**Thames Tideway Tunnel**
Thames Water Utilities Limited

# Application for Development Consent

Application Reference Number: WWO10001

# Heritage Statement

Doc Ref: **5.3**

## Main Report

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

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January 2013

Thames Tideway Tunnel

Creating a cleaner, healthier River Thames

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# Thames Tideway Tunnel

# Heritage Statement

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## List of abbreviations

| | |
|---|---|
| CoCP | *Code of Construction Practice* |
| CSO | combined sewer overflow |
| DCO | Development Consent Order |
| NPPF | *National Planning Policy Framework* |
| NPS | the National Policy Statement for Waste Water |
| NSIP | Nationally Significant Infrastructure Project |

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# 1 Executive summary

1.1.1 The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 requires that, where applicable, an application for development consent must be accompanied by "*a plan with accompanying information identifying any statutory or non-statutory sites or features of the historic environment, including scheduled monuments, World Heritage sites, listed buildings and other historic structures, archaeological sites and registered battlefields, together with an assessment of any effects on such sites, features or structures likely to be caused by the proposed development*" (para. 5(2)(m)). This *Heritage Statement* contains plans showing the heritage assets that may be affected by the Thames Tideway Tunnel project and assesses the potential effects of the proposals, in accordance with these regulations.

1.1.2 The National Policy Statement for Waste Water provides the primary policy basis for deciding the application for development consent. Section 4.10 of the NPS sets out policies in relation to the historic environment. The *Heritage Statement* assesses the likely significant effects of the proposals on the historic environment at each site, in accordance with the historic environment policies of the NPS and other guidance as appropriate. However, it is not the purpose of the *Heritage Statement* to weigh up harm versus public benefit. This analysis is presented within the *Planning Statement*, which accompanies the application.

1.1.3 The *Heritage Statement* presents and assesses the proposals for works in the historic environment that would normally require Listed Building Consent and Conservation Area Consent. It also describes where the historic environment has influenced the design. There are no proposals to alter Scheduled Monuments. The proposals in relation to the historic environment are set out in detail in the *Design Principles*, the *Code of Construction Practice* and the drawings within the *Book of Plans*.

1.1.4 The *Heritage Statement* is mutually supported by the *Design and Access Statement,* which accompanies the application. While the *Design and Access Statement* sets out the design evolution and alternatives considered for each site, the Heritage Statement specifically addresses the historic environment considerations that shaped the design, particularly in relation to alterations to listed buildings. Where appropriate, the *Design and Access Statement* is cross-referenced.

1.1.5 The *Heritage Statement* assesses the significant and the less significant effects of the proposals on the historic environment, and considers these effects in relation to the criteria and policies in the NPS. The likely significant effects of the proposals on the historic environment are set out in detail in the *Environmental Statement*.

1.1.6 Section 2 of this document explains the relationship between the *Heritage Statement* and other application documents and explains the methodology used for the assessment of effects.

1.1.7 Section 3 describes project-wide matters relevant to the historic environment and summarises the associated NPS policies, and other national and regional policies that apply to the historic environment. It also sets out proposals for safeguarding the significance of the historic environment during the detailed design and construction phases, including:

a. the generic (project-wide) Heritage Principles set out in the *Design Principles* document, which accompanies the application

b. the procedures to be followed to ensure that significant materials or items removed during construction would be properly stored prior to reinstatement, and, where reinstatement is not proposed, procedures to ensure that the reuse of these materials is properly considered and that appropriate alternative uses are sought

c. the proposals to monitor listed buildings for ground movement where it is expected to be generated by tunnelling or excavation and procedures to safeguard their significance from its effects.

1.1.8 Of the total of 24 proposed development sites, the proposals at 15 sites would normally require Listed Building Consent or Conservation Area Consent or the proposals were influenced by historic environment considerations. The 15 appendices to this document set out the detailed assessment of the proposals in relation to the significance of the potentially affected heritage assets at each site, in accordance with the NPS and with reference to regional and local policy where relevant. They provide the requisite detail of the proposals and their effects in proportion to the designation and significance of the heritage assets affected, in accordance with the NPS. For ease of reference, the 24 sites are summarized in Table 4.1.

1.1.9 Listed Building Consent would normally be required at a number of sites including Putney Embankment Foreshore, Cremorne Wharf Depot, Albert Embankment Foreshore, Victoria Embankment Foreshore, Blackfriars Bridge Foreshore, and Greenwich Pumping Station.

1.1.10 Demolitions that would normally require Conservation Area Consent are proposed at Putney Embankment Foreshore, Carnwath Road Riverside, Dormay Street, Chelsea Embankment Foreshore, Albert Embankment Foreshore, Blackfriars Bridge Foreshore, Shad Thames Pumping Station, Deptford Church Street and King Edward Memorial Park Foreshore.

1.1.11 The sites at which the historic environment influenced the design include Hammersmith Pumping Station, Chambers Wharf, and Abbey Mills Pumping Station, as well as those mentioned in the preceding two paragraphs.

1.1.12 The assessment demonstrates that none of the permanent design proposals would result in substantial harm to or total loss of designated heritage assets, although there may be some significant temporary impacts during the construction phase. It also demonstrates that the proposals would have beneficial effects on a number of heritage assets, which would generally outweigh any harm.

# 2 Introduction

## 2.1 The purpose of the *Heritage Statement*

2.1.1 The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (the 'APFP Regs 2009') requires that, where applicable, an application for development consent must be accompanied by "*a plan with accompanying information identifying any statutory or non-statutory sites or features of the historic environment, including scheduled monuments, World Heritage sites, listed buildings and other historic structures, archaeological sites and registered battlefields, together with an assessment of any effects on such sites, features or structures likely to be caused by the proposed development*" (para. 5(2)(m). This *Heritage Statement* contains plans showing the heritage assets that may be affected by the Thames Tideway Tunnel project and assesses the potential effects of the proposals, in accordance with these regulations

2.1.2 The National Policy Statement for Waste Water (the 'NPS') provides the primary policy basis for deciding the application for development consent (the 'application'). The policies in relation to the historic environment are contained in Section 4.10 of the NPS. The *Heritage Statement* assesses the likely effects of the proposals on the historic environment at each site, in accordance with the relevant historic environment policies of the NPS and other guidance as appropriate. However, it is not the purpose of the *Heritage Statement* to weigh up harm versus public benefit. This analysis is presented within the *Planning Statement*, which accompanies the application.

2.1.3 The application for development consent for the project is made under the Planning Act 2008 (as amended by the Localism Act 2011) (the '2008 Act'), which disapplies the normal planning procedures of the Planning (Listed Buildings and Conservation Areas) Act 1990, for Nationally Significant Infrastructure Projects (NSIPs). If granted, the Development Consent Order (DCO) would encompass all of the normal consents. The Secretary of State[1] has assumed responsibility under the 2008 Act for deciding applications for NSIPs and will judge the application for the project primarily on the basis of the policies in the NPS.

2.1.4 The project proposals that relate to the historic environment are presented and assessed in the *Heritage Statement.* They are also set out in:

a. the drawings within the *Book of Plans*, which accompanies the application

b. the *Design Principles*, which includes generic (project-wide) and site-specific heritage design principles

[1] In this case, the Secretaries of State for the Department for Communities and Local Government and the Department for Environment, Food and Rural Affairs will act as joint decision maker.

c. the *Code of Construction Practice* (*CoCP*), of which Section 12 which relates to the historic environment.

2.1.5 The *Heritage Statement* also presents and assesses the proposals for works that:

a. would normally require Listed Building Consent, if the project were not subject to the 2008 Act, in this case, alterations to listed buildings[2]

b. would normally require Conservation Area Consent, if the project were not subject to the 2008 Act, in this case, demolition or substantial demolition of unlisted buildings in conservation areas

c. are located within the historic environment and where historic environment considerations have therefore influenced the design.

2.1.6 There are no proposals that would normally require Scheduled Monument Consent and no works within World Heritage Sites.

2.1.7 In addition to the NPS, the *Heritage Statement* also assesses the proposals in the light of other national, regional and local policies, where appropriate.

2.1.8 This document is intended to satisfy the requirements of para. 5(2) (m) of the APFP Regs 2009 and to inform the decision maker's understanding of the proposed works within the historic environment.

2.1.9 The appendices to this document set out the detailed assessment of the proposals in relation to the designation and significance of the potentially affected heritage assets at each of the 15 sites that have a bearing on the historic environment, in accordance with the NPS and with reference to regional and local policy where relevant.

2.1.10 This document contains a number of photographs of heritage assets and locations. The photographs are reproduced to illustrate the context for the analysis and were not used in the assessment of effects. The assessment was based on site visits, research, analysis and discussions with key stakeholders and was prepared by a team of qualified and experienced historic environment experts, as required by para. 4.10.7 of the NPS.

## 2.2 Relationship with other application documents

2.2.1 This section sets out the relationship between the *Heritage Statement* and the other documents within the application that address, assess or present the proposals relating to the historic environment. These documents include:

a. the *Design and Access Statement*

b. the *Environmental Statement*

[2] The definition of a listed building is a building included in the statutory list compiled or approved by the Secretary of State under Part I, Section 1 of the Planning (Listed Buildings and Conservation Areas) Act 1990. This definition includes any type of structure included in the list. The *Heritage Statement* generally refers to listed buildings and this definition encompasses listed structures, bridges and river walls. Where these different types of structures are treated or discussed separately they are referred to differently for clarity (eg, as listed bridges, or listed bollards).

c. the *Design Principles*

d. the drawings within the *Book of Plans*

e. the *CoCP*.

2.2.2 The *Heritage Statement* is supported by the *Design and Access Statement,* which accompanies the application. While the *Design and Access Statement* sets out the design evolution and alternatives considered for each site, the Heritage Statement specifically addresses the historic environment considerations that shaped the design, particularly in relation to alterations to listed buildings. Where appropriate, the *Design and Access Statement* is cross-referenced.

2.2.3 The *Environmental Statement* assesses the likely significant effects of the proposals on the historic environment. The *Heritage Statement* assesses the significant and less significant effects of the proposals on the historic environment, and considers them in relation to the criteria and policies in the NPS. The *Heritage Statement* concentrates on the above – ground heritage assets – i.e. Listed Buildings and Conservation Areas – since, if granted, the DCO would encompass all of the consents normally required to undertake works to these assets. A fuller assessment of the effects on archaeology is contained within the *Environmental Statement.* None of the proposed works would normally require Scheduled Monument Consent.

2.2.4 The *Design Principles* document sets out project-wide principles and site-specific heritage design principles that seek to ensure that the significance of the potentially affected heritage assets is protected. The generic principles are also set out in the main section of the *Heritage Statement*, and the site-specific principles are set out in the relevant appendices. The application contains draft Requirements to be attached to the DCO, if approved, which require various details, including plans and drawings, to be submitted to the local planning authorities for approval. The detailed plans would have to comply with the *Design Principles*.

2.2.5 The relevant 'as existing' survey and proposals drawings within the *Book of Plans* are reproduced as A3 drawings in the site-specific appendices to aid understanding of the proposals and the assessment. The drawings illustrate the proposed temporary construction works and the permanent works. As with 'normal' Listed Building Consent applications (that is, applications that do not fall under the 2008 Act), the drawings showing the proposed design at the interface with listed buildings and the maximum extent of loss of historic fabric of listed buildings are submitted for approval as part of the application.

2.2.6 Unlike normal Listed Building Consent applications, some elements that are specifically identified as 'for approval' appear on drawings with elements that are not 'for approval' (refer to Section 4.3). This is made explicit in the drawings and in the relevant part of the *Heritage Statement*.

2.2.7 The proposals relating to construction methods are set out in the *CoCP*. *Part A: General Requirements* sets out overarching project-wide construction methods and addresses works to heritage assets in Section 12. *Part B: Site-specific Requirements* sets out site-specific construction

methods and proposed site-specific mitigation and protection measures for the historic environment in Section 12 for each site.

## 2.3 Methodology

2.3.1 The methodology followed in the *Heritage Statement* for assessing the potential effects of the project on the historic environment is based on and consistent with the methodology contained within the *Environmental Statement* (Vol 2, Section 7). The methodology used in the *Environmental Statement* is summarised below; refer to the *Environmental Statement* for further details.

2.3.2 The methodology assesses the impact of the scheme on all heritage assets, whether formally designated or not. Professional judgement has been used to determine the heritage significance of those assets which are not designated. Table 2.1 below defines asset significance of designated and non-designated, above-ground and buried heritage assets:

**Table 2.1 Historic environment: Asset significance criteria**

| Asset significance | Definition |
|---|---|
| High | World Heritage Sites<br>Scheduled monuments<br>Grade I, II*, II listed buildings<br>English Heritage Grade I, II*, II registered parks and gardens<br>Conservation areas<br>Burial grounds<br>Undesignated heritage assets of national and international significance (as defined through the process defined in the Environmental Statement)<br>Protected wrecks, designated historic battlefields, protected heritage landscapes (eg, ancient woodland or historic hedgerows) are also assets of high significance but do not fall within the project baseline |
| Medium | Undesignated heritage assets (as defined through the process defined in paras. 7.4.21 to 7.4.25 of the Environmental Statement (Vol 2, Section 7)<br>Locally listed buildings |
| Low | Undesignated heritage assets (as defined through the process defined in paras. 7.4.21 to 7.4.25 of the Environmental Statement (Vol 2, Section 7) |
| Negligible | Undesignated heritage assets (as defined through the process defined in paras. 7.4.21 to 7.4.25 of the Environmental Statement (Vol 2, Section 7) |

| Asset significance | Definition |
|---|---|
| Uncertain | Applies to areas where past human activity is likely but where there is insufficient evidence to assess or assign potential significance |

2.3.3 The level of significance of effects on heritage assets is derived from measures of the magnitude of impact (change) and the sensitivity of the receptors (heritage assets) affected. The assessment relies on the heritage team's professional judgement to determine the degree of change to an asset and its significance. Table 2.2 below sets out the criteria used to define the magnitude of impacts.

**Table 2.2 Historic environment criteria for magnitude of impacts**

| Magnitude of impact | Definition |
|---|---|
| High | Complete removal of asset<br>Change to asset significance resulting in a fundamental change in our ability to understand and appreciate the asset and its historical context, character and setting. The transformation of an asset's setting in a way that fundamentally compromises its ability to be understood or appreciated. The scale of change would be such that it could result in a designated asset being undesignated or having its level of designation lowered. |
| Medium | Change to asset significance resulting in an appreciable change in our ability to understand and appreciate the asset and its historical context, character and setting. Notable alterations to the setting of an asset that affect our appreciation of it and its significance; or the unrecorded loss of archaeological interest. |
| Low | Change to asset significance resulting in a small change in our ability to understand and appreciate the asset and its historical context, character and setting. |
| Negligible | Negligible change or no material change to asset significance. No real change in our ability to understand and appreciate the asset and its historical context, character and setting. |

2.3.4 The significance of historic environment effects is determined by combining the identified impact magnitudes with the significance of the affected heritage assets, as set out in the matrix in Table 2.3 below.

2.3.5 The value 'uncertain' is a variation that relates to buried archaeological resources, which are often unknown. The matrix is intended as a guide to make the assessment process transparent. However, it allows flexibility to apply professional judgement depending on the nature of the asset and the potential impact upon it.

2.3.6 In the *Heritage Statement* the terminology used to describe the significance of effects is slightly different from that used in the

*Environmental Statement*. However, the criteria for identifying significance, magnitude of change and the process of identifying significance of the effects are the same.

**Table 2.3 Criteria for significance of effects on the historic environment**

| Impact magnitude | Asset significance (receptor value/sensitivity) | | | | |
|---|---|---|---|---|---|
| | **High** | **Medium** | **Low** | **Negligible** | **Uncertain** |
| High | Major – beneficial or adverse | Major/Moderate* – beneficial or adverse | Moderate* – beneficial or adverse | Negligible | Uncertain |
| | | | Minor* – beneficial or adverse | | |
| Medium | Major/Moderate* – beneficial or adverse | Moderate – beneficial or adverse | Minor – beneficial or adverse | Negligible | Uncertain |
| Low | Moderate – beneficial or adverse | Minor – beneficial or adverse | Minor – beneficial or adverse | Negligible | Uncertain |
| | Minor* – beneficial or adverse | | | | |
| Negligible | Minor – beneficial or adverse | Negligible | Negligible | Negligible | Uncertain |

** Where the environmental effect is shown as major/moderate or moderate/minor, the significance of effect was identified through professional judgement.*

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2.3.7 Table 2.4 below defines each significance rating. Major and moderate effects are considered to be significant.

**Table 2.4 Definition of significance of effect**

| Significance of effect | Description |
|---|---|
| Major adverse | Substantial harm to, or loss of, an asset's significance as a result of changes to its physical form or setting |
| Moderate adverse | Less than substantial harm to an asset's significance as a result of changes to its physical form or setting |
| Minor adverse | Limited harm to an asset's significance as a result of changes to its physical form or setting |
| Negligible | No appreciable, or very small change to an asset's significance |
| Uncertain | Significance of effect uncertain due to lack of information on buried heritage asset significance |
| Minor beneficial | Limited improvement of an asset's significance as a result of changes to its physical form or setting |
| Moderate beneficial | Notable enhancement of an asset's significance as a result of changes to its physical form or setting |
| Major beneficial | Substantial enhancement of an asset's significance as a result of changes to its physical form or setting |

2.3.8 The NPS (paras. 4.10.13 and 4.10.14) refers to the concept of 'substantial harm' to heritage assets. Para. 4.10.14 states that:

"*Where the application will lead to substantial harm to or total loss of significance of a designated heritage asset the decision maker should refuse consent unless it can be demonstrated that the substantial harm or loss of significance is necessary in order to deliver substantial public benefits that outweigh that loss or harm.*"

2.3.9 For the purposes of the *Heritage Statement*, 'substantial harm' is equivalent to a 'major adverse' effect, in terms of the methodology adopted in the *Environmental Statement*. Any other scale of significant effect is taken to mean 'less than substantial harm'.

## 2.4 Structure of the *Heritage Statement*

2.4.1 The *Heritage Statement* consists of this main report, which provides the background context for specific heritage issues that are relevant to the proposed works and sets out the proposals themselves. The 15 appendices detail the proposals relating to each site that would have implications for the historic environment. They then provide a detailed assessment of the potential effects of the proposed works on any heritage assets and any mapping required by the APFP Regs 2009.

