Section 48
Report on site selection process

Volume 2 / General appendices:
1. Site selection methodology paper (Summer 2011)
2. Site selection background technical paper (Summer 2011)

Summer 2012
Section 48: Report on site selection process

Volume 2: General Appendices
Thames Tideway Tunnel
Section 48: Report on site selection process

List of volumes

Volume 1  Main report

Volume 2  General appendices (this document):
  1. Site selection methodology paper (Summer 2011)
  2. Site selection background technical paper (Summer 2011)

Volume 3  Western site Appendices A to H

Volume 4  Central site Appendices J to Q

Volume 5  Eastern site Appendices R to W
List of contents

Introduction
1 Site selection methodology paper
2 Site selection background technical paper
Glossary
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSO</td>
<td>combined sewer overflow</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>PS</td>
<td>pumping station</td>
</tr>
<tr>
<td>SR</td>
<td>storm relief</td>
</tr>
<tr>
<td>STW</td>
<td>sewage treatment works</td>
</tr>
<tr>
<td>TBM</td>
<td>tunnel boring machine</td>
</tr>
<tr>
<td>UK</td>
<td>United Kingdom</td>
</tr>
</tbody>
</table>
1.1.1 This volume contains the full text of following background documents:
   a. Site selection methodology paper (Summer 2011)
   b. Site selection background technical paper (Summer 2011).

1.1.2 This volume contains the latest versions of each of the above documents and should be read in conjunction with Volumes 1, 3, 4 and 5 of the Section 48: Report on site selection process.

1.1.3 These are the main documents that guided our site selection process.

1.1.4 The *Site selection methodology paper* and *Site selection background technical paper* were subject to two separate rounds of consultation:
   a. Round 1: 12 weeks from Autumn 2008 to Winter 2009 – involving initial, general consultation on the documents, leading to a number of changes to the methodology prior to its application.
   b. Round 2: four weeks from Spring 2009 – further consultation focusing on changes resulting from the first round of consultation, leading to additional changes to the methodology; both papers were finalised, distributed to consultees and published in May 2009.

1.1.5 In Summer 2011 we consulted on our *Statement of Community Consultation* (SOCC) and *Community Consultation Strategy* (CCS), two documents developed to amend our initial *Stakeholder and community engagement strategy* (SCES) to ensure our approach to consultation for this project complied with the relevant consultation requirements in the Planning Act 2008.

1.1.6 As a result of the amendments to our consultation strategy and new legislation and guidance on the preparation of applications for National Significant Infrastructure Projects, we also consulted in the Summer 2011 on some minor changes to our *Site selection methodology paper*. Stage 2 of the *Site selection methodology paper* originally envisaged one phase of consultation, but in order to conform to the evolving consultation requirements and guidance for Nationally Significant Infrastructure Projects, Thames Water introduced a second phase of consultation. This was added to the end of Stage 2 of the site selection process along with some minor factual amendments. No concerns were raised in relation to the amendments and they had no bearing on the approach or principles set out and followed in the agreed 2009 methodology.

1.1.7 The earlier versions of all documents are available on Thames Water’s website ([http://www.thamestunnelconsultation.co.uk](http://www.thamestunnelconsultation.co.uk)) or on request.
Site selection methodology paper
Foreword

The publication of the Thames Tunnel Site selection methodology paper is an important milestone for the London Tideway Tunnels.

This document sets out how we will go about assessing potential sites to support the construction of the Thames Tunnel, which will be between 25km – 32km long (depending on the route alignment finally selected), and up to 34 connections to the combined sewer overflows – resulting in a cleaner, healthier river Thames.

The methodology has been produced with input from local authorities potentially directly affected and strategic pan-London stakeholders by the construction of the Thames Tunnel.

On behalf of the whole Thames Tunnel project team I would like to thank everyone who took the time to contribute to the Site selection methodology paper and all those involved in its production.

Phil Stride
Head of Tideway Tunnels
May 2009

Update

We have updated our Site selection methodology paper in recognition of the Government’s intention to bring the Thames Tunnel within the remit of the Planning Act 2008. These amendments relate to the introduction of a second phase of consultation. We consulted in June 2011 on these changes and we received no objections to them.

We have also made minor factual amendments where required, and have updated the standard terminology to match the terms that we are currently using on the project. The amendments have not changed the site selection methodology, which we will continue to follow.

Phil Stride
Head of London Tideway Tunnels
August 2011
# Thames Tunnel

## Site selection methodology paper

### List of contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive summary</td>
<td>1</td>
</tr>
<tr>
<td>1 Introduction</td>
<td>3</td>
</tr>
<tr>
<td>1.1 Purpose of this paper</td>
<td>3</td>
</tr>
<tr>
<td>1.2 Structure of this paper</td>
<td>3</td>
</tr>
<tr>
<td>1.3 Background to London’s sewerage system</td>
<td>3</td>
</tr>
<tr>
<td>1.4 Need for improvements to London’s sewerage system and the tidal River Thames</td>
<td>4</td>
</tr>
<tr>
<td>1.5 Policy support for Thames Tunnel</td>
<td>5</td>
</tr>
<tr>
<td>1.6 Project description and programme</td>
<td>5</td>
</tr>
<tr>
<td>1.7 Approach to site selection</td>
<td>6</td>
</tr>
<tr>
<td>2 Site selection methodology: main tunnel sites</td>
<td>9</td>
</tr>
<tr>
<td>2.1 Introduction</td>
<td>9</td>
</tr>
<tr>
<td>2.2 Definition of site requirements and area of search</td>
<td>9</td>
</tr>
<tr>
<td>2.3 Stage 1: Site identification, considerations and assessment</td>
<td>13</td>
</tr>
<tr>
<td>2.4 Stage 2: Engagement on preferred list of sites</td>
<td>23</td>
</tr>
<tr>
<td>2.5 Stage 3: Selection of sites</td>
<td>26</td>
</tr>
<tr>
<td>3 Site selection methodology: CSO sites</td>
<td>29</td>
</tr>
<tr>
<td>3.1 CSO introduction</td>
<td>29</td>
</tr>
<tr>
<td>3.2 CSO site selection context</td>
<td>29</td>
</tr>
<tr>
<td>3.3 Stages 1-3: Assessment of shortlisted CSO sites, identification of preferred sites, consultation and confirmation of selected sites</td>
<td>30</td>
</tr>
<tr>
<td>Appendix A – List of consultees</td>
<td>31</td>
</tr>
<tr>
<td>Appendix B – Initial list of data sources</td>
<td>35</td>
</tr>
<tr>
<td>Appendix C – References</td>
<td>37</td>
</tr>
</tbody>
</table>
List of figures

Page number

Figure 1.1 Site selection flowchart................................................................. 8
Figure 2.1 Initial site search area: Main tunnel sites and intermediate sites........... 12

List of tables

Page number

Table 2.2 Long list of sites: Assessment considerations and indicative values ...... 15
Table 2.3 Draft short list of sites: Assessment....................................................... 18
Executive summary

The Thames Tunnel (the project) is required in order to intercept flows from combined sewer overflows (CSOs) along the Thames between west London and Beckton Sewage Treatment Works in east London. The project will benefit London as a whole, and those living and working in London, by providing a cleaner River Thames.

The main tunnel will be between 25-32km long (depending on the route alignment finally selected) and will require main tunnel (and possibly intermediate) sites to facilitate construction and CSO interception and other works for CSOs. It is these sites that will be the subject of the proposed site selection exercise. A Site selection background technical paper accompanies this document and provides more information on the project.

Sections 2 and 3 of this document set out the proposed methodology for main tunnel sites, intermediate sites and CSO sites respectively. Each type of site has certain size requirements and the methodology to identify such sites will be applied within an identified area of search. In general terms, the methodology for each type of site can be summarised as follows:

- Outlining the methodology itself, outlining site requirements and the proposed area of search and consulting on the methodology.
- Stage 1: Creation and assessment of a long list of sites; creation and assessment of a short list of sites; creation of a list of preferred sites.
- Stage 2: Engagement on preferred list of main tunnel sites, intermediate and CSO sites.
- Stage 3: Reassessment following engagement exercise and final selection of sites.
Executive summary
1 Introduction

1.1 Purpose of this paper

1.1.1 The Thames Tunnel (the project) is required in order to intercept flows from combined sewer overflows (CSOs) along the Thames between west London and Beckton Sewage Treatment Works in east London. The project will benefit London as a whole, and those living in, working in and visiting London, by providing a cleaner River Thames. While the completed tunnel will require relatively few above-ground structures, there is a need for a number of construction sites along the route of the project to facilitate its construction. It is these sites that will be the subject of the proposed site selection exercise.

1.1.2 This paper summarises the background to the project and then focuses on the proposed site selection methodology (the methodology). The accompanying Site selection background technical paper provides more information on the project.

1.2 Structure of this paper

1.2.1 The structure of this paper is as follows:

- Section 1 – provides an overall background to the sewerage system in London, the need for improvements, policy support for the Thames Tunnel programme and the main features of the project
- Section 2 – describes the site selection methodology for the two types of sites (main tunnel and intermediate) required for the main tunnel
- Section 3 – describes the site selection methodology for CSO sites.

1.3 Background to London’s sewerage system

1.3.1 London’s sewerage system dates from the 19th century and is based on the ‘combined’ principle, whereby a single set of sewers convey both foul sewage and rainwater runoff to sewage treatment works (STWs) for treatment, prior to discharge to the river.

1.3.2 It is usual for a combined sewer to incorporate overflows in the system, which allows excess storm flows to discharge directly to the river to prevent flooding. This is the case with the London sewerage system.

1.3.3 The Thames Tunnel will be designed to intercept flows from up to 34 of the most polluting CSOs.

1.3.4 Unsatisfactory CSOs affect the water quality of the tidal River Thames in three main ways:

- by introducing quantities of sewage derived solid material into the river that can give rise to offensive conditions both in the river and on the foreshore
- by producing a fall in dissolved oxygen (DO) concentrations that can drop sufficiently low to result in fish mortality, and
• by introducing pathogenic organisms into the river, which increases the health risk to both river users and wildlife.

1.4 Need for improvements to London’s sewerage system and the tidal River Thames

Legal background

1.4.1 Thames Water is the licensed sewerage undertaker for the London area and has a duty under the Water Industry Act 1991 to provide and maintain a system of sewers.

