the construction period by extension through the cofferdam. This would allow the CSOs to remain operational throughout the construction period.

Code of Construction Practice

15.2.3 Appropriate guidance regarding flood defence construction and emergency planning are included in 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)* The relevant measures are summarised below:

a. No temporary living accommodation would be permitted on-site, and an evacuation route and safe refuge would be provided in the event of a flood event.

b. The Contractor would be responsible for providing and maintaining continuous flood defence provision, for both permanent and temporary works, to the statutoryi flood defence level as detailed within the FRA. This is a requirement of the Thames River Protection of Floods Amendment Act 18792.

Operation

15.2.4 The permanent elements of the proposed development relevant to flood risk include:

a. A new flood defence wall would be constructed. This would be designed to allow future raising in accordance with the Thames Estuary 2100 Plan (TE2100) (EA, 2012)[3]. The crest level of the new flood defence would be set at the existing level and would be tied into the adjacent flood defences.

b. Once the project has been completed the North East Storm Relief CSO would be intercepted, so that flows are diverted to the main tunnel.

c. Surface water runoff from the site would be discharged directly into the tidal Thames without attenuation. In the event of discharge being restricted by tide-locking additional storage would be provided onsite.

[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 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.

15.3.2 This assessment is based on the FRA screening exercise that identified relevant potential flood sources and pathways. The tidal and fluvial assessments were based on the 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)[4] was considered to be preferable to the general 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 further in the methodology (see Vol.2).

Tidal flood risk to the proposed development

Level of risk based on the flood zones

15.3.5 Approximately half of the King Edward Memorial Park Foreshore site is situated within the tidal foreshore of the tidal Thames, adjacent to the northern river bank. The remainder of the site is located inland from the tidal Thames. The Environment Agency (EA) Flood Map identifies the site to lie within Flood Zone 3. The location of the site in relation to the flood zones is shown in Vol 21 Figure 15.3.1 (see separate volume of figures).

15.3.6 The part of the site, which is located within the foreshore, 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 "risk of flooding" to this foreshore part of the site (without the design measures) is considered to be very high (see methodology in Vol 2).

15.3.7 The inland component of the site is not located within the functional floodplain of the tidal Thames and is considered to be within defended Flood Zone 3a. Due to its location within Flood Zone 3a, the risk of flooding to the inland component of the site is considered to be high (see methodology in Vol 2).

Existing tidal defences

15.3.8 The site (with the exception of the foreshore area) is protected from tidal flooding by a raised flood defence aligned along the boundary between the tidal Thames and King Edward Memorial Park promenade.

15.3.9 The EA has stated that the statutory flood defence level relevant to the King Edward Memorial Park Foreshore site is 5.23m Above Ordinance Datum (AOD). The National Flood and Coastal Defence Database (NFCDD [EA, 2011][5]) crest levels for flood defences in the vicinity of the site are above the statutory level and range between 5.44m AOD to 5.69m AOD.

15.3.10 Condition surveys of the flood defences carried out by the EA in November 2010 (EA, 2012)[6] confirm that the condition of these defences is overall good (Grade 2) with some areas in fair condition (Grade 3) (see methodology in Vol 2).

15.3.11 The inland component of the site would therefore only be subject to flooding, should there be a breach in the flood defence walls, or overtopping of the flood defence walls as a result of the failure of the Thames Barrier. Such a risk would be residual (as the site would be defended to the statutory level) and is not considered to compromise the long term functionality of the project (see Vol.3).

Tidal flood level modelling

15.3.12 The most extreme flood risk scenario that could affect the site would be a 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 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 (2008) (EA, 2008)[7] provides modelled tidal flood levels for the 1 in 200 year (0.5% AEP) flood event for specific locations (model node locations) within the tidal Thames.

15.3.14 Vol 21 Table 15.3.1 presents the modelled tidal levels from this study for model node 2.39 which is the most relevant (ie, closest) to the site (Vol 21 Figure 15.3.1) (see separate volume of figures). It should be noted that the water levels are expected to decrease in the future due to an amended future Thames Barrier closure rule (see Vol 2), therefore the 2005 scenario (ie, the present day scenario provided by the EA) produces the highest water level.