2.4.2 The main report is divided into two sections:

a. Section 3 Project-wide matters: this section sets out issues that are relevant to the project as a whole.

b. Section 4 Site-specific matters: this section sets out a series of minor site-specific issues that did not merit a separate appendix. It then provides a guide to the detail within the site appendices in tabular form.

2.4.3 Section 3 is structured as follows:

a. Heritage policy and guidance: this section sets out the policies relevant to the historic environment and is divided into:

i National policy: the historic environment policies in the NPS (the primary policy guidance in respect of the project) and the *NPPF*

ii Regional policy: the London Plan (2011).

b. Project-wide design principles and requirements: this section sets out the principles that were applied to the proposed design and explains how these will be delivered through the proposed requirements attached to the DCO. Any final detailed designs subsequently submitted to the relevant local planning authorities for approval following any decision to grant a DCO would comply with these principles.

c. The reuse of materials of heritage significance: this section sets out procedures for storing and reusing any significant materials or items that would be removed during construction.

d. Ground movement effects on listed buildings, mitigation of potential ground movement, and proposed monitoring: this section sets out the measures relating to mitigating and monitoring the effects of construction and tunnelling induced settlement or ground movement. It identifies any listed structures that would be likely to be affected by ground movement and, where relevant, sets out proposals for installing monitoring equipment. Maps are provided as appropriate.

2.4.4 Section 4 deals with site-specific matters in two parts, as follows:

a. This section provides a consideration of four sites at which the historic environment is of minor significance in relation to the proposals.

b. Table 4.1 provides a summary of statutory requirements relating to the historic environment at the 24 proposed development sites and the following details:

i the appendix in which each site is addressed

ii any listed buildings or registered parks and gardens that would be altered as part of the proposals

iii whether the site falls within a conservation area and whether Conservation Area Consent would normally be required for the proposals

iv any non-statutorily designated heritage assets that would be altered as part of the proposals

v the setting of any heritage assets that are relevant to the proposals and the assessment thereof

vi the relevant design drawings for each site from the *Book of Plans*, their location in the application documents and their status (refer to Section 4.3) the design drawings are reproduced in the relevant site appendix).

2.4.5 The 15 site appendices are structured as follows:

a. Site location and context

b. Historical context

c. Relevant local heritage policy and guidance

d. Heritage assets: this section defines the nature, character and significance of the heritage assets assessed and the site's archaeological potential

e. Proposed works: this section describes the proposals in the requisite detail, asset by asset, and sets out what form of heritage consent (if any) would normally be required

f. Heritage design considerations: this section sets out how the historic environment influenced the development of the proposed design

g. Mitigation measures: this section sets out mitigation embedded into the designs and any proposed protective measures or programme of archaeological recording

h. Assessment of potential effects: this section assesses the proposals relating to the heritage assets and how they meet the NPS criteria and other policy considerations

i. Conclusion: this section summarises the results of the assessment

2.4.6 Table 2.5 lists the 15 site-specific appendices.

**Table 2.5 List of site-specific appendices**

| Appendix | Site name |
|---|---|
| Appendix A | Hammersmith Pumping Station |
| Appendix B | Putney Embankment Foreshore |
| Appendix C | Carnwath Road Riverside |
| Appendix D | Dormay Street |
| Appendix E | Cremorne Wharf Depot |
| Appendix F | Chelsea Embankment Foreshore |
| Appendix G | Albert Embankment Foreshore |
| Appendix H | Victoria Embankment Foreshore |
| Appendix J | Blackfriars Bridge Foreshore |

| Appendix | Site name |
|---|---|
| Appendix K | Shad Thames Pumping Station |
| Appendix L | Chambers Wharf |
| Appendix M | Deptford Church Street |
| Appendix N | Greenwich Pumping Station |
| Appendix P | King Edward Memorial Park Foreshore |
| Appendix Q | Abbey Mills Pumping Station |

# 3 Project-wide matters

## 3.1 Heritage policy and guidance

3.1.1 This section sets out the policies that directly relate to all elements of the historic environment that would potentially be affected by the proposed development.

3.1.2 The project is a Nationally Significant Infrastructure Project (NSIP) subject to the procedures of the 2008 Act. Therefore the NPS is the primary policy document against which the application will be assessed. In addition to the NPS, the decision maker must have regard to any other matters that it considers both relevant and important to the determination of the application, which may include national, regional and local policies and other guidance as appropriate. The NPS explains the extent to which such documents should be taken into account (para. 4.10.12).

3.1.3 The historic environment policies in the NPS are set out in Section 3.2 below. This section also discusses the heritage policies contained in the *NPPF*, although that document does not set criteria for determining the acceptability of NSIPs.

3.1.4 Section 3.3 below summarises relevant regional policy. Local policy specific to sites within certain London boroughs is not considered in the main report, but is considered where relevant within the site-specific appendices.

## 3.2 National policy and guidance

3.2.1 The NPS clearly states that the need for the project has been demonstrated. It concludes that: *"detailed investigations have confirmed the case for a Thames Tunnel*[3] *as the preferred solution"* (para. 2.6.33). It also states in Section A1.3.6 that: *"[t]he Thames Tunnel is considered to be an infrastructure scheme of national significance for a number of reasons:*

a. *"It is essential to meet the ecological water quality objectives of a major river of national importance;*

b. *"It is essential to reduce the risk of human health impacts;*

c. *"It is essential to reduce aesthetic impacts;*

d. *"It is essential to meet statutory requirements"*.

3.2.2 The NPS also sets out general policies against which applications for development consent for wastewater NSIPs are to be determined (Part 3), and policies in relation to likely significant impacts of the construction and operation of such infrastructure (Part 4).

[3] The project changed its name from the Thames Tunnel project to the Thames Tideway Tunnel project in July 2012.

3.2.3 Section 3.5 of the NPS sets out criteria for good design. Para. 3.5.1 states that: *"Good design is about ensuring attractive, usable, durable and adaptable places and contributing to sustainable development. The expectation should be that good aesthetic and functional design can go together although the nature of much waste water infrastructure development will often limit the extent to which it can contribute to the enhancement of the quality of the area".* The use of Design Council CABE design reviews is also recommended. Para. 3.5.3 states: *"The development should, by the use of good architecture and appropriate landscaping, be as visually attractive as possible. While the applicant may have no, or very limited choice in the physical appearance of some waste water infrastructure, there may be opportunities for the applicant to demonstrate good design in terms of siting relative to existing and currently planned landscape character, landform and vegetation"*.

3.2.4 Section 4.7 provides guidance regarding landscape and townscape impacts. Para. 4.7.6 states: *"Having regard to siting, operational and other relevant constraints, the aim should be to minimise harm to the landscape, providing reasonable mitigation where possible and appropriate".*

3.2.5 In relation to local landscape and townscape designations, para. 4.7.12 states: *"Outside nationally designated areas, there are local landscapes that may be highly valued locally and protected by local designation. Where a local development document in England or a local development plan in Wales has policies based on landscape character assessment, these should be paid particular attention. However, local landscape designations should not be used in themselves as reasons to refuse consent, as this may unduly restrict acceptable development".*

3.2.6 Para. 4.7.16 suggests various mitigation approaches and states that: *"reducing the scale or otherwise amending the design of development may result in a significant operational constraint and reduction in function. There may, however, be exceptional circumstances, where mitigation could have a very significant benefit and warrant a small reduction in function".*

3.2.7 Section 4.10 provides guidance regarding historic environment impacts. Para. 4.10.7 states: "*As part of the ES [Environmental Statement] the applicant should provide a description of the significance of the heritage assets affected by the proposed development and the contribution of their setting to that significance. The level of detail should be proportionate to the importance of the heritage assets and no more than is sufficient to understand the potential impact of the proposal on the significance of the heritage asset*". This policy is also relevant to the assessment presented in this document of the significance of historic environment impacts, which is proportionate to the significance of the relevant heritage assets.

3.2.8 Para. 4.10.12 acknowledges the desirability of making a positive contribution to the character and local distinctiveness of the historic environment and suggests considering *"scale, height, massing, alignment, materials and use"* in order to achieve this.

3.2.9 Para. 4.10.13 states that: *"There should be a presumption in favour of the conservation of designated heritage assets and the more significant the designated heritage asset, the greater the presumption in favour of its conservation should be. Once lost, heritage assets cannot be replaced and their loss has a cultural, environmental, economic and social impact. Significance can be harmed or lost through alteration or destruction of the heritage asset or development within its setting. Loss affecting any designated heritage asset should require clear and convincing justification. Substantial harm to or loss of a grade II listed building, park or garden should be exceptional. Substantial harm to or loss of designated assets of the highest significance, including Scheduled Monuments, registered battlefields, grade I and II* listed buildings, grade I and II* registered parks and gardens, and World Heritage Sites, should be wholly exceptional".*

3.2.10 Para. 4.10.14 states that harm to the significance of a designated heritage asset "*should be weighed against the public benefit of development, recognising that the greater the harm to the significance of the heritage asset the greater the justification will be needed for any loss. Where the application will lead to substantial harm to or total loss of significance of a designated heritage asset the decision maker should refuse consent unless it can be demonstrated that the substantial harm to or loss of significance is necessary in order to deliver substantial public benefits that outweigh that loss or harm*".

3.2.11 In relation to conservation areas and World Heritage Sites, para. 4.10.15 states that: *"the decision maker should take into account the relative significance of the element affected and its contribution to the significance of the World Heritage Site or conservation area as a whole".*

3.2.12 In relation to development proposals affecting the setting of a designated heritage asset, para. 4.10.17 states that: *"the decision maker should treat favourably applications that preserve those elements of the setting that make a positive contribution to, or better reveal the significance of, the asset. When considering applications that do not do this, the decision maker should weigh any negative effects against the wider benefits of the application. The greater the negative impact on the significance of the designated heritage asset, the greater the benefits that will be needed to justify approval*".

3.2.13 The *NPPF* is aligned with the NPS and much of the text is identical. It does not therefore add materially to the guidance in the NPS. Section 12, paras. 126 to 141 of the *NPPF* deal with conserving and enhancing the historic environment. *NPPF* para. 128 is almost identical to NPS para. 4.10.7 (refer to para. 2.2.5 above). *NPPF* para. 132 is very similar to NPS para. 4.10.13 (refer to para. 2.2.7 above). *NPPF* para. 138 is very similar to NPS para. 4.10.15. The need to treat favourably applications that preserve elements of setting or better reveal the significance of heritage assets is set out in NPS para. 4.10.17 and *NPPF* para. 137.

## 3.3 Regional policy and guidance

3.3.1 The main regional policy relevant to the project is the *London Plan* (2011). This document sets out the Mayor's spatial planning framework for London, which aims to promote an attractive, well-designed and sustainable city.

3.3.2 *London Plan* Policy 7.8 (Heritage Assets and Archaeology) states that: "*London's heritage assets and historic environment, including listed buildings, registered historic parks and gardens and other natural and historic landscapes, conservation areas, World Heritage Sites, registered battlefields, scheduled monuments, archaeological remains and memorials should be identified, so that the desirability of sustaining and enhancing their significance and of utilising their positive role in place shaping can be taken into account. […] Development should incorporate measures that identify, record, interpret, protect and, where appropriate, present, the site's archaeology. [...] Development affecting heritage assets and their settings should conserve their significance, by being sympathetic to their form, scale, materials and architectural details".*

3.3.3 *London Plan* Policy 7.10 (World Heritage Sites) states that: "*Development in World Heritage Sites and their settings, including any buffer zones, should conserve, promote, make sustainable use of and enhance their authenticity, integrity and significance and Outstanding Universal Value. The Mayor will work with relevant stakeholders to develop supplementary planning guidance to define the setting of World Heritage Sites*".

3.3.4 *London Plan* Policy 7.29 (The River Thames) states that the River Thames is "*a strategically important and iconic feature of London. This role should be protected and promoted".*

3.3.5 The London View Management Framework sets out visual management guidance for river prospects. Several of these river prospects take in views of proposed development sites. Para. 62 states that: "*The character and composition of built form above the river is often coherent and of very high quality. In many cases, it encompasses conservation areas, listed buildings and World Heritage Sites, enhanced by mature trees lining well-*designed *publicly accessible walkways. In areas where historic townscape of high quality exists, new development should, where appropriate, preserve or enhance the historic skyline. In other areas the current framing of the view and the settings of landmarks, including Strategically Important Landmarks, is poor and could benefit from new development*". Guidance is also provided in relation to the protection of views to and from the Greenwich Maritime World Heritage Site (view 24).

## 3.4 Project description

3.4.1 At present, untreated sewage mixed with rainwater (combined sewage) regularly overflows into the River Thames from London's Victorian sewerage system via combined sewer overflows (CSOs).

3.4.2 Combined sewage discharges must be reduced in order to comply with relevant wastewater legislation. The primary objective of the proposed project is to control discharges from CSOs in order to meet the requirements of the European Union's Urban Waste Water Treatment Directive (91/271/EEC) (UWWTD) and the related United Kingdom Urban Waste Water Treatment Regulations. Other European Union and United Kingdom legislation also forms part of the legal framework within which the project is to be designed and delivered. The Water Framework Directive, and the regulations that transpose it into United Kingdom law, set out various 'environmental objectives' to be achieved in relation to surface water quality.

3.4.3 Solutions to the problem of wastewater discharges into the tidal reaches of the River Thames have been under examination for more than ten years. The project has been determined to be the most technologically-sound and cost-effective means of controlling CSO discharges and satisfying regulatory requirements. This has been confirmed by independent studies and by Thames Water.

### The proposed solution

3.4.4 Thames Water[4] propose to control CSO discharges by intercepting and diverting combined sewage flows into a new storage[5] and transfer tunnel. The tunnel would run from Acton Storm Tanks in west London to Abbey Mills Pumping Station in the east, where it would connect to the Lee Tunnel, which would transfer the flows to Beckton Sewage Treatment Works for treatment.

3.4.5 The new infrastructure would protect the tidal Thames from increasing pollution for at least the next 100 years. The current assumption is that construction would commence in 2016 and be completed by 2023.

3.4.6 The project forms part of the wider London Tideway Improvements scheme, which includes the Lee Tunnel project and improvements at Mogden, Crossness, Longreach and Riverside Sewage Treatment Works, and a major capacity extension at Beckton Sewage Treatment Works to treat flows collected by the Thames Tideway and Lee tunnels.

[4] 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.

[5] It should be noted that wastewater would only be stored in the tunnel for a temporary period until it can be pumped out at Beckton Sewage Treatment Works.

## Project overview

3.4.7 The project comprises two principal elements:

a. tunnels:

   i the main tunnel

   ii connection tunnels

b. sites:

   i main tunnel sites

   ii CSO sites

   iii system modification sites

   iv Beckton Sewage Treatment Works.

### Main tunnel

3.4.8 The main tunnel would capture and temporarily store combined sewage from the unsatisfactory CSOs along its route and transfer it to Beckton Sewage Treatment Works.

3.4.9 The horizontal alignment of the main tunnel would generally follow the River Thames, where possible and practical, in order to:

a. ensure the most efficient route to connect the CSOs located on both banks of the river

b. enable river transport during construction to supply and remove materials, where practicable and economic

c. minimise the number of structures the tunnel would pass beneath in order to reduce the number of third parties affected.

3.4.10 The main tunnel route would take the shortest practical line from Acton Storm Tanks to the River Thames and stay beneath the river from west London to Rotherhithe. It would then divert from beneath the River Thames to the northeast via the Limehouse Cut and terminate at Abbey Mills Pumping Station, where it would connect to the Lee Tunnel.

3.4.11 The main tunnel would be approximately 25km long with an approximate internal diameter of 6.5m in the west increasing to 7.2m through central and east London. The approximate depth of the tunnel would be between 30m in west London and 65m in the east in order to provide sufficient clearance to existing tunnels and facilities under the city and meet the hydraulic requirements.

### Connection tunnels

3.4.12 Two long connection tunnels would be required in order to connect five remote CSOs to the main tunnel. The tunnels are known as:

a. the Frogmore connection tunnel (approximately 2.6m to 3m internal diameter and approximately 1.1km long), which would be situated in the London Borough of Wandsworth

b. the Greenwich connection tunnel (approximately 5m internal diameter and approximately 4.6km long), which would pass through the London boroughs of Southwark and Lewisham and the Royal Borough of Greenwich.

3.4.13 A series of shorter connection tunnels would also be necessary to connect various CSOs that are close to the proposed main tunnel route.

### Site types

3.4.14 The Environment Agency has identified 34 'unsatisfactory' CSOs that the project needs to address. CSO control studies and design development have established that 14 of these CSOs could be controlled indirectly, which reduces the number of worksites required.

3.4.15 The multidisciplinary team carried out a detailed site selection process, having regard to engineering, planning, environment, socio-economic, community and property constraints. Twenty-four worksites were selected in total, which can be categorised by function as follows:

a. Five 'main tunnel sites': These sites would be used to construct the main tunnel and can be further classified as 'drive sites' and/or 'reception sites'. Shafts would be excavated to the appropriate depth and the tunnel boring machines would start at 'drive shafts' and be removed via 'reception shafts'. A shaft may serve as both a drive and a reception shaft.

b. Sixteen 'CSO sites': These sites would be used to construct the CSO drop shafts and interception structures and to drive or receive connection tunnels.

c. Two 'system modification sites': These sites would be used to control CSOs locally rather than connecting them to the main tunnel.

d. Beckton Sewage Treatment Works: This site would be used to lift the combined sewage flows from the main tunnel system and transfer them for treatment. This site also requires a siphon tunnel to bypass the pumping mechanism when the tunnel system is full.

### Above-ground permanent works

3.4.16 Some permanent above-ground infrastructure would be required, which would vary according to the type of site. This infrastructure might include:

a. air management facilities including ventilation structures and ventilation columns

b. a kiosk structure to house electrical and control equipment

c. a means of access

d. areas of hardstanding adjacent to shafts and structures to enable periodic inspection and maintenance.

3.4.17 Maintenance visits would be required approximately every three to six months for above-ground equipment inspections and every ten years for tunnel system and shaft inspections. Construction sites would be restored

on completion of the works by means of levelling, in-filling, landscaping and making good.

## 3.5 Design principles and requirements

3.5.1 Design principles for the design of the permanent above-ground elements are submitted as part of the application for development consent. Further information is provided in the *Design Principles* document that accompanies the application. The *Design Principles* were developed in consultation with local authorities and other stakeholders. They establish standards and principles that must be met or addressed in the final detailed design of the above-ground structures and spaces associated with the project.