1.4.2 The EC Urban Waste Water Treatment Directive 1991 (UWWTD) and UK Urban Wastewater Treatment (England and Wales) Regulations (DoE, 1994) establish general standards for collecting systems (sewers) and sewage treatment works (STW). Compliance with these requirements is an extension of the duties under the Water Industry Act 1991.

1.4.3 The need to meet the requirements of relevant legislation is a major driver for the Thames Tunnel.

European Commission reasoned opinion and Government decision

1.4.4 On 10 April 2006, the European Commission handed down its ‘reasoned opinion’ that the untreated discharges from the CSOs along the Thames Tideway at the existing frequency of 50 to 60 times per year were unacceptable and that the United Kingdom Government was therefore failing to comply with the requirements of the UWWTD on collecting systems and treatment facilities. The Government has accepted that further measures are needed to improve parts of London’s sewerage network and to meet the requirements of the UWWTD.

1.4.5 On 27 July 2006, Ian Pearson (Minister of State for Climate Change and the Environment) wrote to Thames Water requesting that Thames Water provides a detailed assessment of two of the storage and transfer tunnel options for providing improvements to the Thames Tideway.


1.4.7 A Regulatory Impact Assessment (RIA) was prepared by Defra and signed off by Ian Pearson in March 2007. The RIA recommended that: “.....a phased, single tunnel approach, which addresses all the unsatisfactory overflows, is the minimum required to meet our obligations. It is therefore proposed that TW are asked to proceed urgently with the development and implementation of a scheme which reduces and limits pollution from storm water overflows.”

1.4.8 In September 2010, the Secretary of State for Environment, Food and Rural Affairs, Caroline Spelman, issued a written ministerial statement
confirming the coalition Government’s support for the construction of the tunnel. The Environment Secretary’s statement confirmed that: “I am also minded that development consent for the project should be dealt with under the regime for nationally significant infrastructure projects established by the Planning Act 2008. I consider that this project, with its unique scale and complexity, is of national significance, and therefore appropriate for this regime.”

1.5 Policy support for Thames Tunnel

1.5.1 The Government’s 2008 water strategy for England (refer to Appendix C) specifically supports the series of London Tideway projects and states: “The Thames Tideway scheme, consisting of large scale infrastructure improvements to London’s combined sewer system and treatment works, will address pollution from sewage, which affects the tidal River Thames and the River Lee. It is expected to be completed by 2020, and will make significant improvements to water quality and the natural environment in London, where there are currently between 50 and 60 overflows per year.”

1.5.2 One of the main aims of the Thames Tunnel project is to improve the overall quality of the tidal River Thames. This aim is consistent with the Government’s objectives for the planning system set out in Planning Policy Statement 1: Delivering Sustainable Development (2005) (PPS1). PPS1 states in Paragraph 3: “(at) the heart of sustainable development is the simple idea of ensuring a better quality of life for everyone, now and for future generations.”

1.5.3 It is important to note that in autumn 2010, the Government consulted on its draft Waste Water National Policy Statement, which sets out the need for the Thames Tunnel.

1.5.4 The London Plan also states general support for the Thames Tunnel. The London Plan (2011) in Policy 5.14D states: “[t]he development of the Thames Tideway Sewer Tunnels to address London’s combined sewer overflows should be supported in principle.”

1.5.5 The supporting text to this policy (Paragraph 5.59) states that the Thames Tunnel: “will address the long-term problem of combined sewer overflows, which has resulted in the discharge of millions of tonnes of untreated sewage into the Thames each year. This is a strategic project for London that should be completed by 2020. Opportunities to reduce the construction and operational impacts, the overall energy demand and the costs of the project should be taken.”

1.6 Project description and programme

1.6.1 Information concerning the project and proposed means of construction is provided in the Site selection background technical paper. The text below provides a summary of the project and programme.

1.6.2 The Thames Tunnel is a linear infrastructure project that will pass physically through the administrative areas of up to 14 London local authorities. The alignment of the tunnel will broadly follow the route of the Thames from west London to Beckton STW (or Abbey Mills Pumping
Station) in the east. The existing CSOs to be intercepted will be connected to the Thames Tunnel, and flows will be forwarded for treatment at Beckton STW.

1.6.3 The provisional outline schedule for the Thames Tunnel project is given below:

- Design development 2008 to 2010
- Site selection 2008 to 2011
- EIA, ES and planning documentation 2009 to 2012
- Submission of application for development consent 2012
- Target for development consent 2013
- Procurement of main construction packages 2013
- Site investigation and enabling works 2008 to 2013
- Construction work 2013 to 2020

1.6.4 The project involves a network of sites to enable the main tunnel to be constructed and maintained by Thames Water.

Main features of the Thames Tunnel

1.6.5 The main elements of the proposed Thames Tunnel project include the following:

a. Main tunnel approximately between 25km – 32km long (depending on the route alignment finally selected) with an estimated 7.2m internal diameter (ID) running from west London to Beckton STW (or Abbey Mills Pumping Station) in east London.

b. Main shafts, including one main shaft at Beckton STW (or Abbey Mills Pumping Station) (up to 25m ID), plus other main drive/reception shafts (up to 25m ID) to facilitate tunnel construction and for permanent operational tunnel access. The precise nature of the main tunnel sites required will be determined in part by the availability and suitability of sites along the tunnel length, and by the need to optimise drive lengths for tunnel boring machines (TBMs).

c. Intermediate sites may be required to undertake planned inspections of TBMs and to provide access for secondary lining, should secondary lining be needed.

d. CSO interception works that may typically be in the highway or other public areas in reasonable proximity to the river frontage. These existing CSOs will need to be connected in situ.

1.6.6 Further information on the above features of the project is included in the Site selection background technical paper.

1.7 Approach to site selection

1.7.1 Thames Water’s intention is to be transparent, accountable and fair in the implementation of the methodology.
1.7.2 Relevant planning policy informs the proposed approach to site selection. *Planning Policy Statement 1: Delivering Sustainable Development* (2005) (PPS1) places an emphasis on sustainable development in order to ensure a better quality of life for everyone, now and for future generations. The principles set out in PPS1 underpin Thames Water’s approach to site selection.

1.7.3 Other relevant government advice in terms of site selection is set out in *Planning Policy Statement 10: Planning for Sustainable Waste Management* (2005) (PPS10). This general waste management policy has been used as it provides clear advice on identifying suitable sites and areas and the application of locational criteria. While the worksites are not waste management sites, they are considered sufficiently similar in nature to recommend the approach taken in PPS10. It stresses that decisions on sites should be based on clear policy objectives, robust analysis of available data and information, and assessment of options. Community engagement is also important and should be proportionate to the scale of development proposed.

1.7.4 The site selection process will take into account relevant environmental, planning, engineering (‘buildability’ and ‘operability’), property (including cost), social and economic aspects to enable selection of the most suitable combination of sites along the route of the tunnel.

1.7.5 There is a relationship between the processes for site selection, engineering design and optioneering of the project. The engineering design process for the tunnel and various connections is proceeding in tandem with the site selection process. There will be an iterative relationship between these two processes.

1.7.6 The development of the project will require a comprehensive baseline of information from a wide range of data sources. Information will be collected and used throughout the site selection process. A list of initial data sources is provided in Appendix B. During the course of the site selection process, other data sources will be used, especially Environmental Impact Assessment (EIA) baseline research. Information will also be obtained from transport and utilities providers, particularly in respect of subsurface infrastructure.

1.7.7 There are three main stages to the methodology, including the planned consultation review and feedback activities. Figure 1.1 provides a broad summary of the main stages and associated activities. The subsequent sections describe in more detail what will happen at each of the three stages.
Figure 1.1 Site selection flowchart

Thames Tunnel site selection methodology
Main tunnel and CSO sites

**Preliminary stage**
- Define site requirements and areas of search
- Produce draft methodology 12-week consultation period on draft methodology
- Data collection

**Consultation, review and feedback**
- Methodology
  - Review responses and make revisions
  - Consultees to comment on revised methodology and summary of comments (28 days)
  - Send consultees final methodology

**Stage 1.**

- **Site identification, criteria and assessment**
  - Long list
    - Table 2.2
  - Draft short list
    - Table 2.3
    - Project team review workshop
    - Summary of shortlisted sites
  - Final short list
    - Site suitability reports
    - Engineering options reports
    - Project team optioneering workshops
    - Preferred scheme report
  - Preferred list

**Stage 2.**

- **Consultation on preferred list of sites**
  - 12-week consultation period
  - Stakeholder briefings
  - Exhibitions
  - Information giving

**Stage 3.**

- **Selected sites**
  - Review consultation responses and technical assessments
  - Revise and determine if any key sites may drop out then find replacement sites
  - Confirm or modify list of preferred sites to arrive at selected sites
  - Final report on site selection process
  - Monitor selected sites

- **Final list**
  - Send to consultees:
    - Notify consultees of list of selected sites and final report on site selection process and future opportunities to comment on Thames Tunnel project

**Back-checking and targeted repeat of stages 1-3 in event of material changes in circumstance and/or to find new replacement sites, if needed:**
- Identify and assess new potential replacement sites by working back through the process
- Create an updated list of preferred sites
- Carry out a targeted consultation exercise on these new sites
- Analyse consultation responses
- Incorporate any new replacement sites into selected list of sites
2 Site selection methodology: main tunnel sites

2.1 Introduction
2.1.1 This section sets out the methodology for main tunnel and intermediate sites. It reflects the three main stages of site selection, as shown in Figure 1.1.

2.2 Definition of site requirements and area of search
2.2.1 In order to establish the scope of the site selection exercise, it has been necessary to consider and establish:

- number and types of site
- site features and parameters
- search area for sites.

2.2.2 This section explains the number and types of sites (main tunnel and intermediate), the site features and parameters for each type of site, and the site search area for the main tunnel sites and intermediate sites. Section 3 of this paper sets out the equivalent context information for the CSO sites.

2.2.3 Further background and fuller descriptions of characteristics of main tunnel sites and intermediate sites, including possible indicative layouts for main tunnel sites and intermediate sites, are provided in the supporting Site selection background technical paper.

Number and type of sites
2.2.4 There are two types of sites required to enable the project to be built and operated. The site selection process will identify a combined package of suitable sites that meet the requisite criteria, are in suitable locations, are suitably spaced by reference to one another and of a suitable size. The following sites are expected to be identified:

- up to six main tunnel sites (one of which will be at Beckton STW or Abbey Mills Pumping Station), and
- up to five intermediate sites.