15.3.15 Vol 21 Table 15.3.1 also identifies 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 21 Table 15.3.1 Flood risk – modelled water levels

Return period	Flood level (mAOD)	Statutory flood defence level (mAOD)
0.5% AEP (2005)	4.88	5.23
0.5% AEP (2107)	4.85	

[ii] A flood with a 0.5% AEP has a one in 200 year probability of occurring

Tidal risk from the proposed development

New tidal defences

15.3.16 The presence of permanent structures within the foreshore has the potential to affect flood risk upon the site itself and upon the surrounding environment. The proposed development includes raising the foreshore site to adjacent land levels and building a new flood defence to the existing statutory level. As such, the component of the site which is currently within Flood Zone 3b would be located in Flood Zone 3a and defended from tidal flooding. Therefore the risk of tidal flooding is considered to be high (see methodology in Vol 2). Potential risks are described further in paras. 15.3.17 to 15.3.27 below and measures included within the design are outlined in Section 15.4.

Flood defence integrity

15.3.17 The tunnel excavation process using tunnel boring machines (TBMs) and other construction methods, has the potential to create differential settlement (that is a gradual downward movement of foundations due to compression of soil), which could affect the level of some of the existing flood defences (as well as other buildings and structures). The proposed tunnel route runs immediately adjacent to the tidal Thames river wall and therefore could potentially affect the defences at this site during construction. In addition to that, the shaft construction process has also the potential to affect the 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 9mm and 53mm is estimated across the river walls at this site (based on information provided by Thames Water). The flood defence levels flowing settlement is estimated to range from 5.23mAOD to 5.70mAOD. As such, the river walls would remain above the EAs statutory flood defence level (5.23mAOD) following settlement of this degree. Furthermore, it should be noted that the section of the river walls where the maximum degree of potential settlement is estimated would be replaced as part of the proposals.

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 arising from additional surcharge loading, increased water differential, 'Burland'[iii] damage and tie-rod stress[iv] increase.

15.3.21 The proposed schedule of works (Schedule 1 of *The Draft Thames Water Utilities Limited (Thames Tideway Tunnel) Development Consent Order*)

[iii] Tensile strains in gravity wall due to longitudinal differential settlement.

[iv] 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.

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 to flood defences have the potential to impact on the level of tidal flood risk to the surrounding area. In this case the proposed cofferdam and the new flood defence wall would be constructed to the same height as the existing flood defences ensuring that the level of residual risk to the site and adjacent areas remains the same.

Scour management

15.3.23 The TE2100 Plan 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 this 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, the study concludes that any permanent or temporary works within the river which cause the channel width to be considerably altered, could alter the flow velocity of the river at this point and so alter patterns of scour across the channel bed as well as adjacent to any new structures.

15.3.24 Both the temporary and permanent works have the potential to influence scour and /or deposition rates within the river and affect river structures including flood defences.

15.3.25 A scour summary report outlines 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 King Edward Memorial Park Foreshore site.

15.3.26 Scour is predicted at the King Edward Memorial Park Foreshore site to be greatest during construction with maximum estimated scour depths to temporary works of up to 1.5m. The contraction scour has been estimated during construction to be less than 0.5m across the river bed and less than 0.1m at the adjacent river walls. During the permanent works local scour depths of up to 1m are predicted around the permanent works. Contraction scour has been estimated to be less than0.5m. As a proactive approach permanent scour protection is envisaged at the base of the new flood defence wall.

Loss of volume from the tidal Thames

15.3.27 The presence of temporary and permanent structures within the foreshore has the potential to reduce the availability of flood storage within the tidal foreshore of the tidal Thames. The effect of removal of flood storage on flood levels is propagated throughout the hydrological unit of the tidal Thames reach and has been modelled on a project-wide basis.

15.3.28 The King Edward Memorial Park Foreshore site is located within the reach of Tower-Charlton in the tidal and fluvial modelling study. The modelling identifies that for this reach the potential maximum decrease in peak water level is 0.002m during the temporary works scenario reducing to 0.001m during the permanent scenario. The modelling also identifies a potential maximum increase of 0.014m in peak water level during the temporary works scenario reducing to 0.005m during the permanent scenario. As identified in para.15.3.15 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 0.59-0.84m 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.

15.3.29 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.

Fluvial flood risk to the proposed development

Level of risk based on the flood zones

15.3.30 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.

15.3.31 As the foreshore component of the King Edward Memorial Park Foreshore site is located within 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. The inland part of the site is considered to be located within Flood Zone 3a and as the tidal and fluvial floodplain cannot be distinguished from each other at this location the risk of flooding from this flood source is considered to be high. Further detail is included in Vol 2.