3.5.2 The *Design Principles* accompany the Site works parameter plans and the indicative and illustrative plans that are submitted with the application for development consent. They provide more detail of the design intent but still ensure some flexibility to develop the detailed designs at a later date in the light of the prevailing circumstances when the project is implemented. The *Design Principles*, together with the approved parameter plans, and indicative and illustrative plans, are intended to provide assurance of the type and quality of design proposed. Once the DCO is made, the Design Principles and parameters will be fixed.

3.5.3 The purpose of the *Design Principles* relating to the historic environment is to ensure that the proposed design is sensitive to and responds to the character and significance of the historic environment. The design principles include high-level design objectives (*Design Principles*, 2.1), a key focus of which is the preservation and enhancement of the historic environment, by building on the legacy of Sir Joseph Bazalgette's historic sewerage system. These objectives state the following:

a. In keeping with Bazalgette's tradition, any new public open spaces shall be designed to positively enhance the environment and provide a lasting legacy.

b. Site designs shall be of high quality and provide value. They shall respect each site's individual location and setting, while recognising the contribution of all sites to providing a cleaner, healthier River Thames.

c. Designs shall recognise the importance and quality of the engineering infrastructure below-ground. They shall meet safety, functional, environmental, maintenance and access requirements. The structures and finished surfaces shall be robust and of appropriate quality.

3.5.4 The proposals were designed in accordance with a clear set of Heritage design principles, with the aim of safeguarding the special interest of heritage assets and the quality of the historic environment. They apply to sites in sensitive heritage environments and are augmented by site-specific design principles, as well as the proposals set out in the *CoCP*. The design principles take account of current policy and guidance and good conservation practice, including:

a. English Heritage's *Conservation Principles* (2008)

b. the NPS (2012)

c. the *NPPF* (2012)

d. PPS5 *Practice Guide* (2010, with revision note June 2012).

3.5.5 The generic Heritage design principles that have guided design development to date and would subsequently guide the detailed design phase are set out in Table 3.1 below.

**Table 3.1 Heritage design principles**

| Reference | Heritage principles |
|---|---|
| HRTG.01 | Where interventions to the fabric of listed buildings or listed structures are proposed, they shall be designed to remove as little historic fabric as possible in order to ensure maximum retention of historic form and fabric. |
| HRTG.02 | Modern structural and environmental designs that interface with listed buildings or structures shall respect the historic structural and environmental behaviour of the adjacent listed building or structure. |
| HRTG.03 | Monitoring equipment for assessing the effect of the works on listed buildings and structures shall be designed to be unobtrusive and to ensure the significance of the listed building is undamaged. |
| HRTG.04 | Facing materials and detailing shall be compatible with the visual character of existing adjacent listed buildings and heritage assets. |
| HRTG.05 | Designs shall aim to support the legibility of the key historic functions of heritage assets. |
| HRTG.06 | Alterations to historic fabric shall be reversible, wherever reasonably practicable. |
| HRTG.07 | Interpretive material shall be provided at sites of heritage value where this would be of wider public benefit. The design of interpretation materials shall not lead to unacceptable visual clutter. Material shall be developed in line with a project-wide interpretation strategy and shall take account of any existing local interpretation strategies. |
| HRTG.08 | Trees that need to be removed in a conservation area shall be replaced as close as possible to the original position with a species that relates to the character of the area. For new trees, reference shall be made to the principles outlined in the Mayor of London's *London Trees and Woodland Framework* and the *Right Place, Right Tree* initiative. |

3.5.6 The *Design Principles* will be secured through the DCO Requirements. Schedule 3 of the Draft DCO contains the proposed Requirements that would be imposed on the DCO if it were confirmed. These have been developed in consultation with the local authorities and other stakeholders.

The commitment to the design principles and parameters for individual works is secured through the DCO Requirements.

3.5.7 There are project-wide Requirements and site-specific Requirements, and both may relate to heritage matters. The project-wide Requirements apply across the whole project and essentially set the framework within which the project will be delivered. There are project-wide heritage Requirements, for example, which require works to record built heritage to be undertaken in accordance with the *Overarching Archaeological Written Scheme of Investigation.* Site-specific Requirements address issues and secure mitigation at individual sites. The proposed site-specific Requirements are unique to each site and may include matters such as details of works to listed buildings and structures.

3.5.8 Requirements which concern detailed design approval necessitate the submission to and approval by the local planning authority of details in accordance with the approved design principles and parameters, prior to the construction of a particular part of the authorised development.

3.5.9 The *Design Principles* and Requirements provide a robust framework of control to ensure the project is implemented in accordance with the principles, parameters and plans enshrined within the application documents and that the special interest of heritage assets and the quality of the historic environment is preserved and enhanced.

3.5.10 The proposed Requirements were consulted upon with the local planning authorities that would be responsible for approving any submitted details. The Requirements are still in draft form and will be finalised in consultation with stakeholders.

## 3.6 Reuse of materials of heritage significance

3.6.1 At a number of sites, where alterations are proposed to listed buildings, some historic elements and materials would be temporarily or permanently removed. The procedures set out here seek to ensure that these materials are reused where appropriate.

3.6.2 The items and areas of listed building fabric to be removed temporarily and permanently are shown on drawings within the *Book of Plans*. In some cases the designs specify the reuse of materials recovered from demolition work in new elements. The application contains draft Requirements relating to the relevant sites which identify the items to be removed and retained for reuse and require method statements to be submitted to the local planning authorities for approval setting out the method of removal, storage and, where appropriate, reinstatement.

3.6.3 The *Code of Construction Practice (COCP), Part A* requires the Contractor to produce a Heritage Management Plan (HMP) for each site that would set out how the contractor would discharge the requirements of the DCO in relation to heritage, in consultation with relevant statutory bodies such as English Heritage and the Local Planning Authority (*CoCP, Part A*, 12.2). The *CoCP* states that the HMP would include a detailed methodology for the dismantling, removal and storage of any identified

historic elements of heritage assets removed during construction, and details of reinstatement (*CoCP, Part A*, 12.2).

3.6.4 Sites where materials or items of significance would be removed from listed buildings for the duration of the works and reinstated towards the end of the construction phase include: Putney Embankment Foreshore, Victoria Embankment Foreshore, Blackfriars Bridge Foreshore and Greenwich Pumping Station. In the case of the Chelsea Embankment Foreshore site and Shad Thames Pumping Station significant items and materials from unlisted buildings within conservation areas would be removed and reinstated or reused in making good. Some materials that would be removed during construction demolition would be retained for use in making good historic finishes following construction. Some materials or items would be removed permanently.

3.6.5 The designs for the sites were developed to minimise the need to remove the most significant historic materials. However, at a number of sites, the removal of some historic materials and objects in order to construct the necessary infrastructure would be unavoidable.

3.6.6 Where historic materials would be removed, the following principles and procedures are proposed in order to identify alternative uses:

a. Where undertaking alterations to historic buildings or structures, the potential to reuse any demolished materials would be considered as a priority. Sufficient demolished materials would be retained intact to ensure that the buildings or structures could be made good in accordance with the approved design. Any demolished materials would be carefully removed from site, stored indoors in stable conditions under the curatorship of a nominated body, named within the relevant method statement.

b. In relation to the most significant elements that would be removed (eg Bazalgette's lamp standards, Lion's head mooring rings, York stone paving , granite river wall blocks), efforts would be made to reuse the materials elsewhere in the project to make good other historic buildings or structures or, where appropriate, as part of new finishes in historic settings.

c. Where it is not possible or appropriate to reuse such elements elsewhere on the project, Thames Water would approach other potential users to seek appropriate alternative uses. If none are identified, Thames Water would approach English Heritage and the local authorities for advice as to potential users.

d. If no alternative users are identified, the rarer elements would be offered to museums/collections (eg the Victoria and Albert Museum, the Science Museum, the Museum of London, or the Brooking Collection). English Heritage, the Institution of Civil Engineers and the local planning authorities would be consulted as to appropriate collections to approach.

e. If no museums/collections are willing to receive the elements, they would be sold to specialist architectural salvage agents. Any

remaining rare elements would be recorded (photographed and, if appropriate, sketched) prior to disposal. Any records would be appropriately archived and, if they are sufficiently significant, disseminated along with any other archaeological findings brought to light during the construction phase.

## 3.7 Ground movement effects on listed buildings

3.7.1 The proposed development would generate ground movement from tunnelling and construction during the construction phase.

3.7.2 The settlement generated by the tunnelling has the potential to affect the designated heritage assets within the area affected by the settlement of ground above the tunnels. The construction works at individual sites also have the potential to affect the designated heritage assets, including through ground movement. These effects are assessed in the historic environment section of the *Environmental Statement*, Volume 3 project-wide effects and the historic environment sections of each site assessment (Vols 4 to 27). A summary is presented here.

3.7.3 Settlement generally continues for some time after the activities that generate it and would continue into the period of the tunnel's operation. As the settlement is instigated by the construction activity, the effects are all assessed with the construction phase.

3.7.4 A preliminary engineering damage assessment was carried out for the listed buildings that were predicted to be affected by ground movement in excess of 1mm for the assumed tunnel alignment within the proposed limits of deviation for the tunnels and shafts. The damage assessment methodology used is sufficiently conservative that variations of tunnel alignment and shaft location within the limits of deviation and within other parameters set out in the *CoCP* and *Design Principles* would not damage additional listed buildings to those included within the preliminary assessment. Such variations in alignment and location would also not cause more severe damage than that predicted in the assessment. . The assessment determined the sensitivity of the listed buildings to the predicted ground movement and assessed the damage risk. This was used as the basis of the assessment of likely effects on the historic environment resulting from predicted ground movement.

3.7.5 The method of assessing damage from tunnelling is based on the method used in previous major urban tunnelling projects, which was first used in London for the Jubilee Line extension and most recently for Crossrail. The method of assessment for listed buildings takes account of the sensitivity of the listed buildings to the predicted levels of damage from ground movement.

3.7.6 Construction works and deep excavations at the following sites would induce ground movement that could potentially affect listed buildings:

a. Putney Embankment Foreshore, where the excavations for the CSO interception structure would be located adjacent to, the Grade II listed Putney Bridge's southern abutment

b. Cremorne Wharf Depot, where shafts and culverts are in the vicinity of the Grade II listed Lot's Road Pumping Station

c. Albert Embankment Foreshore, where the demolitions and excavations for the CSO interception structure would be adjacent to the Grade II* listed Vauxhall Bridge

d. Victoria Embankment Foreshore, where demolitions and excavations for the CSO interception and drop shaft structures would affect the Grade II listed Victoria Embankment river wall (see *Environmental Statement* Vol 3 Figure 7.4.12 in separate volume of figures)

e. Blackfriars Bridge Foreshore, where the demolitions and excavations for the CSO interception and drop shaft structures would be adjoining the Grade II listed Victoria Embankment, adjacent to the Grade II listed Blackfriars Bridge, and in the vicinity of five listed buildings on the north side of Victoria Embankment

f. Kind Edward Memorial Park, where the shafts and culverts of the CSO drop shaft would be close to the Grade II Listed Rotherhithe Tunnel Air Shaft

g. Deptford Church Street, where tunnels and shafts would be near to the boundary of the Grade I listed St Paul's Church

Ground movement induced by tunnelling could also affect listed buildings outside individual sites.

3.7.7 The *Code of Construction Practice* (*CoCP*) sets out the measures and procedures which would be adopted to ensure that the heritage assets are protected from the effects of settlement. It contains general requirements (Part A), and site-specific requirements (Part B). For each site a *Heritage management plan* would be prepared that would set out the measures to protect designated heritage assets from settlement (*CoCP Part A* Section 12.2) including monitoring, establishing limits of acceptable movement and procedures for repair to listed buildings damaged as a result of ground movement (*CoCP Part A* Section 12.3).

3.7.8 Section 13 of the *CoCP Part A* sets out the measures that would be implemented to protect existing infrastructure and buildings from ground movement, including listed buildings. There would be initial pre-condition surveys prior to the commencement of any works that have the potential to generate ground movement (*CoCP Part A* Section 13.1).

3.7.9 Where necessary protective measures would be undertaken and the installation of instrumentation and monitoring would be used to confirm that ground movement is as predicted and acceptable (*CoCP Part A* Section 13.1). Section 13.2 of *CoCP Part A* sets out that 'appropriate techniques would be implemented in order to control and limit as far as reasonably practicable, the impacts of construction induced ground movement.' For tunnelling works these techniques would include a range of measures, such as the targeted adoption of tunnelling procedures which would minimise volume loss resulting from tunnel construction.

3.7.10 Where required instrumentation and monitoring would be attached to sensitive listed buildings and structures, or those where a risk of damage

is predicted in such a way as to limit the adverse effects on their special architectural or historic interest, thus preserving their significance. The need for this can be minimised by establishing survey points to monitor movement of the adjacent ground and confirm this is behaving as predicted.

3.7.11 The construction effects of ground movement on the historic environment are assessed with relevance to the period during which the effects generated from ground movement are at their peak, which is during construction of the tunnels. The effects are assessed against the findings of the damage assessment and detailed bridge assessment reports (in the *Environmental Statement*, Vol 3 Appendix E.1, Vol 3 Appendix E.2 and Vol 3 Appendix E.3), which detail the key significance of each listed building or structure, their vulnerabilities, and the predicted settlement and damage risk that is likely for the building or structure.

3.7.12 Bridges, buildings and other structures have different structural systems, which require slightly different engineering assessment methodologies. The listed buildings have therefore been divided for the purposes of assessment into two main categories: listed bridges and tunnels; and listed buildings and structures. Table 3.2 sets out the likely impacts of ground movement generated by the construction works on the listed buildings, and the significance of the impacts The table sets out the listed buildings first, by borough, from west to east. The listed bridges and viaducts are then also set out from west to east.

**Table 3.2 Historic environment: Construction effects assessment**

| Name/ Significance | Description of effect | Magnitude of change | Significance of effect |
|---|---|---|---|
| **LB Hounslow** | | | |
| 60-62 Bath Road (High significance) | Settlement would be between 5mm in the east, to 1mm in the west. The damage assessment identifies the damage risk to be negligible, with the possibility of hairline cracks of a typical maximum width of 0.1mm. | Negligible | Minor negative |
| Swan House (High significance) | The peripheral curtilage of this building would experience a settlement of 1mm. The damage assessment identifies the damage risk to be negligible, with the possibility of hairline cracks of a typical maximum width of 0.1mm. | Negligible | Minor negative |
| Cedar House (High significance) | Settlement of between 1mm and 2mm is predicted. The damage assessment identifies the damage risk to be negligible, with the possibility of hairline cracks of a typical maximum width of 0.1mm. | Negligible | Minor negative |
| **LB Kensington and Chelsea** | | | |
| Lots Road Pumping Station (High Significance) | Towards the rear of the building a maximum of 15mm of settlement is predicted, reducing to 1mm of settlement at the front, and more significant and sensitive part of the building. In the area of greatest settlement the damage assessment identifies the risk of cracks of up to 10mm due to settlement, concentrated on existing joints within the walls and where the foundations differ. | Low | Moderate negative |
| **LB Wandsworth** | | | |

| Name/ Significance | Description of effect | Magnitude of change | Significance of effect |
|---|---|---|---|
| 7-9 Church Row (High significance) | Settlement between 1mm and 6mm is predicted. It could impact upon the structural and heritage significance of the west side of the building. Although the damage assessment identifies the damage risk to be negligible, with the possibility of negligible hairline cracks of a typical maximum width of 0.1mm, they would be concentrated on the façade of the building. | Low | Minor negative |
| 1-6 Church Row (High significance) | Settlement between 1mm and 10mm at its west side is predicted. This could impact upon the structural and heritage significance of this building. Although the damage assessment identifies the damage risk to be negligible, with the possibility of hairline cracks of a typical maximum width of 0.1mm, they would be concentrated on the façade of the building. | Low | Minor negative |
| Church of All Saints (High significance) | Settlement of between 1mm and 2mm at its east end is predicted. Although the building is of high significance and in poor condition, the damage assessment identifies the damage risk to be negligible, with the possibility hairline cracks of a typical maximum width of 0.1mm. | Negligible | Minor negative |
| Wentworth House (High significance) | This building would experience settlement of between 1mm and 6mm across its structure. The damage assessment identifies the damage risk to be negligible, with the possibility of hairline cracks of a typical maximum width of 0.1mm. | Negligible | Minor negative |
| **City of London** | | | |
| Hamilton House (High significance) | The peripheral curtilage of this building would experience a settlement of 1mm. The building damage assessment considers the potential risk of probable damage to be negligible, with the possibility of the impact of this movement to be negligible | Negligible | Minor negative |

| Name/ Significance | Description of effect | Magnitude of change | Significance of effect |
|---|---|---|---|
| | hairline cracks of a typical maximum width of 0.1mm. | | |
| Telephone House (High significance) | The southern tip of this building would experience a settlement of 1mm. The building damage assessment considers the potential risk of probable damage to be negligible, with the possibility of the impact of this movement to be negligible hairline cracks of a typical maximum width of 0.1mm. | Negligible | Minor negative |
| Sion House (High significance) | The southern elevation of this building would experience a settlement of 1mm. The building damage assessment considers the potential risk of probable damage to be negligible, with the possibility of the impact of this movement to be negligible hairline cracks of a typical maximum width of 0.1mm. | Negligible | Minor negative |
| 9 Carmelite Street (High significance) | The southern elevation of this building would experience a settlement of between 1mm and 2mm. The building damage assessment considers the potential risk of probable damage to be negligible, with the possibility of the impact of this movement to be negligible hairline cracks of a typical maximum width of 0.1mm. | Negligible | Minor negative |
| Carmelite House (High significance) | The southern (modern) elevation of this building would experience a settlement of between 1mm and 2mm. The building damage assessment considers the potential risk of probable damage to be negligible, with the possibility of the impact of this movement to be negligible hairline cracks of a typical maximum width of 0.1mm. | Negligible | Minor negative |
| **LB Southwark** | | | |
| Corbett's Wharf (High significance) | Settlement of between 1mm and 3mm is predicted across its structure. Taking into account the condition of the building, the damage assessment identifies the damage risk to be negligible, with the possibility of hairline cracks of a typical maximum width of 0.1mm. | Negligible | Minor negative |