2.2.5 In general terms, the more TBMs used to create the tunnel, the faster the overall programme and the more sites required. Health and safety, geological and economic factors also bear on the distance between sites. A site is required to launch the TBM (ie, drop it down a shaft so it can start tunnelling). Another site is required to remove the TBM from the ground. The number of TBMs used will ultimately depend on the distances between main tunnel sites and the time available for tunnelling.

2.2.6 The requirement for intermediate sites will be informed by factors such as health and safety and whether or not there is a need for secondary lining.
2 Site selection methodology: main tunnel sites

Site features

2.2.7 Each site has its own locational characteristics, size requirements, and uses associated with construction and operational activities.

2.2.8 The size, shape, location and other characteristics of sites are dictated by the scale of the shafts they will accommodate, the activities to be carried out during the construction phase and the activities to be carried out post construction.

2.2.9 The main tunnel site shafts and intermediate site shafts are assumed to be up to 25m internal diameter, with depths ranging from 40m in west London to 75m in east London.

2.2.10 The site activities and facilities can be divided into core activities at the shaft and ancillary activities which could be located on a site away from the shaft. It is estimated that the sizes required for the sites will range from 18,000m² (15,000m² in clay) to 20,000m² for main tunnel sites and 5,000m² to 7,500m² for intermediate sites.

2.2.11 For main tunnel sites, the majority of structures, plant and equipment on site will be needed for construction purposes only and, following construction, will be removed. However, some permanent above-ground structures will remain on all main tunnel sites. Typically, these might include access covers, an air extraction/intake structure, space adjacent to the shaft footprint to accommodate mobile cranes for maintenance, and an emergency overflow culvert to the river\(^1\). There will also need to be adequate vehicular access from the highway for maintenance. Further details are provided in the Site selection background technical paper.

2.2.12 For intermediate sites, depending on the final design and operational considerations, there may be a requirement for an access manhole, ventilation structures and vehicular access. However, it is also possible that some or all intermediate sites may only be required for construction purposes and may not have any permanent above-ground facilities.

2.2.13 When assessing the suitability of sites, regard will be had to their ability to accommodate the types of permanent structures referred to above.

Search area: main tunnel sites and intermediate sites

Search area for sites

2.2.14 The boundaries of the proposed site search area for the main tunnel sites and intermediate sites are shown in Figure 2.1. The site selection process will search for sites along the whole length of the tidal River Thames from the western limit to the eastern limit at Beckton STW. For reasons set out in the Site selection background technical paper, it is anticipated that main tunnel sites and intermediate sites will be located on land. However, should it prove difficult to identify suitable land-based sites, it may be necessary to explore further the potential for siting shafts wholly or partially within or on the foreshore of the river. Regard will also be had to

\(^1\) Further design development has confirmed that emergency overflows are not required for main tunnel and intermediate sites.
the possibility of locating part of a temporary worksite (eg, workers’ welfare facilities) upon the river, where appropriate, and adjacent or close to a land-based worksite.

2.2.15 Ongoing engineering and design work may identify options for variations in the route, and it is possible that circumstances could arise which render it necessary to search for sites outside the areas of search identified in this document. Should this situation arise, Thames Water would inform all those listed in Appendix A of any proposed changes to the agreed area of search and of the reasons for the change.

Western limit

2.2.16 The proposed western limit of the search area for the main tunnel sites and intermediate sites is in the vicinity of the westernmost CSO to be intercepted by the tunnel (Acton CSO).

Eastern limit

2.2.17 The proposed eastern limit of the search area for the main tunnel sites and intermediate sites is Beckton STW because this is the point to which flows from the tunnel will be conveyed.

Northern and southern limit

2.2.18 The initial proposed extent of the width of the site search area is about 500m either side of the river, but this will be applied flexibly as this distance will depend on a variety of factors on the ground, such as the route to the riverbank, the direction the measurement is taken and specific local circumstances. The 500m will be measured from the north and south bank side and extend inland in all directions to adopt a flexible approach in implementation. If too few or no potentially suitable sites are found within these initial limits, the search area may need to be extended outwards and/or to include the river. The extension of the search area may also be required if a site is spread across two linked sites or where a site extends across the outer search area boundary. There are particular advantages to using sites closer to the river for the reasons set out in Paragraph 4.2.1 of the Site selection background technical paper, including the assumption that the majority of materials delivered to and removed from the sites will be transported by river wherever possible. Similar considerations may also apply to sites alongside or close to navigable creeks within the 500m area of search.

Excluded areas

2.2.19 The site search area is a large and all-inclusive area and, in order to make sure the search is realistic, two types of areas have been excluded after consideration of core London Plan policies:

a. London’s four World Heritage sites:
   i. Westminster Palace
   ii. Westminster Abbey and Saint Margaret’s Church
   iii. Tower of London
iv  Maritime Greenwich.

World Heritage sites are places of international importance for the conservation of mankind’s cultural and natural heritage and are designated by the World Heritage Convention established in 1972 by the United Nations Educational, Scientific and Cultural Organisation (UNESCO). (Policy 7.10 – World Heritage Sites.)

b. Existing housing within concentrated residential areas, on the basis of London Plan policies 3.15B – Loss of housing and affordable housing and 3.15C – Loss of hostels, staff accommodation and shared accommodation. These policies are designed to protect existing residential stock unless there is a planned replacement. In addition, these London Plan policies are further supported in all unitary development plans (UDPs) and emerging core strategies across London local authorities. The aim across London is to prevent the loss of existing housing stock unless replaced as part of the proposed development. As exceptions to this general rule: (a) derelict or vacant housing sites will be identified and (b) if particular sites are put forward by local authority stakeholders as being potentially suitable, they will be considered. Should it be impossible to identify potential sites without including areas of housing – which is thought unlikely – the back-checking exercise would allow Thames Water to return to this point and reconsider whether there are, in fact, potential sites within this category of land use.

2.2.20 This study will therefore use a refined site search area within the boundary limits described above.

Figure 2.1 Initial site search area: Main tunnel sites and intermediate sites
2.3 Stage 1: Site identification, considerations and assessment

2.3.1 There are three main parts to Stage 1:

- 1A – the creation of a long list of potential sites, along with an explanation of how information will be verified and moved to 1B
- 1B – the creation of a short list of potential sites, along with an explanation of how information will be verified and moved to 1C
- 1C – the creation of a preferred list of sites, along with an explanation of how information will be verified and moved to Stage 2.

2.3.2 Sites will be identified within the refined site search area shown in Figure 2.1 and excluding the areas described in paragraph 2.2.19.

2.3.3 The methodology in Stage 1 is based on a planning and environment policy approach that starts from the national level, moves to the regional (London-wide) level and works down to the local level. The aim is to use a hierarchy of policies in order to go from strategic to site-specific issues. This approach will identify potential sites and then screen out less suitable sites (in combination with other relevant factors, including engineering, property and community related considerations). By mapping potential sites, this will help clarify and move towards identifying the most suitable combination or network of sites. The aim of the site selection process is not to try to identify every piece of land within the refined search area but rather realistic site alternatives. As London is a dense, complex urban environment, most potential sites will be subject to some form of constraint or issues that may need measures to make them suitable sites for development activities.

2.3.4 The subsequent sections describe the information, considerations and assessment method that will be used for the long, short and preferred list of sites.

Part 1A – Creation of a long list of potential sites

2.3.5 The long list will be created by conducting a desktop survey of the land within the site search area (see Figure 2.1) to identify sites that may be suitable for main tunnel sites and/or intermediate sites. This exercise will be done mainly by examining aerial photographs, OS maps and atlases.

2.3.6 For the purpose of this paper, ‘a site’ is generally defined as an area for which boundaries can be readily distinguished and defined.

2.3.7 Sites should potentially be capable of being used during construction of the main tunnel and for post construction operational activities. In order to determine whether a site should be included on the long list, a professional judgement will be made to determine whether it is potentially large enough to accommodate either a main tunnel site or intermediate site on either one single site or more than one linked site (it is unlikely that more than two sites would be linked, but this should not be discounted). Regard will also be had to potential river linkages and, to that end,
Thames Water will give preference to the use of the river for transport of materials wherever possible.  

2.3.8 Identified areas of land will be included in the long list of sites and plotted on a GIS map. Identification of these sites should only be taken to mean that a site may meet physical site requirements and a more detailed assessment of its suitability will be carried out.

2.3.9 When determining whether sites should be included on the long list, a combination of factors will be taken into account. For example, if a site is not located next to the river but is within the 500 metres search area (or even just outside the search area), it may be included if it can readily be linked to a site near the river. By starting with the basic suitability of the site, this approach allows for a large search area to be rapidly assessed and a different combination of local factors to be considered in order to create a realistic long list of sites.

2.3.10 However, if relatively few sites are suitable for inclusion on the long list, it may be necessary to widen the initial 500 metres from the northern and southern riverbank further inland.

2.3.11 The long list will be published as part of the final site selection report and will also be discussed with stakeholder consultees at the stage of consultation on the short list.

**Part 1B – Creation of a short list of potential sites**

2.3.12 Part 1B explains how the move from the long list to the short list of potential sites will be made. There are four steps that are described in subsequent paragraphs and can be summarised as follows:

- collect data on longlisted sites.
- assess longlisted sites against set considerations and values that reflect planning/environment, engineering criteria and other material considerations (see Table 2.2), then identify sites that move from the long list to the draft short list.
- create a draft short list of potential sites and assess against criteria in Table 2.3, prepare pre-workshop reports, hold optioneering workshops, hold meetings and verify sites with relevant London local planning authorities and other stakeholders, and consider responses.
- create a final short list of potential sites and provide feedback to relevant London local planning authorities and other stakeholders.

**Data collection**

2.3.13 In order to assess and differentiate between potential sites on the long list, relevant information will be collected about longlisted sites. This information will be used to determine which sites are shortlisted.
Criteria and assessment of longlisted sites to produce a draft short list

2.3.14 The potential sites on the long list will be assessed against the criteria in Table 2.2 and policy information used to inform this assessment. Table 2.2 is intended to allow a preliminary ‘high’ level of assessment sufficient to determine which sites move from the long list to the draft short list. Table 2.3 is intended to allow for a more detailed assessment of similar factors when assessing the draft short list.