Fluvial flood risk from the proposed development

15.3.32 As explained in Vol.2, it is considered that a fluvial flood event on the tidal Thames with a return period of 1% AEP would result in lower water levels on the tidal Thames than those experienced during an extreme tidal flood event with the same return period. As such, the greatest risk posed by the tidal Thames is a combined tidal and fluvial flood risk.

15.3.33 Fluvial influences were also considered when developing the hydraulic modelling summarised in para. 15.3.26. 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 River Thames. This is discussed further in Vol 3.

Surface water flood risk to the proposed development

15.3.34 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.

15.3.35 As part of the Drain London Project[v] , a Surface Water Management Plan (SWMP) was prepared for the London Borough (LB) of Tower Hamlets (GLA, 2012)[8]. This identifies that the King Edward Memorial Park Foreshore site is not located in a Critical Drainage Area[vi], which suggests therefore that the site is relatively less susceptible to surface water flooding than other local areas in the borough. Modelling results for a 1 in 100 year (1% AEP) rainfall event plus climate change allowance show potential surface water flooding of up to 0.1m-0.5m deep within the King Edward Memorial Park adjacent to the foreshore site.

15.3.36 King Edward Memorial Park is at an elevation of approximately 3.5m below the road level of The Highway to the north. Ground levels within the park generally decline from 10mAOD in the north to 5mAOD in the south, suggesting a flow path towards the site across the park. However, while some surface water flooding is identified within the King Edward Memorial park in a 1% AEP rainfall event plus climate change, the park is an open space with extensive areas of grass which is likely to allow some infiltration. Runoff from the surrounding area is therefore unlikely to run onto the site in substantial quantities. The walkway in front of the river wall is raised above the grassed area at approximately 5.5mAOD and so would act as a barrier to flow from the park towards the tidal Thames. Glamis Road to the west of the site is raised by approximately 1m above the adjacent park.

15.3.37 The site is shown to experience potential flood depths up to 0.5m and pathways are present to the site, therefore the flood risk associated with this source is considered to be medium (see methodology in Vol.2).

Surface water flood risk from the proposed development

15.3.38 An assessment of the likely significant effects of surface water from the King Edward Memorial Park Foreshore site is provided in Vol 21 Section 14 Water resources - surface water.

15.3.39 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. When redevelopment of brownfield sites is proposed, the *London Plan 2011* (GLA, 2011)[9] and the Mayor's Water Strategy (GLA, 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.

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[v] A London-wide strategic surface water management study undertaken by the Greater London Authority (GLA) and London Councils.

[vi] An area assessed to be susceptible to surface water flooding.

15.3.40 In accordance with the EA (as set out in their phase two consultation response), surface water runoff from the proposed development would be discharged directly to the tidal Thames. Due to the tidal nature of the receiving watercourse, surface water runoff rates to the tidal Thames would not increase surface water flood risk to the site or surrounding area and would therefore not require attenuation prior to discharge.

15.3.41 It is estimated that the total impermeable area of King Edward Memorial Park Foreshore site would decrease from approximately 0.70ha to 0.5ha. Furthermore, a brown roof is proposed on the above ground structures, which would help manage runoff as well as provide wider sustainability benefits.

15.3.42 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 site. If necessary, on-site storage would therefore be provided to manage the risk of site flooding in the event of tide-locking of the surface water outfall.

15.3.43 Following the construction of the proposed development the risk of flooding from this source would be unchanged and therefore would remain medium.

Groundwater flood risk to the proposed development

15.3.44 Groundwater flooding occurs where groundwater levels rise above ground surface levels.

15.3.45 Groundwater levels for the upper aquifer have been recorded by Thames Water for the nearest borehole to the site (SR1034A). At this location, water levels in the upper aquifer within the river terrace deposits have an average level of approximately 3.1m below ground level (bgl) at the King Edward Memorial Park Foreshore site. This is confined by the overlying made ground at the site.

15.3.46 The LB of Tower Hamlets Strategic Flood Risk Assessment (SFRA) (Capita Symonds, 2012)[11] documents that there are no groundwater flooding incidents on or around the vicinity of the site.

15.3.47 Although the water level of the upper aquifer is relatively shallow, the aquifer is confined so there is no pathway to the site surface. Therefore there is no risk of groundwater flooding to the site (see methodology in Vol 2).

Groundwater flood risk from the proposed development

15.3.48 An assessment of the likely effects on groundwater at the King Edward Memorial Park Foreshore site is provided in Section 13 Water resources - groundwater.