| Name/ Significance | Description of effect | Magnitude of change | Significance of effect |
|---|---|---|---|
| Chambers Wharf (High significance | Settlement of between 1mm and 5mm is predicted across its structure. The damage assessment identifies the damage risk to be negligible, with the possibility of hairline cracks of a typical maximum width of 0.1mm. | Negligible | Minor negative |
| 33 Bermondsey Wall East – (High significance) | Settlement of between 1mm and 3mm is predicted across its structure. The damage assessment identifies the damage risk to be negligible, with the possibility of hairline cracks of a typical maximum width of 0.1mm. | Negligible | Minor negative |
| **LB Tower Hamlets** | | | |
| Free Trade Wharf (High significance) | Settlement of between 1mm and 3mm is predicted at the building's southern end. The damage assessment identifies the damage risk to be negligible, with the possibility of hairline cracks of a typical maximum width of 0.1mm. | Negligible | Minor negative |
| Prospect of Whitby Public House (High significance) | Settlement of between 2mm and 6mm is predicted across its structure, with the greater settlement occurring at its rear. The damage assessment identifies the damage risk to be negligible, with the possibility hairline cracks of a typical maximum width of 0.1mm. | Negligible | Minor negative |
| British Waterways Custom House | Settlement of between 2mm and 5mm is predicted across its structure. The damage assessment identifies the damage risk to be negligible, with the possibility of hairline cracks of a typical maximum width of 0.1mm. | Negligible | Minor negative |

| Name/ Significance | Description of effect | Magnitude of change | Significance of effect |
|---|---|---|---|
| (High significance) | | | |
| British Sailors Society (High significance) | Settlement of between 1mm and 4mm is predicted across its structure. The damage assessment identifies the damage risk to be negligible, with the possibility of hairline cracks of a typical maximum width of 0.1mm. | Negligible | Minor negative |
| Limehouse Town Hall (High significance) | Settlement of between 1mm and 4mm is predicted across its structure. Although the building is in poor condition, the damage assessment identifies the damage risk to be negligible, with the possibility of hairline cracks of a typical maximum width of 0.1mm. | Negligible | Minor negative |
| Limehouse District Library (High significance) | Settlement of between 3mm and 10mm is predicted across its structure, with the greatest settlement occurring directly above the tunnel. Due to the condition of the building, and the resulting fragile heritage features, there may be an impact upon the heritage significance even though the damage assessment report (see Vol 3 Appendix E.1) identifies the risk damage to be negligible, with the possibility of cracks typically up to 0.1mm wide. | Low | Minor negative |
| Dowgate Wharf (High significance) | The peripheral curtilage of this building is predicted to experience 1mm of settlement. The damage assessment identifies the damage risk to be negligible, with the possibility of the impact of hairline cracks of a typical maximum width of 0.1mm. | Negligible | Minor negative |
| 777-783 Commercial Road | Settlement of between 1mm and 8mm is predicted across its structure. Although the damage assessment has identified the damage risk category as negligible, with the possibility of typical cracking of up to 0.1mm, the very poor condition of | Low | Minor negative |

| Name/ Significance | Description of effect | Magnitude of change | Significance of effect |
|---|---|---|---|
| (High significance) | this building may be worsened by significant ground movement. | | |
| Block A, Metropolitan Wharf – (High significance) | Settlement of between 1mm and 2mm is predicted at its southern end. The damage assessment has identified the damage risk to be negligible, with the possibility of hairline cracks of a typical maximum width of 0.1mm. | Negligible | Minor negative |
| Block B&C, Metropolitan Wharf – (High significance) | Settlement of between 1mm and 2mm is predicted at its southern end. The damage assessment identifies the damage risk to be negligible, with the possibility hairline cracks of a typical maximum width of 0.1mm. | Negligible | Minor negative |
| Block D, Metropolitan Wharf – (High significance) | The southern edge of this building would experience 1mm of settlement. The damage assessment identifies the damage risk to be negligible, with the possibility hairline cracks of a typical maximum width of 0.1mm. | Negligible | Minor negative |
| Rotherhithe Tunnel Air Shaft – (High significance) | 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 0.01mm 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 | Low | Minor negative |
| Wall to St Anne's House – (High significance) | The tunnel alignment runs beneath the centre of the wall, at the point of the junction between older and newer brickwork. The damage assessment identifies the risk of damage to be negligible, with the possibility of hairline cracks up to 0.1mm, concentrated at this junction. | Negligible | Minor negative |

| Name/ Significance | Description of effect | Magnitude of change | Significance of effect |
|---|---|---|---|
| Limehouse Accumulator Tower – (High significance) | Settlement of between 1mm and 3mm is predicted, with the damage assessment identifying risk of negligible damage. There is a possibility of hairline cracking of up to 0.1mm. | Negligible | Minor negative |
| **LB Lewisham** | | | |
| Deptford Fire Station – (High significance) | Settlement of between 1mm and 5mm is predicted, with the greatest settlement at its eastern edge. The damage assessment identifies the damage risk to be negligible, with the possibility of hairline cracks of a typical maximum width of 0.1mm. | Negligible | Minor negative |
| 227 Deptford High Street – (High significance) | Settlement of between 1mm and 5mm is predicted, with the greatest settlement at the building's western end (the rear). Due to the condition of this building, it is vulnerable to settlement, and although the damage assessment identifies the damage risk to be negligible, with the typical possibility of hairline cracks at a maximum of 0.1mm, there is potential for damage to the historic fabric of this building | Low | Minor negative |
| Church of St Paul (High significance) | Ground settlement of between 1mm and 3mm is predicted, with the greatest settlement at its western (spire) end. The damage assessment identifies the damage risk category to be negligible with the possibility of cracks typically up to 0.1mm, however due to the poor condition of the churchyard boundary walls and the fragile and important decorative elements within the church, means there may be some impact to the significance of the building | Low | Minor negative |
| **LB Greenwich** | | | |

| Name/ Significance | Description of effect | Magnitude of change | Significance of effect |
|---|---|---|---|
| Greenwich Pumping Station (High significance) | This building would experience settlement of between 1mm and 30mm, with the greatest settlement at the east beam engine house, decreasing across the boiler room. The damage assessment considers that there is a damage risk category of moderate, with the potential for typical cracks up to 15mm and a deterioration in condition, and the heritage fabric of the east beam engine house may be permanently impacted due to damage to its structure | Medium | Moderate negative |
| **Bridges and Viaducts** | | | |
| Hammersmith Bridge (High significance) | This bridge would experience a maximum settlement of 1mm. The damage assessment report (see Vol 3 Appendix E.1) states the potential damage risk be negligible, with the possibility of hairline cracks of a typical maximum width of 0.1mm | Negligible | Minor negative |
| Putney Road Bridge (High significance) | The bridge would experience a maximum vertical movement beneath two piers of less than 8mm and 9mm. The horizontal settlement would not cause significant damage to the bridge structure. The third pier of the bridge and the Putney abutment would experience less than 1mm of settlement. More pronounced vertical and radial movements are concentrated at pier one and two, and the intermediate spans, which would experience hogging. Cracking would therefore be predicted to occur in the intermediate and abutment spans of the bridge; this would be minor cracking of the joints of the voissoirs of the barrel arch, and would not affect the structural integrity of the bridge. | Low | Minor negative |
| Battersea Road Bridge | This bridge would experience a maximum settlement of 17mm. The damage assessment report (see Vol 3 Appendix E.1) states the potential damage risk to be | Low | Minor negative |

| Name/ Significance | Description of effect | Magnitude of change | Significance of effect |
|---|---|---|---|
| (High significance) | negligible, with the possibility of hairline cracks of a typical maximum width of 0.1mm. There may be slight damage to the significant cast iron and decorative elements of the superstructure of the bridge. | | |
| Albert Bridge (High significance) | The bridge would experience a concentration of settlement at its two northern piers, resulting in a maximum settlement of 17mm. The assessment report states the damage risk to be negligible, with the possibility of hairline cracks of 0.1mm. It is not predicted that this level of settlement will have any structural impact upon the bridge. | Negligible | Minor negative |
| Chelsea Bridge (High significance) | This bridge would experience a maximum settlement of 16mm. The damage assessment report (see Vol 3 Appendix E.1) states the potential damage risk to be negligible, with the possibility of hairline cracks of a typical maximum width of 0.1mm. However there may be small impact upon decorative elements. | Low | Minor negative |
| Vauxhall Road Bridge (High significance) | This bridge would experience an approximate maximum vertical settlement of 8mm at pier 3 and 10mm at pier 4. There is a risk of hairline cracks of 0.1mm. | Negligible | Minor negative |
| Lambeth Road Bridge (High significance) | This bridge would experience a maximum settlement of approximately 7mm. The damage assessment states that cracking is unlikely to the piers and abutments and that movement would be transferred to the deck via bearings. Provided that the bearings are adequate. | Negligible | Minor negative |
| Westminster Bridge (High | This bridge would experience a maximum vertical settlement of less than 9mm in piers two and three (from the west). Generally cracking is expected to be hairline. | Negligible | Minor negative |

| Name/ Significance | Description of effect | Magnitude of change | Significance of effect |
|---|---|---|---|
| significance) | | | |
| Chelsea Rail Bridge (High significance) | The bridge would experience a maximum settlement of 6.5mm, concentrated on the first and second piers from the west. The damage risk to the bridge is assessment as negligible, with a slight risk of hairline cracking to surface finishes. | Negligible | Minor negative |
| Waterloo Road Bridge (High significance) | This bridge would experience a maximum vertical settlement of approximately 14.2mm at foundation level, concentrated at the third span from the north. Cracking is expected to be hairline, with no impact upon the structural stability of the bridge. | Negligible | Minor negative |
| Blackfriars Road Bridge (High significance) | The bridge would experience settlement concentrated to its northern end. The bridge is expected to experience total movements of up to approximately 6.1mm, resulting in a risk of negligible damage, with a risk of cracks typically up to 0.1mm in width. | Negligible | Minor negative |
| Southwark Road Bridge (High significance) | A maximum vertical settlement of 8mm is predicted to two piers of the bridge. The damage risk category is predicted to be negligible, which typically means a risk of hairline cracks of 0.1mm. | Negligible | Minor negative |
| Tower Bridge (High significance) | A maximum vertical settlement of 12mm at foundation level is predicted, with some rotation and displacement between each bascule, which may affect the operation of the nosing joints, which may need adjustment, although this would not damage the bridge. However, the damage risk category is negligible, with the possibility of hairline cracks of a typical maximum width of 0.1mm. | Negligible | Minor negative |
| The Brunel Thames | Differential settlement of the base slab of the tunnels likely to be 3.3mm. The damage risk would be negligible with the possibility of hairline cracks of a typical | Negligible | Minor |

| Name/ Significance | Description of effect | Magnitude of change | Significance of effect |
|---|---|---|---|
| Tunnel, London Overground tunnel (High significance) | maximum width of 0.1mm. | | negative |
| DLR Viaduct on Island Row (High significance) | The viaduct would experience strains that are well below the tensile strain limit that would produce a damage risk category of negligible. There is therefore unlikely to be damage and any damage is likely to be negligible, with at most the possibility of hairline cracks of a typical maximum width of 0.1mm. | Negligible | Minor negative |
| Browne House and Farrar House Viaduct – (High significance) | This section of viaduct would experience a maximum settlement of 6mm. The damage assessment report (see Vol 3 Appendix E.1) states the potential damage risk to be negligible, with the possibility of hairline cracks of a typical maximum width of 0.1mm. | Negligible | Minor negative |
| Mechanic's Path Viaduct – (High significance) | This section of viaduct would experience a maximum settlement of between 2mm and 3mm. The damage assessment report states the potential damage risk to be negligible, with the possibility of hairline cracks of a typical maximum width of 0.1mm. | Negligible | Minor negative |
| Hart's Wharf Viaduct – (High significance) | This section of viaduct would experience a maximum settlement of 4mm. The damage assessment report states the potential damage risk to be negligible, with the possibility hairline cracks of a typical maximum width of 0.1mm. | Negligible | Minor negative |
| Deptford Creek Lifting Bridge – | The predicted maximum vertical settlement at the abutments would be less than 5mm, with the maximum differential vertical settlement between the east abutment | Negligible | Minor negative |

| Name/ Significance | Description of effect | Magnitude of change | Significance of effect |
|---|---|---|---|
| (High significance) | and the central pier being 0.7mm and that between the central pier and the west abutment being 0.6mm. The maximum differential movement perpendicular to the span would be 2.2mm. The damage risk identified as negligible, which typically means a risk of hairline cracks of 0.1mm. | | |
| Sun Wharf Viaduct (High significance) | This section of viaduct would experience a maximum settlement of 6mm. The damage assessment report states that the predicted damage to the viaduct is negligible with even hairline cracking unlikely. | Negligible | Minor negative |
| Twelve Trees Crescent Road Bridge – (High significance) | This bridge would experience a maximum of 15.7mm vertical movement beneath the pier foundation, with the tunnel running obliquely beneath the central pier. The design of the bridge is such that it can absorb such movements without loss of significance. | Negligible | Minor negative |

3.7.13 It is intended that the least possible loss of significance is experienced by heritage assets due to ground movement. Therefore, the least intrusive or damaging mitigation measures would be chosen, except in cases where the predicted detrimental effect due to ground movement is judged to be greater than that caused by intrusive mitigation. There are a number of mitigation options that could be utilised for the control of settlement to buildings during construction.

3.7.14 The listed buildings and structures would be monitored prior to, during, and following the construction works, to ensure that any damage is noted and rectified and to ensure that the actual movements are within predicted and acceptable limits. In the unlikely event that a listed building or structure should become unstable during construction, emergency works such as temporary propping or intrusive wall ties would take place to ensure the heritage asset does not deteriorate. Any other minor damage, such as surface cracking and slight deterioration of finishes, arising from ground movement would be repaired using appropriate conservation techniques following the conclusion of the proposed works. Repairs of damage to significant features and finishes following the significant ground movement would provide appropriate mitigation for the damage that is predicted.

3.7.15 Intrusive mitigation could be applied to the buildings such as ties, pre-construction repairs, or underpinning. These options are generally deployed in instances where the predicted damage risk is greater than that predicted to result from the project-wide settlement, or where buildings are particularly at risk of failure, as the installation of these forms of mitigation could cause more damage to the listed building's significance than the damage predicted from the works. Therefore these types of intrusive mitigation to heritage assets affected by settlement are not proposed. Only where at least partial structural failure or significant permanent damage to significance is anticipated would such measures be used.

3.7.16 The results of the preliminary Damage Assessment have determined in all cases that the listed buildings and structures and the listed bridges and tunnel would not suffer sufficient damage to require interventions in advance of the proposed works. Two of the buildings, Lots Road Pumping Station and Greenwich Pumping Station, would risk suffering moderate damage in the form of cracks of a maximum of 5 to 10mm wide. Although no damage from the tunnelling works was predicted to 777 to 783 Commercial Road and 227 Deptford High Street, these buildings are in very poor condition and may continue to deteriorate through poor maintenance, rather than through the effects of the tunnel. Further deterioration may make them more sensitive to ground movement. The assessment of these four buildings concluded that any intervention in advance of the works to mitigate the risk of ground movement would be likely to cause more damage than repairing the buildings after any damage has occurred, using standard conservation methods to achieve like-for-like repair. (Refer to the *Environmental Statement,* Vol 3, Appendix E.1; the four buildings are covered in Annexes D, H, I and G).

3.7.17 The listed buildings and bridges that are predicted to be subject to ground movement in excess of 1mm and at risk of significant damage would be monitored during and after the tunnelling works. All listed buildings, structures, bridges and tunnels that are predicted to be subject to ground movement in excess of 10mm would be similarly monitored. The listed buildings (including buildings, a tunnel, structures and bridges) to be monitored are shown in the *Environmental Statement*, Volume 3, Section 7.

3.7.18 The detailed design of the monitoring procedures is the subject of a draft DCO Requirement. The purpose of this monitoring would be to ensure that the predicted movement is accurate. In the event that movement materially exceeds predictions to the extent that the significance of the building might be damaged, mitigation measures would be triggered to prevent any such damage. Mitigation might take the form of intervention to a building, controlling the volume loss of soils from tunnelling at the source, or adopting more careful working procedures (refer to *CoCP, Part A*, Section 13, protection measures).

3.7.19 The monitoring would involve attaching instruments, such as prisms to the various types of listed building, which would either be read by hand or automatically by means of remotely-sited Automatic Total Station theodolites, which require a line of site to the prisms. Other types of monitoring equipment that can be read by hand include BRE studs. These studs are screwed into fixings attached to a building close to the ground, on which the surveyor places a level staff and Invar scales that are fixed to a wall at tripod height. Where internal monitoring is required, instruments would be fixed within the building and read automatically by data loggers.

3.7.20 Where the proposed monitoring works would not affect a listed building's character as a building of special architectural or historic interest, the works would not normally require Listed Building Consent. In many instances it would be possible to install monitoring equipment without affecting the building's special architectural or historic interest, as has been achieved on a number of previous major tunnelling projects within London, such as Crossrail.

3.7.21 Heritage design principle HRTG.03 states that monitoring equipment attached to listed buildings would be designed to be unobtrusive and to ensure the significance of the listed building is not damaged.

3.7.22 To achieve this, where practicable, Automatic Total Station theodolites would be attached to non-listed elements in the townscape. External monitoring equipment would be fixed into the mortar joints on the external elevations of listed buildings and structures, where possible, in order to avoid damage to the masonry units. Monitoring equipment would not be fixed into decorative elements, such as capitals, mouldings, and cornices, or into imitation ashlar grooves on stucco or stucco decoration. On stucco surfaces, equipment would be fixed into plain surfaces to facilitate making good. On historic ironwork and steelwork, monitoring equipment would be clamped or strapped in place to avoid drilling into the metal. Where possible, internal monitoring equipment would avoid decorative plaster and would be fixed into plain plaster where necessary.

3.7.23 The draft DCO contains two proposed requirements for monitoring listed structures is as follows:

*"Requirement PW8: Monitoring of listed buildings and structures* Unless otherwise agreed in writing by the local planning authority, where monitoring of effects on any listed building or structure is proposed instrumentation and monitoring equipment will be temporarily attached to a listed building in accordance with the principles set out in the Heritage Statement".