2.3.15 Table 2.2 allows for an initial assessment of each longlisted site against considerations. Acceptability of each site will be determined as red, amber or green for each criterion. By way of an example, if a site is subject to a national designation, which would suggest a site to be unlikely to be suitable in planning terms, a value would be given as red. Similarly, if a site were considered likely to be heavily constrained in engineering terms, a value would be given as red. Inconsistency with regional/local designations may be more capable of being outweighed by other factors, so a value would be given as amber. When no planning or environment designations apply to a site that would conflict with its use as a worksite, or no significant engineering constraints apply to a site, the value would be given against the relevant assessment category as green. Naturally, if a site was shortlisted, a more detailed site investigation at Part 1C may cause the need to reappraise these initial conclusions.

2.3.16 The results of this assessment will be evaluated and professional judgement, informed by inputs from emerging engineering and design requirements, will be used to determine which sites move from the long list to the draft short list. Sites will be compared as a whole, and those that perform best in relative terms and that are least constrained will be selected. If a site is awarded a red value, this will not necessarily prevent a site proceeding to the next stage of assessment if, in overall terms, it performs better than other sites.

### Table 2.2 Long list of sites: Assessment considerations and indicative values

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Indicative values</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Engineering</strong></td>
<td></td>
</tr>
<tr>
<td>Site size</td>
<td>Size or shape likely to prevent use of site</td>
</tr>
<tr>
<td></td>
<td>Smaller than desired, but potential as a linked site</td>
</tr>
<tr>
<td></td>
<td>and/or shape not ideal</td>
</tr>
<tr>
<td></td>
<td>Acceptable size, suitable shape</td>
</tr>
<tr>
<td>Site features</td>
<td>Site features have potential to prohibit development of site.</td>
</tr>
<tr>
<td></td>
<td>Will require compromise/mitigation in order to be workable</td>
</tr>
<tr>
<td></td>
<td>No or limited constraints.</td>
</tr>
</tbody>
</table>
## Site selection methodology: main tunnel sites

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Indicative values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability of jetty/wharf facilities and distance to river</td>
<td>Unlikely to be possible to access jetty/wharf facilities, or to create jetty/wharf and/or distance/route between construction site and river (and any jetty/wharf or potential jetty/wharf) is particularly lengthy or significantly constrained</td>
</tr>
<tr>
<td>Means of access</td>
<td>Significant difficulties achieving road or rail access</td>
</tr>
<tr>
<td><strong>Planning and environment</strong></td>
<td></td>
</tr>
<tr>
<td>Heritage designation</td>
<td>National</td>
</tr>
<tr>
<td>Landscape/Townscape</td>
<td>National</td>
</tr>
<tr>
<td>Open space</td>
<td>National</td>
</tr>
<tr>
<td>Ecological designation</td>
<td>National</td>
</tr>
<tr>
<td><strong>Community and property</strong></td>
<td></td>
</tr>
<tr>
<td>Neighbouring land uses</td>
<td>Nature of surrounding land use likely to preclude development</td>
</tr>
</tbody>
</table>
### Assessment of draft short list

2.3.17 An assessment of all draft shortlisted sites will then be made by using the considerations in Table 2.3. These considerations are intended to assist each discipline in reaching a conclusion on a particular site. The Table 2.3 assessment will also use and build upon the information collected for and assessment undertaken at Table 2.2. The focus at Table 2.3 will be upon more detailed local considerations. Further discussions will be held with relevant London local authorities and agencies to obtain and utilise information required for Table 2.3. At this stage, it is considered appropriate to judge each site against relevant factors for each of the following disciplines:

- Engineering
- Planning and environment
- Property, and
- Community.
Table 2.3 Draft short list of sites: Assessment

<table>
<thead>
<tr>
<th>Assessment table of draft shortlisted sites: List of considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Engineering</strong></td>
</tr>
<tr>
<td><strong>Site size</strong></td>
</tr>
<tr>
<td>• Main tunnel site or intermediate site</td>
</tr>
<tr>
<td>• General dimensions – ie, square, rectangle, etc</td>
</tr>
<tr>
<td><strong>Distance and route to river</strong></td>
</tr>
<tr>
<td>• Detailed consideration</td>
</tr>
<tr>
<td><strong>Jetty/wharfage facilities</strong></td>
</tr>
<tr>
<td>• Facilities available</td>
</tr>
<tr>
<td>• Facilities can be created</td>
</tr>
<tr>
<td><strong>Means of road/rail access</strong></td>
</tr>
<tr>
<td>• Availability of rail connection/practicability of accessing rail connection</td>
</tr>
<tr>
<td>• Suitability of road links to site and river</td>
</tr>
<tr>
<td>• Availability of any other means of access</td>
</tr>
<tr>
<td>• Worker transport considerations</td>
</tr>
<tr>
<td><strong>Site features</strong></td>
</tr>
<tr>
<td>• Above- and below-ground conditions (including third-party assets)</td>
</tr>
<tr>
<td>• Geology</td>
</tr>
<tr>
<td>• Site levels</td>
</tr>
<tr>
<td>• Other considerations</td>
</tr>
<tr>
<td><strong>Site efficiency</strong></td>
</tr>
<tr>
<td>Ability to accommodate all requirements on one site and, if not, describe how facilities can be achieved via a combination of sites.</td>
</tr>
<tr>
<td><strong>Tunnelling and system engineering requirements</strong></td>
</tr>
<tr>
<td>Ability to be compatible with likely system and tunnelling requirements in the vicinity of the site.</td>
</tr>
<tr>
<td><strong>Planning and environment</strong></td>
</tr>
<tr>
<td><strong>Planning applications/permissions</strong></td>
</tr>
<tr>
<td>• Application expected</td>
</tr>
<tr>
<td>• Awaited determination</td>
</tr>
<tr>
<td>• Unimplemented</td>
</tr>
</tbody>
</table>
### Assessment table of draft shortlisted sites: List of considerations

<table>
<thead>
<tr>
<th><strong>London Plan/UDP/LDF allocation or special policy areas</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Specific land use</td>
<td></td>
</tr>
<tr>
<td>• Specific planning objective</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Heritage designations</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Archaeology priority areas</td>
<td></td>
</tr>
<tr>
<td>• Scheduled ancient monuments</td>
<td></td>
</tr>
<tr>
<td>• Historic parks and gardens</td>
<td></td>
</tr>
<tr>
<td>• Conservation areas</td>
<td></td>
</tr>
<tr>
<td>• Listed buildings</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Landscape/Open space designations</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Public open space</td>
<td></td>
</tr>
<tr>
<td>• Metropolitan Open Land (MOL)</td>
<td></td>
</tr>
<tr>
<td>• Other landscape/open space designations</td>
<td></td>
</tr>
<tr>
<td>• Informal/undesignated open space</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Ecological designation</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• SSSI</td>
<td></td>
</tr>
<tr>
<td>• Nature conservation/reserve designations</td>
<td></td>
</tr>
<tr>
<td>• Tree preservation orders</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Transport</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Rights of way</td>
<td></td>
</tr>
<tr>
<td>• Other key transport routes</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Amenity</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Neighbouring land uses and amenity considerations</td>
<td></td>
</tr>
<tr>
<td>• Sensitivity to noise, dust and other construction effects</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Property</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ownership of site</td>
<td></td>
</tr>
<tr>
<td>Tenant on site</td>
<td></td>
</tr>
<tr>
<td>Estimated acquisition cost</td>
<td></td>
</tr>
<tr>
<td>Crown land and special land</td>
<td></td>
</tr>
<tr>
<td>Access and material transfer rights</td>
<td></td>
</tr>
</tbody>
</table>
### Assessment table of draft shortlisted sites: List of considerations

<table>
<thead>
<tr>
<th>Community</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Proximity to sensitive receptors</td>
<td></td>
</tr>
<tr>
<td>Social considerations</td>
<td></td>
</tr>
<tr>
<td>Economic considerations</td>
<td></td>
</tr>
<tr>
<td>Health considerations</td>
<td></td>
</tr>
<tr>
<td>Equality considerations</td>
<td></td>
</tr>
</tbody>
</table>

**NB.** This list of considerations is not intended to be exhaustive at this stage. If other relevant factors are identified, they will also be used for assessment purposes.

#### 2.3.18 After Table 2.3 has been completed, the Thames Tunnel team (including members of all relevant disciplines) will evaluate all those sites listed and consider the results of this assessment. The project team will use technical knowledge and professional judgement, as appropriate, to evaluate these sites. Reports will be prepared and include sections on the following areas and relevant factors within each area:

- Engineering
- Planning and environment
- Property, and
- Community.

### Consideration and analysis

#### 2.3.19 After reports have been considered, a project team workshop (attended by project managers and all relevant specialists) will be held to evaluate both main tunnel sites and intermediate sites, and will need to consider which sites should be confirmed as on the final short list for each type of site. Regard will also be given to the potential combinations of sites, co-location of sites and spatial distribution across the length of the tunnel route, and their potential use as either a main tunnel site and/or intermediate site.

#### 2.3.20 At the project team workshop, each draft shortlisted site will be discussed in turn, and each discipline representative will comment on the site with regard to that particular discipline, having regard to all relevant material considerations. The project team will reach agreement at the workshop in order to categorise each site, as follows:

- site potentially suitable – remains on short list
- site unsuitable – delete from short list.

#### 2.3.21 It is intended that sufficient preparatory work will be completed by all parties prior to the workshop to ensure that informed, balanced judgements on the likely acceptability of sites can be taken. However, should new issues or additional concerns arise during the course of the workshop which merit additional research/assessment, the workshop will
be suspended and reconvened at a future date when the required information/assessment is available.

2.3.22 The project team workshop will be minuted and the output will be used to supplement the reports produced to precede the workshops. A summary report will be provided which sets out the shortlisted sites and provides an overview of reasons for their inclusion (and a summary of longlisted and draft shortlisted sites that did not make the final short list, and reasons for their exclusion).

**Review of shortlisted sites**

2.3.23 The contents of the shortlisted sites report referred to at Paragraph 2.3.22 above will be the subject of a meeting with officers at relevant London local authorities and statutory and other stakeholders, so they can verify there are no specific sites or general site location factors that have been overlooked in the assessment of the draft shortlisted sites. It is proposed that this consultation is undertaken on a confidential basis because of the potential for undue anxiety and potential blight within the local community. This is in accordance with the recommended approach within the Government’s 1999 *Code of Practice on the Dissemination of Information*.