15.3.49 The CSO drop shaft would pass through made ground, river terrace deposits (upper aquifer), London Clay, Lambeth Group, Thanet Sands and Chalk. Dewatering of the lower aquifer is anticipated during the construction phase to manage the groundwater levels and reduce the risk of flooding from this source. Groundwater treatment would also be required prior to the discharge of groundwater to the tidal Thames.

15.3.50 The presence of the CSO drop shaft creating a physical barrier has been assessed as having a predicted rise in water levels (approximately 0.3m); however, this would result in increased hydraulic pressure within the confined unit rather than an increase of the water table. The impact of the CSO drop shaft extending into the lower aquifer is also considered to be negligible and therefore there is no increase in the risk from groundwater flooding to the site as a result of the development. Therefore, there is no pathway for groundwater to reach the surface of the site and therefore no risk of an increase in groundwater flooding to the site as a result of the development.

Sewers flood risk to the proposed development

15.3.51 The North East Storm Relief sewer (3454mm internal diameter) crosses King Edward Memorial Park in a south-easterly direction to the North East Storm Relief CSO which discharges to the tidal Thames.

15.3.52 The Pennington Street sewer is a combined sewer (dimensions of approximately 1245mm by 1671mm) that flows from the west across the park before being intercepted by the Ratcliffe Highway Sewer in King Edward Memorial Park. Prior to the interception with the Ratcliffe Highway Sewer, there is an overflow weir that controls spills to the Cole Stairs CSO. The outfall of this CSO discharges to the west of the North East Strom Relief CSO outfall into the tidal Thames.

15.3.53 The Ratcliffe Highway Sewer is a main line high level sewer with dimensions of 1600mm by 940mm. This flows in an easterly direction in The Highway, to the north of King Edward Memorial Park. This sewer intercepts the Pennington Street Sewer, and the Ratcliffe Highway sewer (North East Branch, diameter of 813mm by 1270mm). Downstream of this interception, a weir controls the overflow to the Bell Wharf CSO (1219mm diameter), which outfalls to the east of the North Eastern Storm Relief Sewer CSO outfall.

15.3.54 The Ratcliffe Highway sewer (Main line) connects to the Pennington Street Sewer (Reversion Line) that flows in a northerly direction towards the Low Level Sewer No. 1 (Main Line). During high flow conditions of the Low Level Sewer No. 1 (Main Line) can back up in the Pennington Street Sewer (Reversion Line) towards the connection with the Ratcliffe Highway Sewer (Main Line) at The Highway.

15.3.55 If the capacity of these systems was exceeded, the combined sewers would first discharge through the CSO outfalls themselves. If the outfalls were restricted or at capacity, they would potentially discharge at outlets, such as manholes and gullies located along the length of the sewers. The pathway for surcharged combined sewage would follow the topography, and would flow across the site, and towards the tidal Thames. A low point in the topography in the south-east of the site would potentially allow for the ponding of water at this point.

15.3.56 Thames Water records (Thames Water, 2012)[12] state that there have been no recorded incidents of sewer flooding on the site, or within 200m of the site.

15.3.57 As there have been no records of sewer flooding, the flood risk from this source is considered to be low.

Sewers flood risk from the proposed development

15.3.58 Following construction of the Thames Tideway Tunnel, outfalls from the North East Storm Relief sewer would be intercepted by the main tunnel. The Bell Wharf CSO and Cole Stairs CSO would remain operational.

15.3.59 It is proposed that the North East Storm Relief sewer would be intercepted in the foreshore, so that flows are diverted to the main tunnel via a connection culvert and a drop shaft at this site. A connection culvert would be constructed from the interception chamber to the drop shaft connecting to the main tunnel. The flood risk during this phase would be managed using design measures described in Section 15.4.

15.3.60 The CSO interception and connections have been designed so that there is no increased flooding risk in the existing system for the 1 in 15 year design storm when compared to the base case scenario[vii]. Further detail is provided in Vol 3 Section 15.

15.3.61 At present sewage discharges from the North East Storm Relief CSO outfall during storm events and can be restricted at high tides. Following construction, should the main tunnel be closed or not able to accommodate any additional flows from the site, flows would overflow from the storm overflow chamber and discharge to the tidal Thames. The new storm overflow to the tidal Thames would be protected by twin flap valves to prevent upstream flooding

15.3.62 Following the construction of the proposed development the risk of flooding from this source would be unchanged and therefore would remain low.