*"Requirement PW9: Monitoring of listed buildings and structures prior to undertaking works to fix monitoring equipment to any listed building or structure details of the works shall be submitted to the local authority for approval in consultation with English Heritage".*

3.7.24 Requirement PW9 would require the submission of a method statement to the local planning authority, demonstrating that the works would not affect the special character or interest of the building or structure. This may require submission of engineering analysis, together with details of proposed monitoring locations, instrumentation and methodologies.

3.7.25 The listed buildings proposed for monitoring are set out in Table 3.3 below.

**Table 3.3 Listed buildings and structures proposed for monitoring**

| Building name | Grade of listing | Borough |
|---|---|---|
| 1 to 6 Church Row | II* | Wandsworth |
| All Saints Church | II* | Wandsworth |
| Wentworth House | II | Wandsworth |
| Lots Road Pumping Station | II | Kensington & Chelsea |
| Prospect of Whitby | II | Tower Hamlets |
| Limehouse Town Hall | II | Tower Hamlets |
| Limehouse District Library | II | Tower Hamlets |
| 777-783 Commercial Road | II | Tower Hamlets |
| Rotherhithe Air Shaft | II | Tower Hamlets |
| Limehouse Accumulator Tower and Chimney | II | Tower Hamlets |
| Garden wall to the former St Anne's Rectory | II | Tower Hamlets |
| 227 Deptford High Street | II | Lewisham |
| St Paul's Church, Deptford | I | Lewisham |
| Greenwich Sewage Pumping Station | II | Greenwich |
| Chimney at Beckton Sewage Treatment Works (if reinstated following the Lee Tunnel works) | II | Newham |

3.7.26 The listed bridges and the tunnel predicted to be subject to ground movement that Thames Water also proposes to monitor are listed in Table 3.4.

**Table 3.4 Listed bridges and tunnel predicted to be subject to ground movement which are proposed for monitoring**

| Bridge | Grade |
|---|---|
| Hammersmith Roadbridge, 1887 | II* |
| Putney Roadbridge, 1886 | II |
| Battersea Roadbridge, 1890 | II |
| Albert Roadbridge, 1873 | II* |
| Chelsea Roadbridge, 1937 | II |
| Chelsea River Bridge (or Battersea Railway), 1863 | II* |
| Vauxhall Roadbridge, 1906 | II* |
| Lambeth Roadbridge,1932 | II |
| Westminster Roadbridge, 1862 | II* |
| Waterloo Roadbridge, 1942 | II* |
| Blackfriars Roadbridge, 1869 | II |
| Southwark Roadbridge, 1921 | II |
| Tower Roadbridge, 1894 | I |
| The Brunel Thames Tunnel | II* |
| DLR Brick Arched Viaduct at Island Row | II |
| Rail Arched Viaduct Bridge west of Deptford Church Street to Deptford High Street-London and Greenwich Railway | II |
| Rail Bridge over Deptford Church Street | II |
| Rail Arched Viaduct Bridge west of Creekside to Deptford Church Street | II |
| Rail Bridge over Creekside | II |
| Rail Arched Viaduct Bridge west of Deptford Creek Lifting Bridge to Creekside | II |
| Deptford Creek Lifting Bridge | II |
| Rail Harts Wharf Viaduct Arches 45 to 57 | II |
| Twelvetrees Crescent Roadbridge | II |

In one case only is specific mitigation proposed beyond post-construction repair; this is to Tower Bridge, where the predicted rotation between bascule elements may require the adjustment of bascule nosing joints to ensure the continued operation of the bridge. This adjustment in itself would not affect the heritage significance of the bridge, and would mitigate any potential impact on the operation of the bridge caused by ground movements.

# 4 Site-specific matters

## 4.1 Introduction

4.1.1 Listed Building Consent would normally be required for the works proposed at a number of sites including Putney Embankment Foreshore, Cremorne Wharf Depot, Albert Embankment Foreshore, Victoria Embankment Foreshore, Blackfriars Bridge Foreshore, and Greenwich Pumping Station.

4.1.2 Demolitions that would normally require Conservation Area Consent are proposed at Carnwath Road Riverside, Dormay Street, Chelsea Embankment Foreshore, Albert Embankment Foreshore, Blackfriars Bridge Foreshore, Shad Thames Pumping Station, Deptford Church Street and King Edward Memorial Park Foreshore.

4.1.3 Sites at which the historic environment has influenced the design include Hammersmith Pumping Station, Chambers Wharf, and Abbey Mills Pumping Station.

4.1.4 For ease of reference, a summary of the statutory requirements and the heritage assets assessed at each of the 24 sites is set out in Table 4.1 below.

## 4.2 Other heritage assets

4.2.1 This section contains a brief discussion of sites at which there would be minor impacts on heritage assets and sites at which assets of limited heritage significance would be affected. A fuller assessment of the effects on heritage assets at these sites is provided in the *Environmental Statement.*

### Acton Storm Tanks

4.2.2 Bedford Park Conservation Area lies some distance to the west and southwest of the Acton Storm Tanks site (refer to the Acton Storm Tanks Conservation Area and Historic environment features maps). The conservation area is known for its Queen Anne-style suburban development. However, as a result of the distance between the conservation area and the site, the nature of the intervening development, and the orientation of the roads within the conservation area it would not be affected by the proposed works.

### King George's Park

4.2.3 King George's Park is bordered by a non-statutorily designated historic gate with associated railings (refer to the King George's Park Historic environment features map). The gate and railings would be temporarily removed for the duration of construction, stored, refurbished and reinstated as part of the proposed landscaping. The Code of Construction Practice, Part B, King George's Park, Section 13, requires that "The existing park railings will be appropriately and securely stored for the

duration of the works, for final reinstatement.". This would have no permanent effect on their significance.

### Barn Elms

4.2.4 At Barn Elms, minor amendments may be required to traffic signage in the Barnes Green Conservation Area in the London Borough of Richmond. The amendments would have no permanent effect on the character or appearance of the conservation area.

### Bekesbourne Street

4.2.5 At Bekesbourne Street the northern end of the site, nearest to Commercial Road lies within York Square Conservation Area (refer to the Bekesbourne Conservation Area map), in LB Tower Hamlets.

4.2.6 The site is screened from the bulk of the conservation area to the west and north by the relatively wide Victorian railway viaducts (now the DLR), which are topped with steel gantries. To the east of Bekesbourne Street the viaduct is topped by Limehouse DLR Station. The site itself is surrounded by residential buildings and the narrow streets and trees obscure views to the parts of the conservation area to the south.

4.2.7 The part of the conservation area to the south of the viaducts has no historic character, with the modern DLR station extending south to Ratcliffe Road and a small enclosure to a grocers shop set into a viaduct arch, with a steel palisade fence to the west of Ratcliffe Lane. The width of the viaduct and the narrowness of the streets mean that there are limited views through it along Bekesbourne Street and Ratcliffe Lane.

4.2.8 The proposals would be largely screened from the vast majority of the conservation area. The construction works would therefore have a negligible effect on the significance, character and appearance of the conservation area as a whole and there would be no permanent effects.

### Kirtling Street

4.2.9 The site and its immediate vicinity do not contain any nationally or internationally designated (statutorily protected) heritage assets, such as scheduled monuments, listed buildings, or registered parks and gardens. Most of the site is located within an Archaeological Priority Area, as defined by Wandsworth Council in recognition of the archaeological potential of the Thames floodplain. The site does not lie within or adjacent to a conservation area and contains no locally listed buildings (refer to the Kirtling Street Conservation Area map). Site set up would require the demolition of all above-ground structures, including a group of 19th/early 20th century buildings associated with the lead works, which are considered to be of medium asset significance. The removal of these buildings would comprise a major adverse effect.

4.2.10 The archaeological impact of the two neighbouring sites at Kirtling Street and Heathwall Pumping Station would have effects on a very similar range of archaeological receptors. Although they would result in multiple effects on archaeological remains, the impacts at the two sites would either affect specific remains contained within them or constitute a very small impact

on more diffuse landscape features, such as the palaeochannels and eyots of the prehistoric period or 18th and 19th century industrial developments.

4.2.11 Construction and operation would detract from views to Battersea Power Station and would be visible within views across the River Thames from Churchill Gardens Conservation Area and Dolphin Square Conservation Area. However, the site is largely peripheral in views towards the Power Station and, given the traditionally industrial character of the site, the construction works would not detract significantly from the settings of the nearby assets which have traditionally had industrial activities in their settings. Given the distances involved, the nature of these views and the nature of intervening and surrounding land uses there would be minor negative effects.

### Heathwall Pumping Station

4.2.12 The site and its immediate vicinity (ie, within a 100m-radius) do not contain any internationally designated assets, or any nationally designated (statutorily protected) heritage assets, such as scheduled monuments, listed buildings, or registered parks and gardens. The site is located within an archaeological priority area, as defined by Wandsworth Council in recognition of the archaeological potential of the Thames floodplain. The site does not lie within or adjacent to a conservation area, and contains no locally listed buildings (refer to the Heathwall Pumping Station Conservation Area map).

4.2.13 The remains of what is interpreted as a Saxon fish trap has been observed on the foreshore. This consists of a group of twenty-eight wooden stakes in parallel lines and standing at an approximate height of 0.1–0.2m (Vol 15 Appendix E.5, Plate E.9), some of which lie within the site and some beyond it. Their location at the mouth of a Thames tributary would have been ideal for fishing and other fish traps might survive in this area, obscured by the foreshore silts and mud. The *Environmental Statement* details a range of appropriate field evaluation and subsequent mitigation measures, including foreshore condition monitoring.

4.2.14 The construction works would detract from views to Battersea Power Station and would be visible within views across the River Thames from Churchill Gardens Conservation Area, Dolphin Square Conservation Area and Pimlico Conservation Area. However, the site is largely peripheral in views towards the Power Station and, given the traditionally industrial character of the site, the construction works would not detract significantly from the settings of the nearby assets which have traditionally had industrial activities in their settings. Given the distances involved, the nature of these views and the nature of intervening and surrounding land uses there would be minor negative effects.

## 4.3 Status of drawings in the application

4.3.1 The works for which approval is sought are shown on a series of plans for each site contained in the *Book of Plans*. The following categories are used to indicate the level of detail shown on the plans for each site:

a. 'For approval': the detail included on the plan is submitted for approval. The development would be carried out in accordance with the details shown on the plan.

b. 'Indicative': the detail shown on the plan is not for approval. The plan indicates and commits to the way in which the development would be arranged. However, details such as materials, planting schedules etc. remain to be determined. The final detail of the works would be submitted and approved under the DCO Requirements for the site. The details must be in accordance with the indicative layout and the design principles included in the application.

c. 'Illustrative': the detail shown on the plan is not for approval. The plan illustrates one way in which the development or an element of it might be arranged in accordance with site-specific design principles, but it is not a commitment to arrange the development as illustrated. The final layout of the development, or the relevant part thereof, would be submitted for approval under the DCO Requirements for the site in the application. These details may differ from the illustrative layout in the application. The layout submitted for approval under the requirement must, however, be in accordance with the Works plan, Site works parameter plan, and design principles for that site.

d. 'For information'. These plans show existing details on sites (eg the existing site features and layout). They are not for approval as part of the application but are provided to inform consideration the application.

**Table 4.1 Summary of statutory requirements in relation to the historic environment at the proposed development sites**

| Site name | Appendix | Listed building/ registered park and garden grade^ | Listed Building Consent normally required?* | In or partly in a conservation area | Conservation area consent normally required?* | Non-statutory designations (eg locally listed) | Heritage assets assessed |
|---|---|---|---|---|---|---|---|
| **Acton Storm Tanks** | N/A | N/A | N/A | N/A | N/A | N/A | N/A<br>(see section 4.2.2) |
| **Hammersmith Pumping Station** | A | N/A | N/A | Fulham Reach Conservation Area | No | N/A | Fulham Reach Conservation Area<br>Castelnau Conservation Area<br>Hammersmith Bridge (Grade 11*) |
| **Barn Elms** | N/A | N/A | N/A | Traffic signage may be required in Barnes Green Conservation Area | No | N/A | N/A<br>(see section 4.2.4) |
| **Putney Embankment Foreshore** | B | Putney Bridge and walls (Grade II) bollards at junction of Lower Richmond Road (Grade II) | Yes<br><br>Yes | Putney Embankment Conservation Area | No | N/A | Putney Embankment Conservation Area<br>Putney Bridge Conservation Area<br>Bishops Park Conservation Area<br>St Mary's Church<br>(Grade II*)<br>Putney Bridge (Grade II)<br>Deodar Road Conservation Area |

| Site name | Appendix | Listed building/ registered park and garden grade^ | Listed Building Consent normally required?* | In or partly in a conservation area | Conservation area consent normally required?* | Non-statutory designations (eg locally listed) | Heritage assets assessed |
|---|---|---|---|---|---|---|---|
| | | | | | | | University Boat Race Stone<br>Grade II* listed St Mary's Church<br>Grade II listed White Lion Hotel<br>Fulham Palace Registered Garden<br>Hurlingham Conservation Area<br>Winchester House |
| **Dormay Street** | D | N/A | N/A | Wandsworth Town Conservation Area | Yes | N/A | Wandsworth Town Conservation Area<br>Wentworth House (Grade II)<br>Bell Lane Creek<br>Armoury Public House<br>The Causeway - granite setts and boundary wall |
| **King George's Park** | N/A | N/A | N/A | N/A | N/A | N/A | N/A<br>(see section 4.2.3) |
| **Carnwath Road Riverside** | C | N/A | N/A | Sands End Conservation Area | Yes | N/A | Sands End Conservation Area<br>Hurlingham Conservation Area<br>Wandsworth Bridge<br>Wandsworth Park<br>Piper Building murals |

| Site name | Appendix | Listed building/ registered park and garden grade^ | Listed Building Consent normally required?* | In or partly in a conservation area | Conservation area consent normally required?* | Non-statutory designations (eg locally listed) | Heritage assets assessed |
|---|---|---|---|---|---|---|---|
| **Falconbrook Pumping Station** | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| **Cremorne Wharf Depot** | E | Lots Road Pumping Station (Grade II) | Yes | Thames Conservation Area | N/A | N/A | Thames Conservation Area<br>Battersea Square Conservation Area<br>Lots Road Power Station<br>Battersea Square CA and St Mary's Church<br>Station House<br>Cremorne Gardens |
| **Chelsea Embankment Foreshore** | F | Ranelagh Gardens (Grade II registered park and garden) | No | Royal Hospital Conservation Area<br>Thames Conservation Area | Yes | N/A | Royal Hospital (Grade I)<br>Chillianwala Memorial Obelisk (Grade II)<br>Bull Ring Gate (Grade II)<br>Chelsea Bridge (Grade II)<br>Chelsea Embankment (Grade II)<br>Ventilation column (Grade II)<br>Battersea Park (Grade II* registered park and garden) |

| Site name | Appendix | Listed building/ registered park and garden grade^ | Listed Building Consent normally required?* | In or partly in a conservation area | Conservation area consent normally required?* | Non-statutory designations (eg locally listed) | Heritage assets assessed |
|---|---|---|---|---|---|---|---|
| | | | | | | | Royal Hospital Grounds and Ranelagh Gardens (Grade II registered park and garden)<br>Battersea Park Conservation Area<br>Thames Conservation Area<br>Royal Hospital Conservation Area |
| **Kirtling Street** | N/A | N/A | N/A | N/A | N/A | N/A | N/A<br>(see section 4.2.9 – 11) |
| **Heathwall Pumping Station** | N/A | N/A | N/A | N/A | N/A | N/A | N/A<br>(see section 4.2.12 – 14) |
| **Albert Embankment Foreshore** | G | Vauxhall Bridge (Grade II*) | No. Proposed structures would not be fixed into the listed bridge abutment | Albert Embankment Conservation Area | Yes | N/A | Vauxhall Bridge (Grade II*)<br>Albert Embankment Conservation Area<br>Lambeth Palace Conservation Area<br>Pimlico Conservation Area<br>Albert Embankment River Wall<br>Millbank Conservation Area<br>Smith Square Conservation Area<br>Westminster World Heritage Site<br>Lack's Dock |

| Site name | Appendix | Listed building/ registered park and garden grade^ | Listed Building Consent normally required?* | In or partly in a conservation area | Conservation area consent normally required?* | Non-statutory designations (eg locally listed) | Heritage assets assessed |
|---|---|---|---|---|---|---|---|
| | | | | | | | Timber Dolphins |
| **Victoria Embankment Foreshore** | H | River wall with sturgeon lamp standards (Grade II), catenary lamps (Grade II), Sphinx and camel benches (Grade II) | Yes<br><br>Yes<br><br>Yes | Whitehall Conservation Area | No | Tattershall Castle (Vessel) | Whitehall Conservation Area<br>Victoria Embankment river wall<br>Victoria Embankment river wall<br>Sphinx benches<br>The Hispaniola (Vessel)<br>Monument to Sir Joseph Bazalgette (Grade 11)<br>Savoy Conservation Area<br>Victoria Embankment Gardens (Grade 11* Registered Park)<br>The National Liberal Club (Grade 11*)and Whitehall Place<br>Playhouse Theatre (Grade 11)<br>Palace of Westminster World Heritage Site<br>RAF Memorial (Grade 11) |
| **Blackfriars Bridge Foreshore** | J | Blackfriars Bridge (Grade II), Victoria | Yes | Whitefriars Conservation Area and Temple | Yes | HMS President (Vessel) | Whitefriars Conservation Area<br>Embankment Wall<br>Blackfriars Bridge |

| Site name | Appendix | Listed building/ registered park and garden grade^ | Listed Building Consent normally required?* | In or partly in a conservation area | Conservation area consent normally required?* | Non-statutory designations (eg locally listed) | Heritage assets assessed |
|---|---|---|---|---|---|---|---|
| | | Embankment wall with sturgeon lamp standards (Grade II) | Yes | Conservation Area | | | Pump House<br>Temple Conservation Area<br>Pontoons<br>Swan benches |
| **Shad Thames Pumping Station** | K | N/A | N/A | Tower Bridge Conservation Area | Yes | N/A | Shad Thames Pumping Station<br>Superintendent's house<br>Yard<br>Boundary walls<br>Wheat Wharf<br>Tower Bridge Conservation Area<br>Grade II listed Anise Warehouse |
| **Chambers Wharf** | L | N/A | N/A | N/A | N/A | N/A | St Saviour's Dock Conservation Area<br>Tower Bridge Conservation Area<br>Wapping Pier Head Conservation Area<br>Chambers Wharf and associated dolphin<br>29 Bermondsey Wall West and associated dolphin<br>33 Bermondsey Wall West |