2.3.24 London local authorities and statutory and other stakeholders will be asked at a meeting to feed back any comments on shortlisted sites. All comments received will be analysed by the Thames Tunnel project team.

2.3.25 The final shortlisted sites report will be reviewed and consideration will be given to consultation comments. A report will be produced which summarises the consultation comments (made both generally and in relation to particular sites) and will make recommendations concerning changes or rejection of changes to the short list of sites.

**Final short list of sites**

2.3.26 The Thames Tunnel project team will review the revised final shortlisted sites report and consider any new technical information in arriving at the final short list of sites. At this stage, regard will also be had to whether it is necessary to extend the area of search outwards and/or to include the river, as described in Paragraph 2.2.13.

**Part 1C – Creation of the preferred list of sites**

2.3.27 The sites on the final short list emerging from Part 1B will be investigated to identify the final preferred list of sites. This process will involve the following activities for each site on the short list, with contributions from engineering, planning, environment, property and community specialists:

- formulation, review and update of site investigation data
- assessing sites against all relevant planning and environment policies, *London Plan* policies, policies in London borough planning documents (eg, saved UDP policies, LDF documents and any other site specific planning policy documents) and all other information on the site investigation summary form
• producing a site suitability report for each site, including inputs from all disciplines (engineering, planning and environmental, property and community), technical investigations and site surveys. This should include physical inspections and surveys of sites wherever practicable, and an intermediate level assessment of what the likely significant environmental effects would be of operating the site for the estimated construction duration
• producing an engineering options report which will consider how sites work in combination, and options for main tunnel alignment and CSO connections
• optioneering workshops
• optional peer review of preferred sites and then consultation on these sites as set out in Stage 3 below.

2.3.28 All of the above factors will be recorded and incorporated into the final preferred scheme report.

Site suitability and reports

2.3.29 Detailed site level data will be collected at this stage. Site studies and investigations will specifically address themselves towards planning, environmental, engineering, operational, property and/or any other specialist discipline that may relate to an individual site. This data will be used to assess sites.

2.3.30 All the detailed site level data will be confirmed, reviewed and assessed by the Thames Tunnel project team, using professional judgement and experience of other similar tunnelling and large infrastructure projects.

2.3.31 A site suitability report will be produced to a set template that will generally reflect the following considerations:

• review of relevant site specific national, London-wide and local planning policies, including impact on planning and environmental designations, plus results of any site surveys

• engineering, geotechnical, groundwater and technical matters that impact on a site’s ability to host required on-site activities, ‘buildability’ and ‘operability’

• technical assessment of how well the site may fit in with tunnel design options, and ensuring combinations of sites spread across the length of the tunnel route provide a reasonable spatial distribution of sites that will best assist with the construction of the tunnel, operation and maintenance

• environmental, social and community issues and impacts associated with the use of the site (and required mitigation measures) during the construction period, and potential restoration and after-uses for the site

• other proposed projects in the locality and potential for cumulative effects, also potential for site sharing with other construction projects
2 Site selection methodology: main tunnel sites

- sites are practical and capable of being granted planning permission, with reasonable and necessary conditions and obligations
- restoration and after-use of site
- sites can reasonably fit in with the overall construction programme
- property (including site acquisition), services and operational matters
- time, cost and economic matters.

2.3.32 An engineering options report will also be produced. Selection of the preferred sites from the final short list will proceed in tandem with refining design options for the Thames Tunnel itself. Options for tunnel alignment and CSO connection points will be refined, having regard to the availability and spacing of suitable sites, as well as to the potential for combined use of sites. Cost considerations associated with engineering options, transport and energy will be reported, balanced and taken into account.

Optioneering workshops

2.3.33 These project team workshops will consider and focus on the detailed contents of the site suitability report for each shortlisted site and the engineering options report referred to above. Following the workshop, a preferred scheme report will be prepared to supplement the reports preceding the workshop. The preferred scheme report will make final recommendations to Thames Water as to the list of preferred sites.

2.3.34 The final preferred list of sites, along with the preferred scheme, will be consulted on in Stage 2.

2.4 Stage 2: Engagement on preferred list of sites

2.4.1 There are six parts to Stage 2:
- 2A – Pre-consultation period activities
- 2B – 12 week consultation period (extended to 18 weeks for first phase of consultation)
- 2C – Consultation activities: briefing sessions
- 2D – Consultation activities: exhibitions
- 2E – Review and assessment of all consultation responses
- 2F – Feedback to consultees and consultation report.

2.4.2 This stage applies to all the preferred sites that will be identified: main tunnel sites, intermediate sites and CSO sites. As described below in paragraphs 2.4.13 to 2.4.15, a second phase of formal consultation will be undertaken after the responses to the first phase of consultation have been taken into account. **It is important to stress that this methodology outlines consultation activities as they relate to the site selection process. Thames Water will, of course, engage regularly with all potentially affected London local authorities and other stakeholders in the period leading to submission of applications for consent for the project and beyond.** A ‘community consultation
strategy’ and ‘statement of community consultation’ have been prepared, which outline Thames Water’s proposals for consulting on proposed application(s).

**Part 2A – Pre-consultation period activities**

2.4.3 A comprehensive programme of community and stakeholder consultation activities will support the site selection process to ensure all relevant parties are effectively engaged. This programme will maximise the opportunities for interested parties to engage and provide feedback on the sites initially identified as preferred sites and other shortlisted sites. The programme will utilise a range of activities to engage with the various community and stakeholder audiences from an early stage in the identification of the preferred sites. For example, leaflets, flyers and newsletters will be distributed to all communities living in the immediate vicinity of all the preferred sites and shortlisted sites. Good use will also be made of local media.

**Part 2B – 12 week consultation period**

2.4.4 The consultation period on the preferred sites will last for 12 weeks (extended to 18 weeks for the first phase of consultation). Widespread notification and publicity about the consultation period will be given to statutory consultees and local communities near to any preferred sites before and during the consultation period.

**Part 2C – Consultation activities: briefing sessions**

2.4.5 Once the preferred sites have been identified, an initial series of briefing sessions will be held with main local stakeholders in each of the local authorities where preferred sites have been identified. These sessions aim to kick-start the engagement process in these neighbourhoods.

2.4.6 It is envisaged that local ward councillors, local MPs, community leaders and other influential people in the community will be invited to a briefing session on the project. Those to be invited will be agreed with the local planning authorities and other relevant statutory consultees.

**Part 2D – Consultation activities: exhibitions**

2.4.7 Following these briefings, public exhibitions will be organised in each of the local authorities to engage directly with the local communities, groups and people living and working in the areas potentially affected. These exhibitions will be designed to provide information on the overall purpose of the project and use of the sites, and to allow the gathering of opinions and comments from the communities and their stakeholders.

2.4.8 The exhibitions will take the form of events at which information is presented on a series of display boards. The events will be staffed by members of the Thames Tunnel project team and its consultants, so that questions can be answered and information on the display boards may be explained in more detail where required. The exhibition will be publicised to the relevant local communities via the press and local sources.
2.4.9 The events will be located as close as possible to the selected sites, so as to make it as easy as possible for the communities likely to be most directly affected to attend. The events should be open from the morning into the evening to allow people to fit in a visit around their other home and work commitments. A range of methods will be used to capture comments, such as traditional comment forms, a graffiti wall, flip charts, and acetate sheets on top of boards and plans.

2.4.10 It is likely that the display boards will cover the following elements:

- an introduction to the Thames Tunnel project
- history of the project’s evolution to-date
- rationale, need and benefits of the tunnel
- explanation of the types of sites and their features
- details of the site selection methodology and process which has been used to generate the list of all the preferred sites – plan showing all sites
- overview of the other sites considered and reasons for their non-selection
- a separate board for CSOs, giving an overview of the site options and reasons for the selection of the site in the area
- deadline to make comments, and programme for the next steps with the sites and the project
- details and timings of future opportunities to engage with local communities and other stakeholders.

Part 2E – Review and analysis of consultation responses

2.4.11 All consultation responses received will be reviewed and analysed from all sources. A summary table will be created that will include:

- a unique reference for each consultee
- how many people made each particular comment
- a summary of substantive comments
- a response to substantive comments
- recommended changes to the list of preferred sites.

Part 2F – Feedback to consultees and consultation report

2.4.12 Should it become apparent, as a result of feedback, that further work is required to confirm the choice of sites, the report on all the consultation responses will provide recommendations as to where this is considered appropriate. The report may also identify potential mitigation measures to address comments made by the local community and/or local planning authority and other stakeholders. The consultation results and report will be fed into Stage 3 in order for Thames Water to come to a conclusion on the final network of sites.
Phase two consultation

2.4.13 Since publication of the original Site selection methodology paper, the Government has announced that it intends to bring the Thames Tunnel within the procedures for nationally significant infrastructure projects (NSIPs) established by the Planning Act 2008. Consequently, Thames Water is proceeding on the basis that a single application for a development consent order will be submitted in due course to the Infrastructure Planning Commission (IPC) (or its successor body) under the Planning Act 2008. During this period, information and guidance has been issued on the pre-application consultation requirements of the Planning Act 2008.

2.4.14 In order to reflect the guidance on the pre-application consultation requirements of the Planning Act 2008, and to ensure that consultees have an opportunity to participate early when options are still being considered (and, where possible, influence the scheme), Thames Water decided that a two-phased consultation would be appropriate.

2.4.15 Phase two consultation will follow broadly the approach set out in paragraphs 2.4.7 to 2.4.10 above, with a series of staffed exhibitions held at venues as close as possible to the preferred sites. Further details of our approach to consultation are set out in our Community consultation strategy and Statement of community consultation.

2.5 Stage 3: Selection of sites

2.5.1 There are five parts to Stage 3:

- 3A – revisions to the preferred list of sites
- 3B – ‘back-check’ repeat of stages 1-3, in the event of significant changes of circumstances in relation to existing sites or combinations of sites, if new or replacement sites are required or found, or if the engineering design develops in unexpected ways
- 3C – agreed final network of sites for scheme
- 3D – final report on site (and scheme) selection process
- 3E – future programme for all final sites.

2.5.2 Parts 3A and 3B of this stage of work will be undertaken following the first phase of consultation and repeated following the second phase of consultation.

2.5.3 Selection of the list of sites will involve a mixture of considerations from a variety of viewpoints including, but not limited to: consultation responses, engineering, planning, environment, property, community, operational and maintenance.