Artificial sources flood risk to the proposed development

15.3.63 The site is in close proximity to Shadwell Basin located approximately 50m to the west of the site. Shadwell Basin was constructed as part of the London Docks and covers an area of 2.8 hectares. It is connected to the tidal Thames but the inflow and outflow is controlled.

15.3.64 Initial discussions with the EA indicate that where basins are identified as benefiting from flood defences (as is the case with Shadwell Basin), it can be assumed that the area is protected from flood risk up to statutory level.

15.3.65 Due to the connection with the tidal Thames, there is a residual risk of tidal flooding if a breach in the flood defences or a failure of the Thames Barrier downstream were to occur. Therefore the flood risk to the development site is considered to be high and residual.

[vii] The base case scenario comprises the sewage treatment works (STW) Improvements and Lee Tunnel in 2020s.

Artificial sources flood risk from the proposed development

15.3.66 The proposed development would not impact on the flood defences, or flood storage relating to Shadwell Basin. Therefore the flood risk from the development is not applicable and 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 runs adjacent to 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 where required repairs would be made in agreement with the asset owner and the EA to ensure crest heights of the flood defences at the site are maintained to the existing level. With this strategy in place, no effects of settlement are anticipated.

15.4.3 Design options to preserve the stability of the flood defences at the site would be dependent on the contractor's construction methodology. Options for ensuring no impact to the river wall from surcharge loading and increased water differential may include temporarily supporting the wall within the temporary cofferdam while it is unfilled.

15.4.4 It is envisaged that 'Burland' damage due to ground movement would be mitigated using pre and post construction survey, monitoring and if necessary reactive repair.

15.4.5 Potential design measures to withstand tie-rod stress increase at the river wall to the west of the proposed foreshore works may include strengthening works to the existing wall.

15.4.6 As discussed in para. 15.3.22 a cofferdam would be constructed to the same height as the existing flood defence level. This would ensure that the current level of flood protection and flood risk is maintained during construction. Further information is included in the *CoCP*.

15.4.7 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

15.4.8 During construction the formation of scour would be monitored, and mitigation proposed if the scour exceeds agreed trigger values.

15.4.9 Mitigation options could include rip-rap 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 design requirements. Further details are provided in *Scour and Accretion Monitoring and Mitigation Plan for Temporary Works in the Foreshore* (Vol 3 Appendix L.4).

Emergency plan

15.4.10 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*.

Operation

Flood Defences

15.4.11 The permanent operational area would be protected from flooding through the provision of a new flood defence wall as outlined in para. 15.2.4. This would be located along the periphery of the operational area and would tie into existing flood defences, providing a continuous defence line along the embankment at all times.

15.4.12 The new defences would be designed to ensure that future flood defence raising can be achieved to meet the TE2100 requirements.

15.4.13 As the new flood defence wall would be constructed to the same height as the existing flood defence, the residual flood risk to the site would be unchanged. As detailed in para. 15.5.4 and Vol 3, the residual risk to the site is considered to be appropriate and no further measures are required.

Loss of volume from the tidal Thames

15.4.14 As discussed in para. 15.3.27, the result of removal of tidal Thames flood storage on flood levels has been considered on a project-wide basis and is discussed further in Vol 3. The floodplain volume loss from river structures has been minimised whilst maintaining fundamental engineering requirements and therefore no further design measures are proposed.

Scour management

15.4.15 The shape of the protrusion for the permanent works has been designed to minimise the influence on river on the flow regime of the tidal Thames.

15.4.16 As a proactive approach permanent scour protection would be provided at the toe of the new flood defence river wall. It is assumed for the assessment that permanent scour protection would consist of loose large stone placed just below foreshore level. This permanent protection would be within the area of the temporary cofferdam.

Emergency plan

15.4.17 During the operational phase the site would not be permanently staffed with the exception of visits from maintenance personnel. An emergency plan would only be required for staff undertaking maintenance visits.

Surface water

Construction

15.4.18 In accordance with the *CoCP,* during construction all site drainage would be drained and discharged 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. This approach 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

15.4.19 It is intended to discharge surface water from the operational site directly into the tidal reaches of the tidal Thames. This outfall would be of appropriate size for the potential discharge volumes. A scour protection apron is included within the operational layout for the site. This would provide sufficient scour protection in front of the surface water outfall and therefore no additional measures are proposed.

Surface water management

15.4.20 Measures are required to ensure that surface water runoff is effectively managed on the site so that the flood risk to the surrounding area from this source does not increase as a result of the permanent development on the site.