| Site name | Appendix | Listed building/ registered park and garden grade^ | Listed Building Consent normally required?* | In or partly in a conservation area | Conservation area consent normally required?* | Non-statutory designations (eg locally listed) | Heritage assets assessed |
|---|---|---|---|---|---|---|---|
| | | | | | | | East Lane Stairs<br>Edward IIIs Rotherhithe Conservation Area<br>49 Farncombe Street<br>Riverside School |
| **Earl Pumping Station** | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| **Deptford Church Street** | M | N/A | N/A | St Paul's Conservation Area | Yes | N/A | St Paul's Conservation Area<br>Deptford Creekside Conservation Area<br>Brick wall and cobbled surface<br>Grade II listed railway viaduct<br>Grade I listed St Paul's Church<br>St Joseph's Roman Catholic Primary School<br>Deptford High Street Conservation Area |
| **Greenwich Pumping Station** | N | Greenwich Pumping Station (Grade II) | Yes | N/A | N/A | N/A | Greenwich Pumping Station<br>Greenwich Pumping Station Coal Sheds<br>London and Greenwich Railway |

| Site name | Appendix | Listed building/ registered park and garden grade^ | Listed Building Consent normally required?* | In or partly in a conservation area | Conservation area consent normally required?* | Non-statutory designations (eg locally listed) | Heritage assets assessed |
|---|---|---|---|---|---|---|---|
| | | Coal Sheds (Grade II)<br>Network Rail viaduct (Grade 11) | No consent required for non-intrusive protection works | | | | viaduct<br>Asburnham Triangle Conservation Area<br>LESC substation<br>Brick Chimney |
| **King Edward Memorial Park Foreshore** | P | N/A | N/A | Wapping Wall Conservation Area | Yes | N/A | Rotherhithe Tunnel ventilation building (Grade 11)<br>Shadwell Dock Stairs (Grade 11)<br>St Pauls Terrace (Grade 11)<br>Sir Hugh Willoughby Memorial<br>King Edward Memorial Park<br>River wall<br>Wapping Wall Conservation Area |
| **Bekesbourne Street** | N/A | N/A | N/A | N/A | N/A | N/A | N/A<br>(see sections 4.2.5 – 8) |
| **Abbey Mills Pumping Station** | Q | N/A | N/A | Three Mills Conservation Area | No | N/A | Three Mills Conservation Area, including The Still LLB<br>Abbey Mills Pumping Station (Grade II* and Grade II) |

| Site name | Appendix | Listed building/ registered park and garden grade^ | Listed Building Consent normally required?* | In or partly in a conservation area | Conservation area consent normally required?* | Non-statutory designations (eg locally listed) | Heritage assets assessed |
|---|---|---|---|---|---|---|---|
| | | | | | | | Bromley-By-Bow Gas holders (Grade II)<br>West Ham Pumping Station (Grade II)<br>Channelsea River Bridge (Grade II) |
| **Beckton Sewage Treatment Works** | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

*If the works had not been considered through the major infrastructure planning process set out in the 2008 Act, listed building consent or conservation area consent would be required through the standard procedures.
^ There are no Scheduled Monuments with above-ground elements on any of the sites or visible in their setting.
*BOP*: *Book of Plans* these are A1 plans. They are reproduced in A3 in the relevant site appendix to the *Heritage Statement*.
*HS*: *Heritage Statement*
*ES: Environmental Statement*
*LLB: Locally listed building*

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# Glossary

| Term | Description |
|---|---|
| above ordnance datum | Ground level/elevation relates to the mean sea level at Newlyn in Cornwall, referred to as Ordnance Datum (OD), and are reported in metres above or below OD. |
| abstraction | Removal of water from a source of supply (surface or groundwater). |
| acoustic enclosures | An enclosed structure installed around plant or machinery to reduce or attenuate noise. |
| acquiring authority | A body with compulsory purchase powers. In the case of the Thames Tideway Tunnel project, Thames Water would be the acquiring authority once a DCO with compulsory purchase powers is approved. |
| acquisition cost | The cost of acquiring an interest in a property, either by agreement or by compulsory purchase. The acquisition cost includes the value of the property, disturbance compensation, owner's fees and other reasonably incurred losses and costs. |
| acquisition of new rights | An acquisition of something less than the freehold, eg, rights of temporary occupation or rights of access (temporary or permanent). |
| acquisition risk | The risk of failure to acquire a property via agreement or compulsory purchase. |
| advanced tree planting | Trees planted before the main construction activities commence. |
| aeration tanks/plant | Tanks in which sewage undergoes biological treatment due to aeration. |
| aesthetic | Aesthetic effects are associated with human sensory or emotional values and judgements. They often relate to environmental effects on human receptors through the senses of sight, smell, taste, and sound. |
| aggradation | The increase in land elevation due to the deposition of water-borne sediment. |
| aggregate | Coarse particulate material used in construction, including sand, gravel, crushed stone, slag, recycled concrete and geosynthetic aggregates. |
| air management structures | Collective term for ventilation equipment. |

| Term | Description |
|---|---|
| air pollutants | Amounts of foreign and/or natural substances occurring in the atmosphere that may result in adverse effects on humans, animals, vegetation and/or materials. |
| Air Quality Management Area | Areas where the local authority has determined that the national air quality objectives are not likely to be achieved by the relevant deadlines. |
| air quality sensitive receptors | People, property or designated sites for nature conservation that may be at risk from exposure to air pollutants that could potentially arise as a result of the proposed development. |
| air treatment chamber | A structure containing carbon that absorbs odour from air flowing out of a tunnel, without the assistance of mechanical pumping. |
| alluvium | Sediment lain down by a river. |
| ambient | Of the surrounding area or environment. For noise, for example, it is the totally encompassing sound in a given situation at a given time, usually composed of sound from many sources near and far. |
| amount | The proposed floor space for each proposed use (DCLG Guidance on information requirements and validation, March 2010). |
| anaerobic environment | An environment with reduced oxygen levels. |
| ancient monument | A monument protected under the *Ancient Monuments and Archaeological Areas Act 1979*. |
| ancillary use | A subsidiary or secondary use or operation closely associated with the main use of a building or piece of land. |
| aquifer | A permeable geological stratum or formation that is capable of both storing and transmitting water in significant amounts.<br>A permeable strata, either through intergranular and/or fracture permeability, that is capable of supporting water supply and/or river base flow. There are two types of aquifers, principal and secondary, depending on whether they are regionally or locally important. |
| archaeological priority area/zone | Area of archaeological priority, significance, potential or other title, often designated by the local authority. |
| artesian | Water rising to the ground surface under internal hydrostatic pressure. |

| Term | Description |
|---|---|
| asset | An existing or proposed/planned physical object, whose stability, form or function is responsive to ground movements to such an extent that these responses need to be fully understood and investigated prior to commencing construction works. |
| asset control limits | Predetermined values of structural response (typically movements and strains) that where experienced in practice trigger specific countermeasures on the part of the contractor in an emergency preparedness plan. |
| Asset Management Plan (AMP) | A plan agreed with Ofwat on a five-yearly basis for the management of water and wastewater assets. AMP4 covered the investment period of April 2005 to March 2010. AMP5 covers the period of April 2010 to March 2015. |
| A-weighted decibel | A-weighted decibels, abbreviated dBA, or dBa, or dB(a), are an expression of the relative loudness of sounds in the air as perceived by the human ear. |
| base case | An assessment of a future case, without the project, in a particular assessment year. |
| baseflow | The component of river flow derived from groundwater sources rather than surface run-off. |
| baseline | The existing conditions against which the likely significant effects of a proposed development are assessed. |
| baseline concentration | Pollutant concentration for any scenario with the proposed development not in operation. |
| bathymetric | Of or relating to measurements of the depths of oceans, rivers or lakes. |
| beneficial use | The use of excavated material for a positive purpose including recycling, use in industrial processes, use in development, land remediation, habitat creation and landfill restoration. |
| biochemical oxygen demand (BOD/$BOD_5$) | The amount of dissolved oxygen used by micro-organisms in the biological process of metabolising organic matter in water. The more organic matter there is (eg, in sewage and polluted bodies of water), the greater the BOD. The greater the BOD, the lower the amount of dissolved oxygen available for higher animals such as fish. The BOD is therefore a reliable gauge of the organic pollution of a body of water.<br>It is most commonly expressed in milligrams of oxygen consumed per litre of sample during five days of incubation at 20°C. |
| biodiversity | Biological diversity – or 'biodiversity' – is the term given to |

| Term | Description |
|---|---|
| | the variety of plant and animal species in a given environment and the natural patterns they form. |
| Blue Ribbon Network (BRN) | The Blue Ribbon Network, which is part of the *London Plan*, includes the River Thames, the canal network, and other tributaries, rivers and streams within London and London's open water spaces, such as docks, reservoirs and lakes. It includes culverted (or covered over) parts of rivers, canals or streams. |
| borehole | A hole drilled into the ground for geological investigation or for the exploitation of geological deposits or groundwater. An abstraction borehole is a well sunk into an aquifer from which water is pumped. |
| British Standard | Produced by the BSI Group in order to set up standards of quality for goods and services. |
| brown roof | A roof that supports a wide variety of plant and animal species and reduces storm water run-off. |
| brownfield land/ brownfield site | Previously developed land and premises that may be partially occupied or used. It is most commonly associated with derelict urban land with redundant industrial buildings. Excludes agriculture or forestry land. |
| building recording | Recording of historic buildings to document buildings, or parts of buildings, that may be lost as a result of demolition, alteration or neglect. Four levels of recording are defined by Royal Commission on the Historical Monuments of England (RCHME) and English Heritage. Level 1 (basic visual record); Level 2 (descriptive record), Level 3 (analytical record), and Level 4 (comprehensive analytical record). |
| Building Research Establishment Limited (BRE) | The trading name of Building Research Establishment Limited. Originally known as the Building Research Station and later the Building Research Establishment. Formally a government establishment, BRE became a private company in 1997. As well as research, BRE undertakes testing and consultancy. |
| bund | An embankment which acts as a visual or noise screen. A bund may also enclose and retain materials that are being stored. |
| bunding | Also called a bund wall, bunding is a separated area within a structure designed to prevent inundation or breaches of various types. |
| cable duct | Pipework (generally below-ground) in which a cable is housed. |
| caisson | A watertight chamber that is open at the bottom |

| Term | Description |
|---|---|
| | (sometimes containing air under pressure) that is used to carry out construction work under water. |
| campshed | An area of stone, concrete or timber lain on the river/sea bed that is exposed at low tide to allow vessels to rest safely and securely in place. |
| capture zone | An area from which groundwater is drawn. |
| carbon filters | Filters that would remove odours as air is passed through. |
| carbon footprint | The total set of greenhouse gas (GHG) emissions caused by an organisation, event, product or person, often expressed in terms of the amount of carbon dioxide, or its equivalent of other GHGs, emitted. |
| cast *in situ* concrete | Concrete (mass or reinforced) that requires a 'shutter' or similar temporary works to facilitate the casting process, until the concrete has gained sufficient strength to dispense with any temporary works. |
| catchment | The area from which surface water and/or groundwater collects and contributes to the flow of a river, abstraction or other specific discharge boundary. Can be prefixed by 'surface water' or 'groundwater' to indicate the specific nature of the catchment. |
| Catchment Abstraction Management Strategy (CAMS) | The Environment Agency's strategy for water resources management in England and Wales through licensing water abstraction. CAMS is used to inform the public on water resources and licensing practice; provide a consistent approach to local water resources management; and to help balance the needs of water-users and the environment. |
| catenary | A curve formed by a perfectly flexible, uniformly dense and inextensible cable suspended from its endpoints. |
| Chalk | In the project area, chalk is firm, white, fine-grained limestone with conspicuous semi-continuous nodular and tabular flint seams. |
| Code of construction practice (CoCP) | A document that sets out control measures to be adopted during the construction period. |
| cofferdam | A temporary wall that is constructed around the outside of a working area within a river that is then pumped dry. The inside of the cofferdam can be filled to create a safe working area. |
| collecting system | A system of conduits that collects and conducts urban wastewater. |
| combined sewer | A sewer that conveys both rainwater and wastewater of |

| Term | Description |
|---|---|
| | domestic or industrial origin. |
| combined sewer overflow (CSO) | A structure, or series of structures, that allows sewers that carry both rainwater and wastewater to overflow into a river when at capacity during periods of heavy rainfall. The flows are discharged to river in order to prevent the sewers backing up and flooding streets or houses. Flows may discharge by gravity or by pumping. |
| compliance statement | A document prepared for each third-party asset that records how the asset owner's concerns have been addressed and how the basis of the asset assessments will be verified during construction. |
| compulsory purchase | The acquisition of property using statutory powers where the agreement of the owner is not required. |
| Compulsory Purchase Order (CPO) | An order that authorises the compulsory purchase of interests in land. |
| condition survey | A survey of an asset that is undertaken prior to construction works that may affect the asset. A further survey can be carried out once construction is complete, if required. |
| confirmation of DCO | The point at which the minister approves the DCO. The powers contained in the DCO may then be used (assuming there is no appeal). |
| connection culvert | A covered linear channel to connect two structures. |
| connection tunnel | A tunnel that connects two structures or tunnels. |
| conservation area | An area designated by a local authority or English Heritage that has special architectural or historical interest. Defined in the Planning (Listed Buildings and Conservation Areas) Act 1990 as "an area of special architectural and historic interest, the character or appearance of which it is desirable to preserve or enhance." |
| consolidation tanks | A tank in which a liquid containing suspended solid material is stored to enable gravity to separate the solid material from the carrier liquid. |
| construction site | The area of a site used during the construction phase. |
| contaminated land | Land that has been polluted or harmed in some way rendering it unfit for safe development and usage unless decontaminated. |
| crawler crane | A mobile crane, usually with caterpillar tracks. |
| Crown land | An interest in land owned by a Crown body, such as a central government department, the Duchy of Lancaster or the Duchy of Cornwall. |

| Term | Description |
|---|---|
| CSO site | A site that contains the CSO interception chambers, connection culverts and the drop shaft and other structures.. Each site needs to be able to provide enough space for all construction-related activities. |
| culvert | A covered structure that conveys a flow under a road, railroad or other obstruction. Culverts are mainly used to divert stream or rainfall run-off to prevent erosion or flooding on highways. |
| curtilage | An area of land or structures around a dwelling or other structure. |
| cut | Excavated material to be reused as part of the project as 'fill' or removed off-site. |
| dB $LA_{eq,T}$ | An equivalent continuous A-weighted sound pressure level that has the same energy as a fluctuating sound over a specified time period T. |
| decibel (dB) | Logarithmic ratio used to relate sound pressure level to a standard reference level. |
| *Design and Access Statement* | A statement to be submitted as part of an application for development consent that covers the concepts and principles of design and addresses access issues. |
| Design Council CABE | An enterprising charity comprising the Design Council and the Centre for Architecture and Built Environment (CABE) that provides advice and support on all aspects of design, including architecture. |
| Design Development Report (DDR) | Design development reports describe the process behind the development of the proposed designs of the permanent above-ground elements of the Thames Tideway Tunnel project and the integration of these elements into the surrounding environment. |
| Design Council CABE design reviews | Hosted by the Design Council CABE and undertaken in consultation with the local planning authorities and pan-London stakeholders, these two-stage reviews have provided independent advice and guidance on the emerging design of the Thames Tideway Tunnel project sites. |
| detention tank | A tank built to store run-off and release it at a controlled rate so that the peak flow is reduced and the flow is spread over a longer period. |
| determination | The process by which an appropriate authority reaches a decision on whether a proposed development requires planning permission. |

| Term | Description |
|---|---|
| development | Development is defined under the 1990 Town and Country Planning Act (as amended) as “the carrying out of building, engineering, mining or other operation in, on, over or under land, or the making of any material change in the use of any building or other land”. Most forms of development require planning permission. |
| development brief | The document to be used to guide the detail design of individual plots within the site and the controls on future operational activities. |
| Development Consent Order (DCO) | An order under the Planning Act 2008 approving a development that is or forms part of a Nationally Significant Infrastructure Project. The order can grant planning permission and compulsory purchase powers. The order is granted by government ministers. |
| development plan | In London, this refers to the LPA/local authorities’ unitary development plan, core strategy, other development plan documents and the *London Plan*. |
| development plan document (DPD) | Development plan documents are a statutory element of the local development framework and are subject to independent examination by an inspector. DPDs include the following types of documents:<br>a. core strategy: sets out the long-term vision and overarching policies for the borough<br>b. site-specific land allocations and policies<br>c. area action plans (where needed): set out the planning framework for areas of significant change and conservation areas<br>d. general development control policies<br>e. a proposals map: illustrates the spatial extent of policies. |
| dewatering | The removal of water from solid material or soil by wet classification, centrifugation, filtration, or similar solid-liquid separation processes, such as removal of residual liquid from a filter cake by a filter press as part of various industrial processes.<br>Construction dewatering is a term used to describe removal or draining groundwater or surface water from a riverbed, construction site, caisson or mine shaft, by pumping or evaporation. |
| diaphragm wall | A diaphragm wall is a reinforced concrete retaining wall constructed *in situ*. A deep trench is excavated and supported with slurry, and then reinforcing material (normally steel) is inserted into the trench. Concrete is |

| Term | Description |
|---|---|
| | poured into the trench and only after this can excavation in front of the retained earth commence. |
| discharge point to river | Where combined sewage is released into the river. |
| discretionary purchase cost | The cost of acquiring a property that is affected by works and where the owner has met the eligibility criteria under Thames Water's hardship scheme. |
| dissolved oxygen level | Indicator of water quality – a higher level is preferable. |
| disturbance compensation | Compensation to cover costs of relocation from a property that is needed for works and has been acquired. |
| domestic wastewater | Wastewater from residential settlements and services that predominantly originates from the human metabolism or household activities. |
| drawdown | A lowering of the water level in a borehole or aquifer, usually in response to abstraction. |
| Drinking Water Standards | Legal standards set in the Europe in the Drinking Water Directive 1998 together with UK national standards to maintain wholesomeness of potable water. |
| drive (shaft) site | Drive (shaft) sites lie at the start of tunnel drives and accommodate the majority of tunnelling activities. A shaft would be constructed and where appropriate a tunnel boring machine (TBM) installed. The TBM would then be used to construct the tunnel by excavating the ground. |
| drive/drive option | A possible tunnelling option. |
| drop shaft | A vertical concrete structure to drop flows from a CSO to a tunnel. |
| dust | Coarse particulate matter (between 1µm and 75µm in diameter) produced as a result of abrasive activities during the construction phase of a development. |
| earth pressure balance (type of TBM) | A mechanised tunnelling method in which spoil is admitted into the tunnel boring machine via a screw conveyor arrangement, which allows pressure at the face of the tunnel boring machine to remain balanced without the use of slurry. |
| ecology | The relationship between organisms and their environment. |
| effect (environment) | The result of an impact on a particular resource or receptor. |
| effluent | Treated wastewater discharged from a sewage treatment works. |
| electrical and control kiosk | A structure that houses electrical and control equipment. |