Part 3A – Revisions to preferred list of sites (if necessary)

2.5.4 In addition to the consultation responses and report produced at the end of each phase of consultation within Stage 2, there may be new technical information that could emerge about individual sites. The source of this information may be from further detailed site studies and investigations,
engineering limitations or design of the tunnel itself, as this process will be running in tandem to the site selection process. All of these, and other factors, may create a need for further revisions to the list of sites required to assist the construction of the Thames Tunnel.

2.5.5 Any changes that are needed to any sites will be recorded and reported upon in the final site selection report.

**Part 3B – ‘Back-check’ repeat of stages 1-3, if new replacement sites are needed**

2.5.6 If any of the main tunnel sites or intermediate sites (or CSO sites) are eliminated for any reason, if there are significant changes of circumstances in relation to existing sites or combinations of sites, if new or replacement sites are required or found, or if the engineering design develops in unexpected ways, a targeted repeat of stages 1-3 will need to be undertaken in order to fill in any site gaps. This will mean a reinvestigation of specific areas in order to:

- identify and assess new potential replacement sites (ie, using the methods outlined in Stage 1)
- review the continuing suitability of the remaining selected sites, having regard to the availability of replacements for the site to be replaced
- create an updated list of preferred sites
- carry out a targeted consultation exercise on these new sites
- analyse the consultation responses, and
- incorporate any new replacement sites into the selected list of sites.

2.5.7 The repeated targeted consultation will ensure relevant local communities are aware of any changes to sites prior to the list being finalised. Feedback will be given to these consultees.

**Part 3C – Selected network of sites**

2.5.8 The sites ultimately selected will make up a network of sites for construction of the tunnel (including delivery and removal of material by barge where possible), future operation of the tunnel, CSO connections and future maintenance inspections.

2.5.9 In order to arrive at a confirmed final list of sites, the factors listed at Paragraph 2.3.31 (engineering, etc) will be reconsidered in relation to each of the sites proposed for selection.

**Part 3D – Final report on site selection process**

2.5.10 A final report that outlines and explains the whole site selection process will be produced along with all background reports, such as the responses from the consultation on the methodology, and any Stage 2 reports about the design of tunnel and other associated works, site studies and investigations. This report will include details of the back-check exercise undertaken as part of the site selection process.
2.5.11 A letter will be sent to all consultees with the final list of sites, how to access the final site selection report and supporting background reports, and how and when there will be future opportunities to comment on this project and sites.

2.5.12 Consultees will be given an opportunity to raise any queries, provide more up-to-date information on sites or suggest corrections/changes.

2.5.13 It is expected that this activity will take place as part of the formal publicity under Section 48 of the Planning Act 2008 on the proposed application, prior to formal submission.

**Part 3E – Future programme for sites and the project**

2.5.14 The final agreed list of construction sites will be given to the engineering team so that it can draw up detailed plans and designs for each site. The sites will then be integrated into the overall tunnel construction programme. The selected sites will be kept under review to ensure that a change in circumstances has not affected their suitability.

2.5.15 All selected sites will be subject to an application for consent to deliver the Thames Tunnel, including any necessary EIA.

2.5.16 The Government has announced its intention to bring the project within the procedures for NSIPs and, consequently, an application for a development consent order will be made in due course to the IPC (or its successor body) under the Planning Act 2008. Ongoing discussions on the associated requirements of the identified route to consent will continue to be held with all affected London planning authorities and statutory consultees, as well as the IPC.

2.5.17 Site specific codes of construction practice will be prepared in due course for each construction site and shared with local authorities and other key stakeholders. These will be based on a scheme-wide generic code of construction practice.
3 Site selection methodology: CSO sites

3.1 CSO introduction

3.1.1 In addition to the sites discussed in Section 2 of this paper, up to 34 existing CSOs will need to be intercepted and connected to the main tunnel. It may be possible to amalgamate the interception of CSOs when they are in close proximity to each other. If main tunnel sites or intermediate sites are identified adjacent to any of the existing 34 CSOs, the CSO interception works will be carried out within a single combined site area.

3.1.2 The site selection process for CSO sites is similar to the process for main tunnel sites and intermediate sites. It is referred to separately here to draw attention to certain differences in emphasis and approach.

3.1.3 Explanation of the characteristics of CSOs is provided in the Site selection background technical paper, including diagrams of interceptions and illustrative site layouts.

3.1.4 A CSO needs to be intercepted along the line of existing sewers that flow into the tidal River Thames. In some cases, this may mean sites may be located in the highway. A different approach is needed for CSOs as the sites are fixed, smaller and present fewer options. Therefore, the methodology for CSOs follows a much more localised optioneering approach.

3.2 CSO site selection context

3.2.1 There are two main areas defined in relation to site selection context:

- CSO site features
- CSO locations and search area.

CSO site features

3.2.2 At this stage in the design process, the CSO site areas are expected to vary in size, depending on factors such as geology or engineering requirements. The range of sizes required reflects differences in location, and nature of underground sewer assets and means of connecting them to the main tunnel. The interception of CSOs will typically be achieved by the provision of an interception chamber, a connection culvert, a drop shaft and a connection tunnel (see the Site selection background technical paper for further explanation of figures and terms used in this section).

CSO locations and search area

3.2.3 The Site selection background technical paper identifies the 34 CSOs originally proposed to be intercepted by the project.

3.2.4 The search area for CSO sites will be much more localised than the search area described above for the main tunnel sites and intermediate sites.
3.2.5 It is anticipated that the search area for CSO sites will vary with each CSO as it will depend on the sewer network of each existing combined sewer, upstream of its current overflow structure. Therefore, it is not possible to define a universally applicable site search area besides saying the CSO sites will be as close to the existing line of the sewer as practicable, after allowing for the availability of suitable sites in the vicinity, and the search area may include the river. For each CSO, the area within which the construction site could be located will be defined within a written report, with a section devoted to each individual CSO (as a first stage in the process of searching for CSO sites), and sub-options within that area identified as appropriate. This will result in a list of potential sites at each CSO location.

3.3 Stages 1-3: Assessment of shortlisted CSO sites, identification of preferred sites, consultation and confirmation of selected sites

3.3.1 The assessment of the CSO sites will broadly follow the methodology for main tunnel sites and intermediate sites from Part 1A through 1C to Stage 3 (as described in paragraphs 2.3.5 - 2.5.15 above). The selection of CSO sites will take place in tandem with those stages of the site selection process and with the evolution of engineering and technical requirements for dealing with CSOs. This will result in a selected list of CSO sites at the same time as main tunnel sites and intermediate sites and a selected scheme.

3.3.2 Due to the differences between CSO sites and main tunnel sites and intermediate sites, the site selection process for CSO sites will, where appropriate, be subject to some amendments to take account of these differences. These amendments will include:

- an additional criterion will be added to Table 2.2 entitled ‘Location (proximity to sewer to be intercepted)’, and
- an additional criterion will be added to Table 2.3 entitled ‘Connection feasibility’.

3.3.3 The purpose of CSO sites is to enable efficient interception of existing sewerage infrastructure, and the complexity of doing so may vary according to the point at which interception is effected. It is for this reason that proximity to the sewer to be intercepted is added to Table 2.2 and connection feasibility is added to Table 2.3. For many CSO sites, the volumes of materials to be imported and exported are likely to be low. Consequently, although the Table 2.2 and 2.3 considerations of proximity to river and availability of jetty/wharfage facilities remain relevant for some CSO sites, they will be less relevant than for others.
Appendix A – List of consultees

A.1 Potentially affected planning authorities

- The City of London Corporation
- London Borough of Ealing
- London Borough of Greenwich
- London Borough of Hammersmith & Fulham
- London Borough of Hounslow
- Royal Borough of Kensington and Chelsea
- London Borough of Lambeth
- London Borough of Lewisham
- London Borough of Newham
- London Borough of Richmond upon Thames
- London Borough of Southwark
- London Borough of Tower Hamlets
- London Borough of Wandsworth
- City of Westminster
- London Thames Gateway Development Corporation
- Olympic Delivery Authority

A.2 Neighbouring planning authorities

- London Borough of Barking and Dagenham
- London Borough of Bexley
- London Borough of Brent
- London Borough of Bromley
- London Borough of Camden
- London Borough of Croydon
- London Borough of Hackney
- London Borough of Hillingdon
- London Borough of Islington
- London Borough of Kingston Upon Thames
- London Borough of Merton
Appendix A – List of consultees

- London Borough of Waltham Forest
- Elmbridge Borough Council
- Spelthorne Borough Council
- Surrey County Council
- Hertfordshire County Council
- Buckinghamshire County Council
- Essex County Council
- Epsom & Ewell Borough Council
- Mole Valley District Council
- Reigate & Banstead Borough Council
- London Borough of Sutton
- Tandridge District Council
- Sevenoaks District Council
- Dartford Borough Council
- Three Rivers District Council
- South Bucks District Council
- Slough Borough Council
- London Borough of Barnet
- Enfield Council
- Broxbourne Borough Council
- Welwyn Hatfield District Council
- Hertsmere Borough Council
- Thurrock Borough Council
- Epping Forest District Council
- Kent County Council
- London Borough of Haringey

A.3 Strategic pan-London stakeholders

- Department of Communities and Local Government
- Mayor of London
- Greater London Authority
- London Development Agency
- Transport for London
Appendix A – List of consultees

- ‘London Councils’
- Environment Agency
- English Heritage
- Natural England
- Sport England
- Port of London Authority
- Crown Estate
- Port Health Authority
- Network Rail
- Metropolitan and City of London Police
- BT Group Plc
- UK Power Networks (formerly EDF Energy Plc)
- National Grid
- British Waterways Board
- London Fire Brigade
- Strategic Health Authority for London
- Health and Safety Executive
- The Commission for Sustainable Development
- The Equality and Human Rights Commission
Appendix B – Initial list of data sources

a. Port of London Authority Information on existing wharf and jetty facilities on the tidal River Thames
b. National planning policy statements and relevant papers, eg, PPS1 (2005) and Defra’s *Future of Water*
c. Office for National Statistics
d. The *London Plan* (Feb 2008 and July 2011) – relevant policies, specific designated areas, views and protected areas
e. The Mayor’s Office adopted supplementary planning documents/guidance (SPD/SPGs) and action area plans (AAPs)
f. Relevant local development documents (LDDs), saved sections of unitary development plans (UDPs), London borough supplementary planning documents/guidance (SPD/SPGs) and action area plans (AAPs) – relevant policies, specific designated areas, protected views and local areas
g. English Heritage records for scheduled ancient monuments and listed buildings plus London Archaeological Archive and Research Centre (LAARC)
h. Natural England records on international, national, local designations
i. Environment Agency maps on flooding and watercourses
j. National Land Use Database (NLUD)
k. Aerial photographs (Thames Tunnel Project)
l. 1:25,000 and 1:10,000 Ordnance Survey sheets
m. *Greater London Street Atlas*

n. One of the main starting points for the collection of relevant data will be the policies in the *London Plan* and relevant London borough UDPs. Most plans are under review and UDPs will be replaced LDDs, so the various subsequent draft plans will also be consulted, but only adopted development plan documents will be taken into account. A visual search of aerial photographs will be undertaken.