15.4.21 As described in para.15.3.40, in agreement with the EA views expressed 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 rates to the tidal Thames 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

15.4.22 Groundwater monitoring is proposed during construction and operation. Dewatering and groundwater treatment are also anticipated at the site. Further measures regarding dewatering and maintaining groundwater levels are described in Section 13 Water resources – groundwater.

Sewers

Construction

15.4.23 There are no diversions proposed for the site other than for the primary purpose of the proposed development ie, to intercept the CSO. The operation of the Cole Stairs CSO and the North East Storm Relief CSO would be maintained and extended through the cofferdam during the construction period.

15.4.24 Surface and highway drains at the site entrance would be protected throughout the works.

Operation

15.4.25 Following construction of the Thames Tideway Tunnel project, outfalls from the North East Storm Relief sewer would be intercepted by main tunnel. The Bell Wharf CSO and Cole Stairs CSO would remain operational.

15.4.26 Following construction, should the main tunnel be closed or not able to accommodate any additional flows or in the event of a storm event exceeding the design capacity of the interception structure, flows would overflow from the storm overflow chamber and discharge to the tidal Thames. The design would ensure that flood risk is not increased for a range of return period events.

15.5 Assessment summary

Flood risk

15.5.1 The King Edward Memorial Park Foreshore site is located in Flood Zone 3a and 3b associated with the tidal Thames. As part of the proposed works, flood defences would be constructed providing protection to the site from tidal flooding during both construction and operation.

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 21 Table 15.3.1 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 Following the construction of the new flood defence wall adjacent to the tidal Thames, the site would be protected from tidal flooding. The site would be at residual risk of tidal flooding in the event of a breach in the new flood defence wall 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 measures above those outlined above are proposed. Further detail is provided in Vol 3.

Residual Risk from the development

15.5.7 Following the incorporation of the design measures outlined in Vol 21 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.

Vol 21 Table 15.5.1 Flood risk – FRA summary

Source	Pathway	Current flood risk to the proposed development site	Design measures	Flood risk from the proposed development (post design measures)	Flood risk to the proposed development post design measures
Tidal	Tidal Thames	Foreshore - Very High Inland - High (but residual only)	Flood Defence height maintained. New flood defences built around foreshore site so site defended from tidal flooding to statutory level (changing the Flood Zone from 3b to 3a). Scour management approach of monitor and mitigation. Scour protection measures for permanent works. Monitoring of flood defence levels and repaired as required to maintain existing crest level.	No increase in tidal flood risk as a result of proposed development.	High (but residual only)

Source	Pathway	Current flood risk to the proposed development site	Design measures	Flood risk from the proposed development (post design measures)	Flood risk to the proposed development post design measures
Fluvial	Tidal Thames	Foreshore - Very High Inland - High (but residual only)	New flood defences built around foreshore site so site defended from fluvial flooding to statutory level (changing the Flood Zone from 3b to 3a). Scour management approach of monitor and mitigation. Scour protection measures for permanent works. Monitoring of flood defence levels and repaired as required to maintain existing crest level	No increase in fluvial flood risk as a result of proposed development.	High (but residual only)
Surface water	Surrounding area	Medium	Site drainage in accordance with CoCP during construction. Discharge surface water to tidal Thames.	No increase in surface water flood risk as a result of proposed development.	Medium
Groundwater	Underlying geology and groundwater levels restricted pathway	No risk	Monitoring proposed during construction and operation.	No increase in groundwater flood risk as a result of proposed development.	No risk

Source	Pathway	Current flood risk to the proposed development site	Design measures	Flood risk from the proposed development (post design measures)	Flood risk to the proposed development post design measures
Sewers	Local drainage system	Low	CSOs maintained during construction.	No increase in sewers flood risk as a result of proposed development.	Low
Artificial sources	Shadwell Basin	High (but residual only)	None required	None created	High (but residual only)

** Definitions of these classifications are included in Volume 2*
() indicate the flood risk is residual ie in the event of a failure or overtopping of flood defences

References

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

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

[4] Communities and Local Government. *National Planning Policy Framework (March, 2012).*

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[7] Environment Agency. *Thames Tidal Defences Joint Probability Extreme Water Levels 2008 Final Modelling Report*. (April 2008).

[8] Greater London Authority. *London Borough of Tower Hamlets Surface Water Management Plan.* (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] Capita Symonds. *London Borough of Tower Hamlets Level 2 Strategic Flood Risk Assessment.* (January 2012)

[12] Thames Water. *Sewer Flooding Records*. (received June 2012)

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