| Term | Description |
|---|---|
| elevation (building) | The actual façade of a building, or a plan showing a drawing of a façade. |
| emergency preparedness plan | A plan prepared for each asset where required, which details actions to be taken at each trigger level that links directly to the outcomes of risk workshops. |
| encroachment | With regards to the Thames Tideway Tunnel project, this refers to the extent that proposed structures extend into the river or foreshore. |
| Environmental Impact Assessment (EIA) | An assessment of the likely significant effects that a proposed project may have on the environment that considers natural, social and economic aspects, which is prepared in accordance with the Infrastructure Planning EIA Regulations 2009. |
| environmental quality standards (EQS) | The concentration of chemical pollutants assessed to have detrimental effects on water quality in terms of the health of aquatic plants and animals. EQS are established in the Water Framework Directive (Annex V) through testing the toxicity of the substance on aquatic biology. |
| Environmental Statement (ES) | A document to be prepared following an EIA that provides a systematic and objective account of the EIA's findings, prepared in accordance with the Infrastructure Planning EIA Regulations 2009. All of the specialist scoping exercises, desktop studies, survey work, baseline and mitigation reports. |
| environmental topics | Specialist studies of the *Environmental Statement* divided into individual topics, eg, archaeology, flood risk, ecology, air quality, etc. |
| estuarine | That which is formed or deposited in an estuary. |
| eutrophication | The enrichment of water by nutrients especially compounds of nitrogen and/or phosphorus, causing an accelerated growth of algae and higher forms of plant life. |
| evaluation (archaeological) | A limited programme of non-intrusive and/or intrusive fieldwork that determines the presence or absence of archaeological features, structures, deposits, artefacts or ecofacts within a specified area. |
| excavated material | The earth/soil/ground material removed when shafts, tunnels and other structures are excavated. Excavated material can be either topsoil, subsoil or other material, such as rock, etc. |

| Term | Description |
|---|---|
| excavation (archaeological) | A programme of controlled, intrusive fieldwork with defined research objectives that examines, records and interprets archaeological remains, retrieves artefacts, ecofacts and other remains within a specified area. The records made and objects gathered are studied and the results published in detail appropriate to the project design. |
| exchange land | Land that is acquired by an acquiring authority in order to reprovide open space needed for works. |
| fill | Material required to raise existing ground levels. This may comprise 'cut' material generated within a site or imported material. |
| final effluent | Treated liquid that results from a treatment process, at the point of discharge to a watercourse. |
| final settlement (sewage treatment) | The process stage in a sewage treatment works where 'mixed liquor' is treated prior to discharge of the final effluent. |
| findspot | The location at which an item is found. |
| flood plain | Generally low-lying areas adjacent to a watercourse or the tidal lengths of a river or sea where water flows in times of flood or would flow but for the presence of flood defences. |
| flood risk assessment | An assessment of the likelihood of flooding in a particular area in order to carefully consider development needs and mitigation measures. |
| fluvial | The processes associated with rivers and streams and the deposits and landforms they create. |
| foreshore | Ground uncovered by a river when the tide is low. |
| foul water sewer | A sewer that conveys wastewater of domestic or industrial origin, but little or no rainwater. |
| future baseline | The situation that would prevail if a proposed development does not proceed. Predicted impacts are compared to this theoretical scenario. |
| global warming | The gradual increase in the temperature of the earth's atmosphere, believed to be due to the greenhouse effect, caused by increased levels of carbon dioxide, chlorofluorocarbons, and other pollutants. |
| Green Flag | A benchmark national quality standard for parks and green spaces in the UK. |

| Term | Description |
|---|---|
| greenfield settlement | The term used to describe predicted movements at the ground surface, calculated on the premise that the ground is a ‘green field’ (ie, free of development) used as a starting point for ground movement calculations. |
| greenfield sites | Land not previously developed, can include agricultural land. |
| greenhouse gas (GhG) | Greenhouse gases are gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth’s surface, the atmosphere and clouds. This property causes the greenhouse effect. |
| ground investigations | Information gathering and collation regarding existing geotechnical ground information to enable the design process (eg, boreholes, groundwater monitoring, trial holes, etc). |
| ground treatment | A range of measures to improve the properties of the naturally occurring ground or to counter the potential pore water pressure changes arising from underground working/excavations in order to facilitate construction and/or reduce ground movement caused by works. |
| groundwater | All water below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil. |
| groundwater body | Distinct volume of groundwater within an aquifer or aquifers |
| grout | A material that is commonly injected in a fluid state to improve the engineering properties of poor ground conditions, fill voids (eg, between a structural tunnel lining and cut ground) |
| habitable rooms | Living rooms, studies, bedrooms, kitchen-diners and larger kitchens, generally used in connection with density assessments and assessment of daylight and sunlight levels for residential amenity. |
| habitat wall | A wall that acts as a wildlife resource for insects and small mammals to feed, shelter and procreate. |
| haul roads | Temporary roads provided within a contractor’s site area to allow the transportation of material around the site. |
| hazardous waste | Waste that is harmful to human health or the environment, either immediately or over an extended period of time. |

| Term | Description |
|---|---|
| health and safety documentation | Health and safety and Construction Design and Management document production for enabling items, preliminary design and reference design (eg, Construction Design and Management documents for topographical surveys, boreholes, etc). |
| health and safety reviews | Review of proposed designs or solutions to ensure health and safety and Construction Design and Management opportunities are maximised in the proposed solution (eg, on-going Thames Water Operations input, hazardous operations, buildability reviews). |
| hectare (ha) | A unit of area, defined as 10,000$m^2$, primarily used in the measurement of land. |
| heritage asset | A building, monument, site, place, area or landscape positively identified as having a degree of significance that merits consideration in planning decisions. Heritage assets are the valued components of the historic environment. They include designated heritage assets and assets identified by the local planning authority (including local listing). |
| Heritage Statement | Description of the significance of the heritage assets affected, and the contribution of their setting to that significance (Policy HE6 of PPS5). |
| historic environment | Above-ground and buried heritage assets that are considered to be significant because of their historic, archaeological, architectural or artistic interest. They might comprise below and above-ground archaeological remains, buildings, structures, monuments or heritage landscapes within or immediately around proposed development sites. |
| historic environment record (HER) | An archaeological and built heritage database held and maintained by the county authority. Previously known as the Sites and Monuments Record. |
| historic parks and gardens | A park or garden of special historic interest graded I (highest quality), II* or II as designated by English Heritage. |
| hogging | Bending upwards, the opposite of sagging |
| home zone | A designated residential area with streets designed to operate primarily as a space for social use. |
| Hydrogeology/hydrology | The area of geology that deals with the distribution and movement of groundwater in the soil and rocks of the Earth's crust (commonly in aquifers). |
| Impact (environment) | A physical or measurable change to the environment that is attributable to the project. |

| Term | Description |
|---|---|
| impermeable surface (geotechnical) | Surfaces or ground unable to absorb rainfall eg, concrete, most tarmac surfaces and hardstanding. |
| infiltration | The process whereby water seeps into a pipe via imperfections such as cracks, etc. |
| Infrastructure provider | Infrastructure provider means any body appointed (by the Secretary of State for the Environment) as an infrastructure provider for the authorised project or part(s) of the authorised project under Section 36B of the Water Industry Act 1991 (as amended by Section 35 of the Flood and Water Management Act 2010). |
| inlet pumping station | A structure that contains pumps to lift fluid. |
| instrumentation and monitoring specification | An approach to instrumentation and monitoring that includes roles and responsibilities, triggers and action plans, a regime to control construction works and the specification of instruments. |
| interception chamber | A structure constructed around an existing combined sewer that diverts storm water from the sewer into a new system of structures to transfer storm water flow to a sewage treatment works. |
| interceptor sewer | A sewer that captures spillages from existing sewers and transports them to be properly treated. |
| intermediate site | A site that contains intermediate shafts to support construction of the main tunnel with activities such as secondary lining. Each site needs to provide enough space for all construction-related activities (also see reception site). |
| Lambeth Group | A complex sequence of highly variable inter-bedded sediments that includes clay, sands, pebble beds and Shelly beds. |
| landscape character areas | Areas of landscape that have a broadly homogeneous pattern of topography and drainage, vegetation cover, settlement, land use and visual structure. |
| launch shaft or drive shaft | The shaft from which a tunnel boring machine is ‘launched’ ie, starts from. Excavated material is removed from and segments are fed into the tunnel at the launch/drive shafts. |
| layout | The way buildings, routes and open spaces are placed or laid out in relation to each other on the ground. |
| Lee Tunnel | The Lee Tunnel comprises a storage and transfer tunnel from Abbey Mills Pumping Station to Beckton Sewage Treatment Works and the interception of the Abbey Mills Pumping Station CSO. |

| Term | Description |
|---|---|
| limits of deviation (LODs) | Land boundary limits within which the permanent works would be located. |
| limits of land to be acquired and used (LLAU) | Land boundary limits around the worksites encompassing both the permanent works and their associated construction facilities and activities to build them. |
| lining | A structural member that is used in tunnels or shafts (vertical or inclined) to withstand ground and hydrostatic loads, both internal and external. |
| listed buildings | A structure of architectural and/or historical interest included on the Secretary of State's list, which affords statutory protection. Such buildings are subdivided in to Grades I, II* and II (in descending importance). |
| locally listed buildings | Buildings designated by the local planning authority as having local significance, which are included on a local list. Although such buildings are not statutorily protected, in general close scrutiny will be given to any development affecting them as a recognised heritage asset. |
| London clay | Fine sandy-silty clay to silty clay. |
| *London Plan* | The *London Plan* is the strategic spatial planning document for London produced by the Mayor of London. It sets out a fully integrated, economic, environmental, transport and social framework for the development of the capital to 2031, and forms part of the development plan for greater London. |
| London Tideway Improvements (LTI) | London Tideway Improvements comprises three major engineering schemes to help prevent sewer overflows and improve water quality in the River Thames. This includes upgrades to all five major sewage works in London, and construction of the Lee Tunnel and the proposed Thames Tideway Tunnel. |
| main tunnel | The large diameter tunnel from Acton Storm Tanks to Abbey Mills Pumping Station. |
| main tunnel site | A site from which the main tunnel would be built. Each site needs to provide enough space for all construction-related activities, which would vary depending on the type of tunnel boring machine used and whether the site is a drive site, double drive site or reception site. |
| Marine Policy Statement | The framework for preparing marine plans, which is applicable to all UK waters. It provides direction for new marine licensing and other authorisation systems, and sets out the general environmental, social and economic considerations that must be taken into account in marine planning. |

| Term | Description |
|---|---|
| method statement | Under Construction Design and Management regulations, a method statement must be prepared for each task prior to work commencing on-site. The statement provides details of how the task will be carried out and include possible risks or dangers, along with methods of control to be established to ensure safety. |
| Metropolitan Open Land (MOL) | A London-specific designation that protects strategically important open spaces within the built-up capital and affords the same level of protection as greenbelt land. |
| mitigation design report | A report that must be prepared for each asset that requires mitigation works. It comprises the detailed design and mitigation works identified in the Stage 3 assessment report. |
| mitigation measures | Proposed actions to prevent or reduce adverse effects arising from the whole or specific elements of a development. |
| modelling | Simulation of a proposed design (eg, hydraulic modelling of a drainage network, physical modelling of drop shafts or odour modelling, etc). |
| monitoring | Monitoring, recording and collection of existing situation data prior to construction (eg, CSO spill frequency, vehicle or pedestrian traffic movements or building settlement monitoring before or during construction). |
| oil interceptor | An underground tank split into sections and connected into a drainage system that contains oil and prevents it being discharged into rivers and streams, etc. |
| open space | All space of public value, including landscaped public areas, playing fields, parks and play areas as well as areas of water such as rivers, canals, lakes and reservoirs that offer opportunities for sport and recreation or provide visual amenity. |
| operational phase | Once construction work is complete and the tunnel system is in use. |
| orthogonal | That which has a set of mutually perpendicular axes meeting at right angles. |
| overflow weir chamber | Used to manage and divert overflows from an existing sewer into another system |
| overlooking | The outlook from a development or building over adjoining land or property. |
| particulate matter | Solid particles or liquid droplets suspended or carried in the air that remain once deposited onto a surface. The term includes all size fractions of suspended matter such as dust, $PM_{10}$ and $PM_{2.5}$. |

| Term | Description |
|---|---|
| pathogenic organisms | Creatures capable of producing disease. |
| penstock | A gate used to control wastewater flow. |
| Permeability (geotechnical) | A measure of the ability of a material (such as rocks) to transmit fluids. |
| permitted development | Permission to carry out certain limited forms of development without needing to make an application to a local planning authority, as granted under the terms of the Town and Country Planning (General Permitted Development) Order 2010. |
| Planning Inspectorate | An independent body that examines applications for development consent for Nationally Significant Infrastructure Projects. |
| planning obligations and agreements (Section 106) | A legal agreement between a planning authority and a developer, or an undertaking offered unilaterally by a developer, that ensures that certain extra work related to a development is carried out. |
| porous (geotechnical) | Containing void spaces. Most sedimentary rocks are porous to some extent, and the term is commonly applied in a relative sense, generally restricted to rocks that have significant effective porosity. |
| pre-application discussions | Meetings and consultation with relevant local authorities and statutory stakeholders prior to submitting an application for development consent. |
| precast concrete segmental lining | Tunnel or shaft lining composed of precast, usually reinforced, concrete elements (segments) designed to form a specific shape, normally circular. |
| preferred site | Sites assessed as most suitable following a review of the suitability of shortlisted sites, having regard to engineering, planning, environment, property and community considerations. |
| preliminary design | An outline design process to develop provisional solutions. |
| *Preliminary environmental information report* (*PEIR*) | A document that sets out initial environmental information. It is subject to pre-application consultation under the Planning Act 2008. |
| preliminary treatment | The initial treatment stage in a sewage treatment works where physical separation techniques are used to remove larger objects and grit to ensure that sewage is amenable to treatment. |

| Term | Description |
|---|---|
| preservation by record | Preservation by recording and advancing understanding of an asset's significance. This is a standard archaeological mitigation strategy in which heritage asset remains are fully excavated and recorded archaeologically and the results are published. For remains of lesser significance, preservation by record might comprise an archaeological watching brief. |
| preservation *in situ* | An archaeological mitigation strategy in which nationally important (whether designated or not) heritage assets are conserved *in situ* for future generations, typically through modifications to design proposals to avoid damage or destruction of such remains. |
| primary treatment | Treatment of urban wastewater by a physical and/or chemical process that involves settlement of suspended solids or other processes in which the $BOD_5$ of the incoming wastewater is reduced. |
| public realm | Any publicly-owned area, including streets, pathways, parks, publicly accessible open spaces, and public and civic facilities. |
| Public Right of Way | Route to which the public has right of access. |
| public sewer | A sewer that is owned and maintained by a UK water and sewerage undertaker. |
| public transport accessibility level (PTAL) | A method of measuring how accessible a location is to rail, tube and bus services. |
| public water supply | A term used to describe the supply of water provided by a water company. |
| pumping station | A vertical structure with pumps used to lift water up to a higher level |
| Ramsar site | Sites identified under the Ramsar Convention (the Convention on Wetlands of International Importance, especially as Waterfowl Habitat) relating to the conservation and sustainable utilization of wetlands, recognizing the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value. |
| raw sludge | Sewage solids that have settled out during primary sedimentation. These particles collect and form sludge. |
| reach | A section of river between two points. |
| real-time control | Live data is used to manipulate control equipment in order to best manage the flow of storm water and sewage within a system's capacity. |

| Term | Description |
|---|---|
| reception site | A tunnel site that would contain the shaft from which a tunnel boring machine would be 'received' ie, ends up. |
| receptor | A person, animal, plant, eco-system, property, surface or groundwater environment, or historic environment that may be impacted by a project. |
| recharge (geotechnical) | Water that percolates downwards from the surface to replenish the water table. |
| red route | The red route is a network of roads designated by Transport for London to carry heavy volumes of traffic, which is essential for the movement of traffic and public transport. It mainly comprises major routes into and around London. Transport for London is responsible for enforcing the red routes, which include clearways, parking and loading bays, bus lanes, yellow box junctions and banned turns. |
| reference design | A design process used to support site selection. |
| regeneration | The economic, social and environmental renewal and improvement of rural and urban areas. |
| reinforced grass | An area of grass reinforced with a mesh to improve load bearing capacity and wear resistance. |
| risk assessment | Assessment of the risks associated with an activity or object and possible accidents involving a source or practice. This includes assessment of consequence. |
| River Basin Management Plans (RBMP) | Management plans that outline the state of water resources within a River Basin District relevant to the objectives of the Water Framework Directive. |
| run-off | Run-off is the movement of rain water over land. Run-off consists of precipitation that does not evaporate, transpire or penetrate the surface to become groundwater. Excess run-off can lead to flooding, which occurs when there is too much precipitation. |
| safeguarded wharf | A wharf that is protected by the Mayor of London and the Port of London Authority, to ensure that it is retained as a working wharf and protected from redevelopment into other uses. |
| saturated zone (geotechnical) | The zone in which the voids in a rock or soil are filled with water at a pressure greater than atmospheric pressure. |
| scale | The height, width and length of proposed buildings in relation to their surroundings. |