o. The Proposals maps, Ordnance Survey maps and the *Greater London Street Atlas* will be used to check addresses, grid references, site areas and site access points. All subsequent sites identified will be plotted on an OS base using GIS.

p. In parallel, all affected London local authorities, LTGDC and, if necessary, ODA will be contacted to obtain up-to-date lists of vacant and underused land and property. The NLUD database will also be used to help identify any potential sites. Information from different data sources will be cross-checked to try to ensure all potential sites have been picked up. In the process of collecting information, other sources may come to light and be used, especially from the EIA baseline research.
Appendix C – References


Site selection background technical paper

Phase two consultation
# Thames Tunnel

## Site selection background technical paper

### List of contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page number</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong> Background</td>
<td>1</td>
</tr>
<tr>
<td>1.1 Purpose</td>
<td>1</td>
</tr>
<tr>
<td>1.2 History</td>
<td>1</td>
</tr>
<tr>
<td>1.3 The combined sewer overflows</td>
<td>2</td>
</tr>
<tr>
<td>1.4 The proposed solution</td>
<td>3</td>
</tr>
<tr>
<td>1.5 Need</td>
<td>3</td>
</tr>
<tr>
<td>1.6 Stages of the Thames Tunnel project</td>
<td>6</td>
</tr>
<tr>
<td>1.7 Structure of this document</td>
<td>6</td>
</tr>
<tr>
<td><strong>2</strong> Scope of the project</td>
<td>7</td>
</tr>
<tr>
<td>2.1 Concept</td>
<td>7</td>
</tr>
<tr>
<td>2.2 CSO discharge control</td>
<td>7</td>
</tr>
<tr>
<td>2.3 Storage, transfer and treatment of CSO discharges</td>
<td>10</td>
</tr>
<tr>
<td>2.4 Type of sites required</td>
<td>13</td>
</tr>
<tr>
<td><strong>3</strong> Combined sewer overflows</td>
<td>14</td>
</tr>
<tr>
<td>3.1 Components – CSO interception</td>
<td>14</td>
</tr>
<tr>
<td>3.2 Components – local modifications</td>
<td>17</td>
</tr>
<tr>
<td>3.3 CSO Sites – construction phase</td>
<td>19</td>
</tr>
<tr>
<td>3.4 CSO Sites – operational phase</td>
<td>23</td>
</tr>
<tr>
<td><strong>4</strong> Tunnels</td>
<td>26</td>
</tr>
<tr>
<td>4.1 Main tunnel components</td>
<td>26</td>
</tr>
<tr>
<td>4.2 Main tunnel</td>
<td>30</td>
</tr>
<tr>
<td>4.3 CSO connection tunnel</td>
<td>33</td>
</tr>
<tr>
<td>4.4 Main tunnel drive sites – construction phase</td>
<td>33</td>
</tr>
<tr>
<td>4.5 Main tunnel sites – operational phase</td>
<td>40</td>
</tr>
<tr>
<td>4.6 Main tunnel reception sites – construction phase</td>
<td>41</td>
</tr>
<tr>
<td>4.7 Main tunnel intermediate sites – construction phase</td>
<td>43</td>
</tr>
<tr>
<td>4.8 Change in site selection nomenclature</td>
<td>46</td>
</tr>
</tbody>
</table>
List of figures

Figure 1.1 Catchment areas draining to Mogden, Beckton and Crossness sewage treatment works................................................................. 2
Figure 1.2 CSOs to be controlled by the Thames Tunnel project................................. 3
Figure 2.1 Routes considered.............................................................................. 12
Figure 3.1 Isometric view of CSO interception arrangements................................. 14
Figure 3.2 Example of a CSO site layout, site area 1,500m².................................... 23
Figure 4.1 EPB TBM diagram............................................................................ 32
Figure 4.2 Slurry TBM diagram........................................................................ 32
Figure 4.3 Main tunnel drive site for a slurry TBM, site area 20,000m²................. 38
Figure 4.4 Main tunnel drive site for an EPB TBM, site area 18,000m².............. 39
Figure 4.5 Main tunnel reception site, site area 7,500m²..................................... 43
Figure 4.6 Main tunnel reception site, site area 5,000m²..................................... 43
Figure 4.7 Main tunnel intermediate site, site area 7,500m²............................... 45
Figure 4.8 Main tunnel intermediate site, site area 5,000m²............................... 46

List of tables

Table 2.1 Method of flow control for each CSO..................................................... 8

List of abbreviations

AOD above Ordnance Datum
ATD above tunnel datum
CSO combined sewer overflow
EPB earth pressure balance
PS pumping station
SR storm relief
STW sewage treatment works
TBM tunnel boring machine
1 Background

1.1 Purpose

1.1.1 This *Site selection background technical paper*, Summer 2011 issue, accompanies the *Site selection methodology paper* and the *Phase two scheme development report* and is an update to the Spring 2010 issue that accompanied the *Project Overview* at phase one consultation. The aim of this *Site selection background technical paper*, Spring 2011, is to provide information for the site selection team about the background and the engineering requirements of the Thames Tunnel project.

1.1.2 This update to the *Site selection background technical paper* includes the engineering requirements that have a bearing on the site selection process, incorporating the developments in the engineering design that occurred during the course of site selection, leading up to the phase two public consultation on the preferred sites and tunnel route.

1.2 History

1.2.1 London’s sewer system was designed in the 1800s to handle wastewater and runoff rainwater through a combined collecting system. Combined sewer overflows (CSOs) were incorporated into the sewer system as relief structures to prevent flooding caused by sewer overloading, especially during periods of heavy rainfall.

1.2.2 The capacities originally allowed for in the interceptor and combined sewer systems designed by Sir Joseph Bazalgette in the 1850s (and subsequently extended) have now been substantially exceeded. Despite improvements over the years, there is little spare capacity in the sewerage network as a whole. This is due to factors such as the increase in population and water usage, and increased hardstanding areas (which reduces the capability of the land to absorb rainwater, which instead enters the sewerage network more rapidly). It now only takes as little as a few millimetres of rainfall to cause some CSOs to discharge combined sewage into the River Thames.

1.2.3 Currently, overflows from the sewers to the Thames Tideway (being the tidal reaches of the River Thames) occur more than 50 times per year at the most frequently overflowing CSOs. An estimated total of some 39 million cubic metres of combined sewage (which is untreated sewage combined with rainwater) enter the river from the Beckton and Crossness sewerage catchments in a typical year. Figure 1.1 illustrates Mogden, Beckton and Crossness sewerage catchments.
1.2.4 There is a need to reduce these overflow incidents in order to comply with legal requirements and to abide by the UK Government’s request for Thames Water to implement a solution. A number of potential options and solutions for meeting this obligation have been examined through the work of the *Thames Tideway Strategic Study* (TTSS). The Thames Tunnel project, in conjunction with the Lee Tunnel and upgrades to London’s sewage treatment works, has been determined by independent studies and confirmed by Thames Water to be the best technological solution and cost-effective means to deal with the discharges and to meet the regulatory requirements.

1.3 The combined sewer overflows

1.3.1 The Environment Agency\(^1\) evaluated 57 CSOs and has identified 36 of these as unsatisfactory, of which 34 require control through the Thames Tunnel project. Figure 1.2 illustrates graphically where the 34 CSOs to be controlled by the Thames Tunnel project are located.

---

\(^1\) The Environment Agency (EA) is an executive non-departmental public body responsible to the Secretary of State for Environment, Food and Rural Affairs (Defra) in England. The EA plays a central role in delivering the environmental priorities of central Government through its functions and roles. More specifically, the Environment Agency is responsible for determining the acceptability of discharges associated with the treatment of wastewater (including combined sewage).
1 Background

Figure 1.2 CSOs to be controlled by the Thames Tunnel project

1.4 The proposed solution

1.4.1 The Thames Tunnel project would comprise a main tunnel, running from west to east London, integrated with the existing sewerage system via connection tunnels, to control 34 of the most polluting CSOs. These tunnels would store and transfer the intercepted flows to Beckton Sewage Treatment Works.

1.4.2 The project consists of two main elements:

a. Works to design, construct and maintain the main tunnel, which would provide the majority of the storage capacity and enable transfer of combined sewage to Beckton STW in east London.

b. Works to control combined sewage overflows from the worst polluting CSOs and transfer them into the main tunnel. This would include connection tunnels to link intercepted CSOs to the main tunnel.

1.4.3 Other elements would comprise:

a. Local modifications to existing structures and pumping stations in the sewerage systems

b. Works to drain down the system at the Beckton STW end.

1.4.4 The Thames Tunnel project is therefore a major linear infrastructure scheme that would extend across 14 local authorities.

1.5 Need

1.5.1 The objective of the European Union (EU) Urban Waste Water Treatment Directive (UWWTD) is to protect the environment from the adverse effects of insufficiently treated wastewater discharges. Wastewater collecting systems in London, according to the European Commission, the Government, the Environment Agency and Thames Water, spill untreated wastewaters from CSOs too frequently and in excessive quantities, and are consequently in breach of the UWWTD. The Directive and related UK legislation (the Urban Waste Water Treatment Regulations 1994 (UWWTR) (SI 1994/2841)) transpose the UWWTD into UK law. Both EU
and UK regulations accept that wastewater collection systems and treatment works may spill wastewater in certain situations, such as a result of unusually heavy rainfall, but the Commission considers that spills in the case of London are excessive and go beyond what the legislation allows for.