| Term | Description |
|---|---|
| scheduled monument | An ancient monument or archaeological deposit designated by the Secretary of State as a 'Scheduled Ancient Monument' and protected under the Ancient Monuments and Archaeological Areas Act 1979. |
| scoping opinion | The formal view of the determining authority on the range of topics and issues to be considered by the environmental impact assessment. |
| scoping report | A document that sets out the proposed approach to the Environmental Impact Assessment, including the range of processes, desktop studies, actions, topics and issues to be addressed. |
| scour | Movement of riverbed materials due to the force of the water. |
| screening opinion | The formal view of the determining authority on the need to undertake an Environmental Impact Assessment. |
| screens (treatment) | As part of the wastewater treatment process, screens are used to physically remove larger objects, including floating debris, from the incoming flow to ensure that sewage is amenable to treatment. |
| secant piles | Alternate piles in-filled with concrete to form a water-tight retaining wall. |
| secondary lining | A second, internal lining of the tunnel to provide additional strength. |
| secondary treatment | The biological treatment of settled sewage, utilising micro-organisms to oxidise the biochemical oxygen demand. |
| Section 106 agreement | A legal agreement under Section 106 of the 1990 Town and Country Planning Act. Section 106 agreements are legal agreements between a planning authority and a developer and related parties as necessary, or undertakings offered unilaterally by a developer, that ensure that certain extra works related to a development are undertaken. |
| segments | Multiple precast concrete segments made in factories that are joined together to build a tunnel. Shafts are also sometimes constructed from segments. |
| sensitive asset | An asset that has limited scope to accommodate the effects of ground movements without adverse effects. This may be due to age, value (heritage and financial), ownership, location, form, function and nature, and construction materials. |
| settled sewage | Sewage after suspended solids have settled during primary treatment. |

| Term | Description |
|---|---|
| settlement | Predicted ground movements arising from construction. |
| sewage derived litter | Rubbish that originates from sewage, such as toilet paper. |
| sewage or wastewater | Water-borne wastes from uses of water, derived from households, trade and industry. |
| sewerage | A system of pipes to collect and transport domestic and industrial wastewater. |
| sewerage undertaker | A statutory undertaker for sewerage who is responsible for sewerage provision and maintenance. |
| shaft | A deep vertical structure, duct, pipe or vertical tunnel. |
| shortlisted sites | Sites that were identified following an assessment of a long list of sites in accordance with the *Site selection methodology paper* (*SSMP*). |
| signature ventilation column | The project's own specially designed ventilation column (a ventilation column is a vertical pipe through which air is released). |
| site definition | The initial stage to define the area of interest for each main tunnel sites, CSO sites, system modification sites or other construction sites, ie, agreeing the area of study for topographical and other survey works, or information requests from third-parties, etc. The area of interest included working area, compound, access route, etc, as necessary. The definition of the area of interest enabled the instruction of surveys, information requests, etc. |
| sites and monuments record | A resource and repository of information regarding the archaeological and historic landscapes under the care of an organisation such as the National Trust and local authorities. |
| slipway | A sloping surface leading down to a body of water from which boats may be launched. |
| sludge | Sediment deposited during the treatment of sewage. |
| Slurry TBM (type of TBM) | Slurry tunnel boring machines - a mechanised tunnelling method using slurry to support the face and transport excavated material through a pumped system. The slurry is normally a mixture of bentonite and water which forms a dense liquid capable of supporting open excavations. |
| source control | Methods of managing and reducing storm water run-off at site level. |
| spalling | The crumbling away of the face of bricks or stone blocks. This may be due to a number of reasons such as poorly maintained guttering leading to soaking brickwork or repeated frost cracking. |

| Term | Description |
|---|---|
| special parliamentary procedure | Once a compulsory purchase order or development consent order is confirmed, it must be approved by Parliament if it includes some types of special land. A special parliamentary procedure is used to seek this approval. |
| specimen trees | Specially selected large trees with a height over 7m and a girth over 50cm when planted. |
| spill event | A spill occurrence isolated by at least 24 hours of no spill before and after. |
| sprayed concrete lining (SCL) | A structural element formed by the application of a mixture of cementitious material, aggregate, water, fibre or other types of reinforcement and admixtures, projected into place from a nozzle at high velocity to produce a dense, homogenous mass that is applied directly to the ground surface in one or more layers. |
| storage and transfer tunnel | A sewer that captures spillages from existing sewers and transports them to be properly treated. |
| storm water | Rainwater that mixes with sewage |
| surface water | A general term used to describe all water features such as rivers, streams, springs, ponds and lakes. |
| surface water run-off | Water that travels across the ground and hard surfaces rather than seeping into the soil eg, from paved roads and buildings. |
| surface water sewer | A sewer that conveys surface water. |
| suspended solids | The small solid particles that remain in suspension within a liquid. |
| sustainable urban drainage systems (SUDS) | A drainage system that controls the quantity and speed of rainwater run-off from a development as defined in the Environment Agency and London Plan hierarchy. |
| temporary works | Works required to facilitate construction, including any works left in place after completion (eg temporary steel piles that do not need to be removed). |
| Thames Water | Thames Water Utilities Ltd. The *Draft Development Consent Order* (DCO) contains an ability for Thames Water to transfer powers to an Infrastructure Provider (as defined in article 2(1) of the DCO) and/or another body, with the consent of the Secretary of State. |
| Thanet Sand | Coarsening upward sequence of well-sorted fine grained sand that has a higher clay/silt content towards the lower part of the sequence, and evidence that intense bioturbation has removed bedding structures. |
| tidal excursion | The length of river channel that is swept by water from a |

| Term | Description |
|---|---|
| | discharge point in one tidal cycle. In the case of the tidal Thames, this is considered to be 13km up and downstream of the river's discharge point. |
| Tideway | The tidal area of the Thames (ie, from Teddington to the Thames Estuary). |
| townscape/cityscape | The general appearance of a built- up area, for example a street, town or city. |
| Transport Assessment (TA) | A formal assessment of traffic and transportation issues relating to a proposed development. The findings are usually presented in a report that accompanies an application for development consent. |
| Transport for London Road Network (TLRN) | The network of major or 'strategic', high capacity roads managed by Transport for London. |
| tree preservation orders | A designation of trees that significantly contribute to the amenity value of an area. An application must be submitted to the local authority before any works are carried out on a tree protected by a TPO designation, including routine maintenance. |
| tunnel alignment | The horizontal and vertical routes of a tunnel. |
| tunnel boring machine (TBM) | A machine that has a circular cross-section used to excavate tunnels through a variety of geological conditions. |
| tunnel datum | A datum based on Ordnance Datum used to design tunnels that pass below sea level. By using a lower datum as the base point, negative numbers can be avoided in calculations, which eliminates a possible source of mistakes. |
| underground pressure release chamber | An enclosed space below ground where air is released to the atmosphere when pressure within a tunnel exceeds a set value. |
| urban wastewater | Domestic wastewater or the mixture of domestic wastewater with industrial wastewater and/or rainwater run-off. |
| Urban Wastewater Treatment Directive 1991 (UWWTD) | The overall aim of the UWWTD is to protect the environment from the adverse effects of urban wastewater discharges. |
| utilities | A basic service such as electricity, gas, or water |
| Utilities Statement | A report that outlines the utilities that would be required for the construction and operation of the project and considers how existing utility assets would be affected. |
| valve chamber | An underground structure on the sewer system that contains valves used to isolate the flow between different |

| Term | Description |
|---|---|
| | parts of the sewerage system. |
| ventilation building | A building that contains fans and filters to remove and treat air. |
| ventilation column | A vertical pipe through which air is released. |
| ventilation duct | Pipework (generally below ground) through which air moves. |
| ventilation structure | An above-ground or below-ground structure that is part of the tunnel ventilation system. |
| venturi | A constricted section of pipe designed to reduce pressure when a fluid flows through it |
| wastewater or sewage | Water-borne wastes from domestic uses of water, derived from households, trade and industry. |
| watching brief (archaeological) | An archaeological watching brief is a formal programme of observation and investigation conducted during any operation carried out for non–archaeological reasons. |
| Water Framework Directive (WFD) | A European Commission (EC) Directive that seeks to improve water quality in rivers and groundwater in an integrated way (2000). |
| water table | The level below which the ground is saturated with water. The water table elevation may vary with recharge and groundwater abstraction. |
| weir | A dam in a watercourse or sewer that alters and manages the flow. |
| wet weather discharges | Spillages of storm sewage due to bad weather. |
| wet well | The part of a pumping station that receives and stores incoming sewage flow before it is removed by pumps. |
| works | All construction work associated with the construction of the Thames Tideway Tunnel project. |
| worksite | Site on which construction works are carried out. |

Keyplan:

Key

- Limits of Land to be Acquired or Used
- Local Authority Boundary
- Conservation Area

Hammersmith and Fulham LB

Ealing LB

BEDFORD PARK CONSERVATION AREA

Hounslow LB

60 30 0 60 m

Scale 1 : 4,000 at A3

# FOR INFORMATION

Location

**Acton Storm Tanks**
London Borough of Ealing

Document Information

**Heritage Statement**

Conservation areas map

1PL03-HE-65275
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

Thames Water

Keyplan:

Key

- Limits of Land to be Acquired or Used
- Local Authority Boundary
- Heritage Feature/Findspot
- Statutorily Listed Building
- Past Investigation
- Bazalgette sewer
- Surrey Iron Railway

The reference number for historic environment features correspond to the descriptions in the 'Gazetteer of known heritage assets' in Environmental Statement Vol. 9 Appendix E.1

30 15 0 30 m

Scale 1 : 2,000 at A3

# FOR INFORMATION

Location

**King George's Park**
London Borough of Wandsworth

Document Information

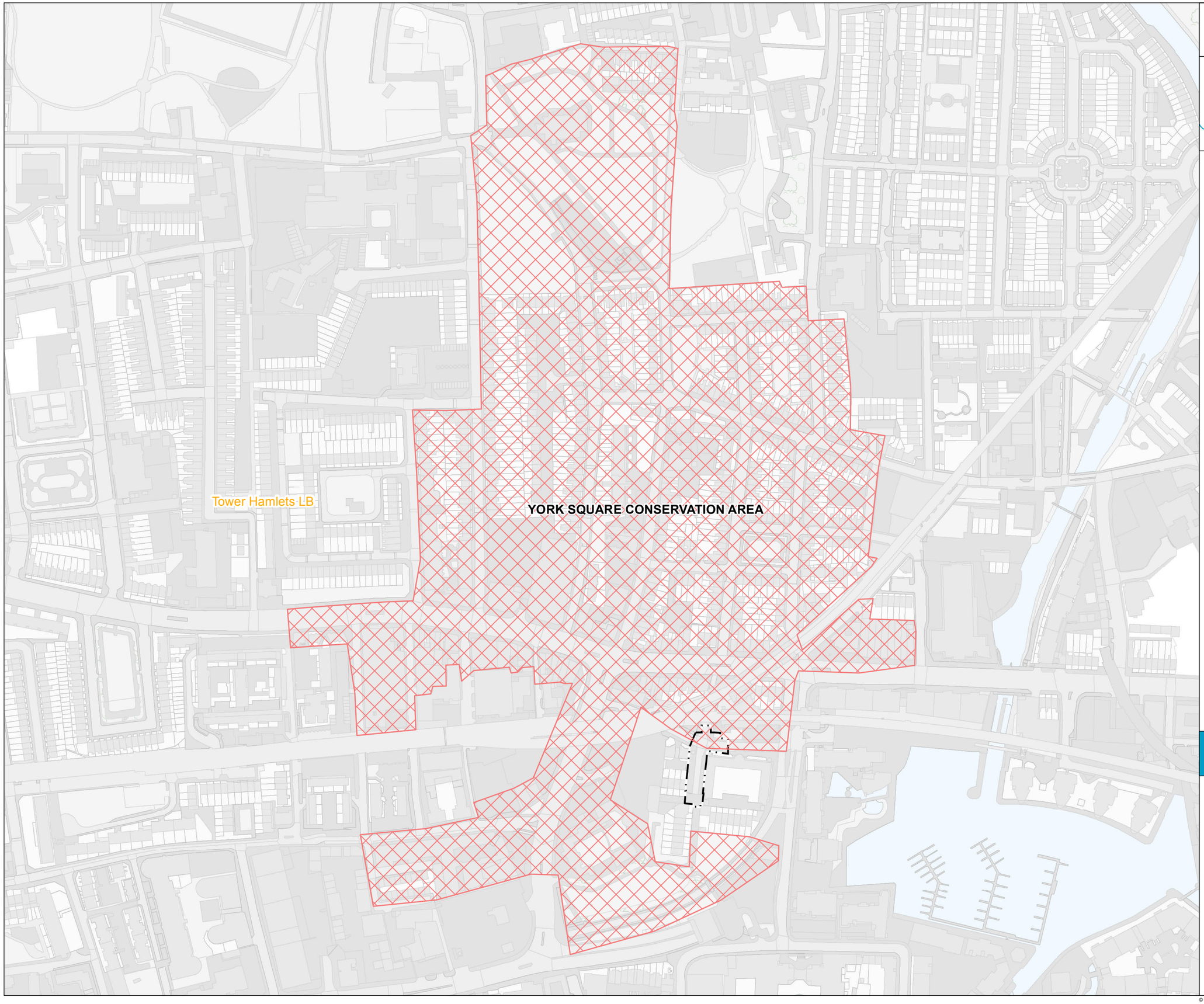
**Heritage Statement**

Historic environment features map

1PL03-HE-65219
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

Thames Water






Keyplan:

Key

- Limits of Land to be Acquired or Used
- Local Authority Boundary
- Conservation Area

40 20 0 40 m

Scale 1 : 3,000 at A3

FOR INFORMATION

Location

**Bekesbourne Street**
London Borough of Tower Hamlets

Document Information

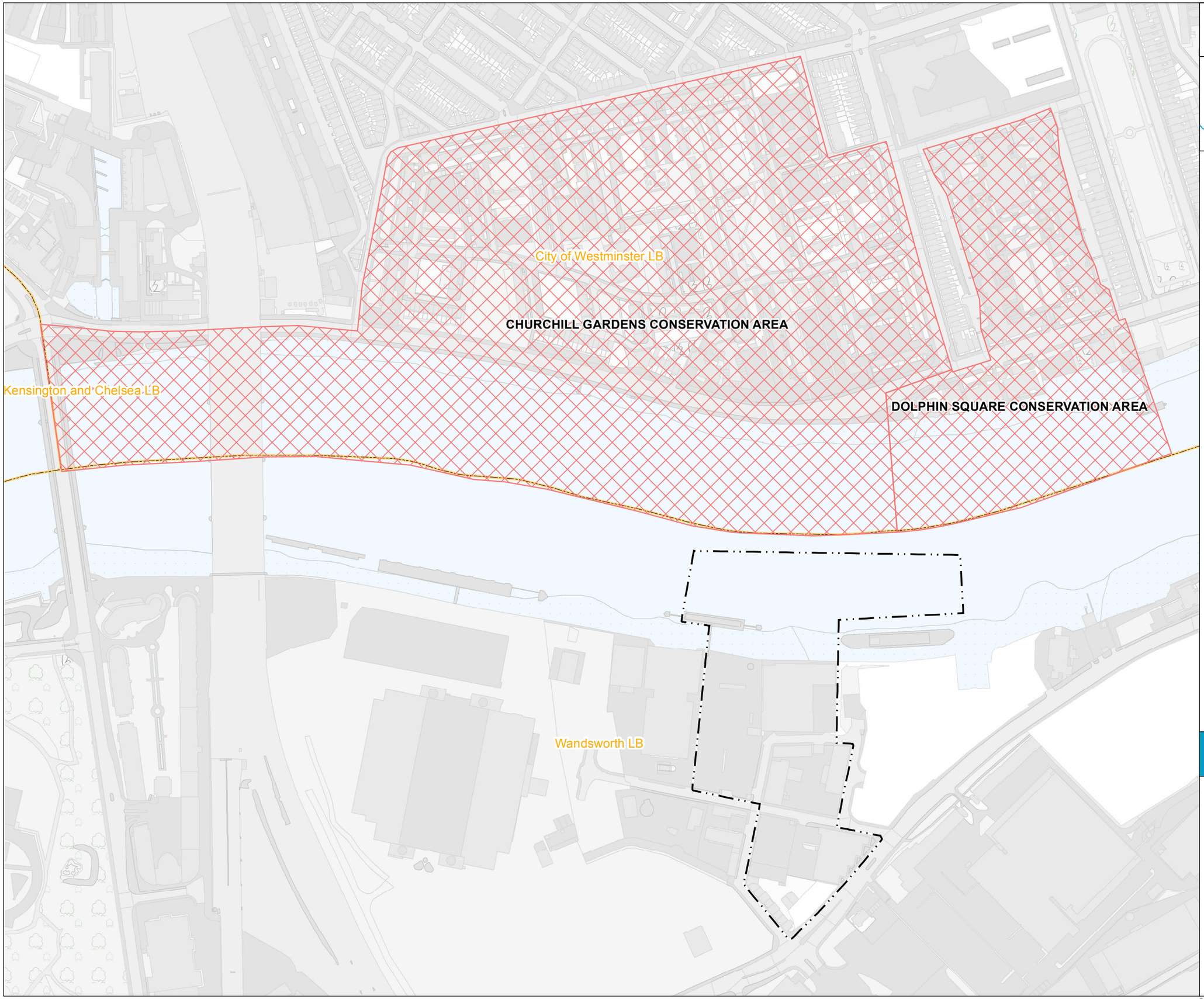
**Heritage Statement**

Conservation areas map

PL03-HE-65249
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

Thames Water






Keyplan:

Key

- Limits of Land to be Acquired or Used
- Local Authority Boundary
- Conservation Area

50 25 0 50 m

Scale 1 : 3,500 at A3

FOR INFORMATION

Location

**Kirtling Street**
London Borough of Wandsworth

Document Information

**Heritage Statement**

Conservation areas map

1PL03-HE-65273
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

Thames Water

Keyplan:

Key

- Limits of Land to be Acquired or Used
- Local Authority Boundary
- Conservation Area

PIMLICO CONSERVATION AREA

City of Westminster LB

CHURCHILL GARDENS CONSERVATION AREA

DOLPHIN SQUARE CONSERVATION AREA

Kensington and Chelsea LB

Lambeth LB

Wandsworth LB

70 35 0 70 m

Scale 1 : 5,000 at A3

FOR INFORMATION

Location

**Heathwall Pumping Station**
London Borough of Wandsworth

Document Information

**Heritage Statement**

Conservation areas map

1PL03-HE-65274
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

Thames Water

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



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