1.5.2 The European Commission has given formal notice that it considers the UK to be in breach of the UWWTD. The Commission has commenced legal proceedings against the UK for failure to comply with the UWWTD in respect of the River Thames Tideway.

1.5.3 The UK Government has made a number of announcements in relation to the project and what is expected of Thames Water. On 22 March 2007, the Minister for Climate Change and the Environment, Ian Pearson, announced the Government’s decision on the full-length tunnel project in a written answer (Hansard Col 53WS), as follows:

“These overflows are having an adverse effect on the environmental quality of the Thames. It has been found that the frequent overflows (on average once a week) and the large quantities of untreated discharges are causing:

adverse environmental impacts on fish species;

unacceptable aesthetic issues; and

elevated health risks for recreational users of the Thames.

… I have carefully considered the reports Thames Water submitted to me at the end of 2006 and met with stakeholders who were involved in this work to hear their views. A Regulatory Impact Assessment has been completed and is available on the Defra website. Today I am announcing the Government decision for an Option 1 type solution. … This approach is needed to provide a River Thames fit for London in the 21st century and to meet the statutory requirements of the (UWWTR 1994)….Thames Water, the Environment Agency, the Water Services Regulation Authority and others will be taking this forward for planning and funding applications. Government will be closely following this detailed work as it develops.”

1.5.4 On 17 April 2007, Ian Pearson wrote to the Chief Executive Officer of Thames Water in the following terms:

“I am writing to request that Thames Water makes provision for the design, construction, and maintenance of a scheme for the collecting systems connected to Beckton and Crossness sewage treatment works which:

• involves a full-length storage tunnel with additional secondary treatment at Beckton sewage treatment works;

• meets the requirements of the 1994 Regulations, including for sewerage undertakers to ensure that the design, construction and maintenance of collecting systems is undertaken in accordance with best technical knowledge not entailing excessive cost (BTKNEEC);

• complies with discharge consent conditions as will be set by the Environment Agency, in exercise of its duty under regulation 6(2) of
the 1994 Regulations, to secure the limitation of pollution of the tidal
Thames and River Lee due to storm water overflows;

- limits overflow discharges at Abbey Mills Pumping Station as soon as
  possible.”

1.5.5 On 7 September 2010, the present Secretary of State, Caroline Spelman,
issued a statement which confirmed the need for the project. She stated:

“…a Thames Tunnel continues to offer (by far) the lowest cost solution to
the problem and I believe Thames Water should continue to press forward
with this project working with Ofwat, the Environment Agency and Defra
on the regulatory, commercial and planning processes.”

1.5.6 The Planning Act 2008 was introduced in response to widespread
acceptance that large infrastructure projects in England and Wales were
taking too long to work through the planning system. The Act introduced
national policy statements to set out clearly what the policy was in respect
of various types of infrastructure.

1.5.7 The draft National Policy Statement for Waste Water (published on 16
November 2010) endorses the need for the Thames Tunnel project and
states at Section 4:

“These improvement works are required to enable us to continue to meet
our obligations under the Urban Waste Water Treatment Directive. The
urgency of the works is increased by the infraction proceedings being
pursued against the UK by the European Commission for an alleged
breach of the Directive.” (Paragraph 4.1.4)

“It is essential to reduce the likelihood of such incidents, which also have a
reputational impact on the UK, as they take place in the capital city’s river.
The … impacts impose an economic cost on the capital, country and
society. These costs include direct financial costs such as the costs of
measures to mitigate against low oxygen, fish re-stocking, costs on the
health service and the wider economy due to people falling ill and costs of
cleaning up debris.” (Paragraph 4.2.4)

1.5.8 A detailed Needs Report on the need for the Thames Tunnel was
published in summer 2010 (see website). A summary, updated version,
Why does London need the Thames Tunnel?, was published in July 2011
and is also available at the Thames Tunnel consultation website. The
documents provide more detail on the requirement for the Thames Tunnel
project, explaining how, even after the provision of the Lee Tunnel and the
commissioning of the Mogden, Beckton, Crossness, Riverside and Long
Reach STW improvements, the UK will still fail to comply with the
requirements of the relevant legislation. Only the completion of the project
will provide the infrastructure necessary for compliance with the UWWTD,
by limiting the frequency and volume of combined sewer discharges and
thereby reducing pollution due to stormwater overflows, to meet dissolved
oxygen (DO) standards in the river set by the EA for the River Thames.
1.6 Stages of the Thames Tunnel project

1.6.1 The project is subject to many external influences, notably the outcome of public consultations and the planning process, but also government direction, regulatory approval and funding will dictate the pace of any implementation.

1.6.2 The main development and implementation steps required for the project to be delivered are all linked together and include:
   a. design
   b. planning and consenting
   c. communication and consultation
   d. field investigations
   e. land acquisition
   f. procurement
   g. enabling works
   h. construction
   i. commissioning
   j. operation.

1.7 Structure of this document

1.7.1 This document:
   a. describes the scope of the Thames Tunnel project in more detail (Section 2)
   b. describes the components and site requirements associated with the CSOs and local modifications to the sewerage network (Section 3)
   c. describes the components and site requirements associated with the main tunnel (Section 4).
2 Scope of the project

2.1 Concept

2.1.1 The general objective of the Thames Tunnel project is to comply with the UWWTD by controlling unacceptable CSOs as designated by the EA. The project would:

a. control and capture CSO discharges
b. store the CSO discharges
c. transfer the CSO discharges for treatment.

2.2 CSO discharge control

2.2.1 During and following storm events, when the sewers are unable to handle extra flow and would otherwise overflow to the river, interception works would divert CSO discharge flows into the tunnel system for storage before transfer for treatment.

2.2.2 CSO flows would be diverted by building a series of structures, known as CSO interception works, to divert the flows from existing sewers into the tunnel system.

2.2.3 Design development has shown that not all of the 34 CSOs would require their own individual CSO interception works in order for them to be adequately controlled. For some CSOs, it should be possible to use existing sewers and pumping station operation modifications to control their overflows at one of the other CSO interception works locations. This has the advantage of reducing the number of CSO sites required. It is envisaged that there would be:

a. some CSOs that would be directly controlled by being intercepted, which would only deal with the flows from one CSO
b. some CSOs that would be directly controlled by being intercepted, which would also need to deal with the flows from CSOs that would not be directly controlled
c. some CSOs where two connections would be needed: one to intercept the flows from the CSO and one to divert some of the flows from another existing sewer. The flows from some other CSOs would be controlled as a result of these double connections so that no modifications would be required at them at all
d. some CSOs that would not be directly controlled through interception, but would be indirectly controlled through modifications to change the operation of the existing sewerage system, including:
   i adjustments to existing pumping stations
   ii local in-sewer modifications that allow flows to be passed forward through the existing sewer system to the treatment works, or to be passed to other CSOs that would be intercepted.
Further studies are required to refine the method of flow control for each CSO, but current findings are that 16 CSOs can be indirectly controlled, reducing the number of CSOs needing to be intercepted from 34 to 18.

The proposed method of flow control of the 34 CSOs to be dealt with is listed in Table 2.1 and described further in sections 3.1 and 3.2.

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
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<td>Acton Storm Relief</td>
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</tr>
<tr>
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</tr>
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<td>CS08B</td>
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<td>CS09X</td>
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<td>CS11X</td>
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<tr>
<td>CS12X</td>
<td>Queen Street</td>
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<tr>
<td>CS13A</td>
<td>Smith Street – Main Line</td>
<td>Controlled indirectly by sewer connection relief works at other CSOs**</td>
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<tr>
<td>CS13B</td>
<td>Smith Street – Storm Relief</td>
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<tr>
<td>CS14X</td>
<td>Ranelagh</td>
<td>Interception and additional sewer connection relief**</td>
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## Scope of the project

<table>
<thead>
<tr>
<th>CSO ref</th>
<th>Combined sewer overflow</th>
<th>Method of overflow control</th>
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<tbody>
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<td>CS19X</td>
<td>Clapham Storm Relief</td>
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</tr>
<tr>
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<td>Brixton Storm Relief</td>
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<tr>
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<td>Interception and additional sewer connection relief**</td>
</tr>
<tr>
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<td>Fleet Main</td>
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<td>Pumping station modifications</td>
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</tr>
<tr>
<td>CS30X</td>
<td>Holloway Storm Relief*</td>
<td>Local modifications</td>
</tr>
<tr>
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</tr>
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2 Scope of the project

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<th>Combined sewer overflow</th>
<th>Method of overflow control</th>
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<tr>
<td>CS34X</td>
<td>Charlton Storm Relief</td>
<td>Controlled by operation changes at Greenwich Pumping Station and improvements at Crossness STW</td>
</tr>
</tbody>
</table>

* These CSOs were planned to be controlled via interception at phase one consultation stage

** The additional sewer connection relief would be connections into the northern Low Level Sewer No.1 at Ranelagh, Regent Street and Fleet Main CSOs.

2.2.6 The system design would be such that interception of CSO discharges and the storage and transfer of the flow in the tunnel system would be controlled by mechanical equipment, such as hydraulic gates, valves or penstocks, to control or direct the flows.

2.2.7 There would be no requirements for on-site operational personnel to actively operate the interception and storage aspects of the system. Control of the system would be mainly through the measurement of tunnel water levels, with overview of the system at a central control centre. Periodic access for maintenance would, however, be necessary.

2.3 Storage, transfer and treatment of CSO discharges

2.3.1 The CSO discharges passing into the tunnel system (ie, the main tunnel and the network of connection tunnels that link the CSO interception structures with the main tunnel) would mainly flow in by gravity. However, some interception works would be located downstream of existing pumping stations and therefore pumping of the flow would continue. The CSO discharges would flow by gravity along the tunnel system to a pumping station in Beckton STW, known as the Tideway Pumping Station. The flow would be stored in the tunnel system until it can be transferred to Beckton STW for treatment. The Tideway Pumping Station would transfer the flows for full treatment when sewage treatment capacity is available.

2.3.2 The Tideway Pumping Station would, at times, transfer some flow from the tunnel to the overflow shaft built as part of the Lee Tunnel project. This transfer of bypass pumping is required to achieve the overall level of control targeted for the River Thames CSOs, and for discharge control for the Abbey Mills CSO.

2.3.3 Additional treatment capacity is being provided at Beckton STW as part of a separate project to extend and upgrade Beckton STW. This would provide sufficient capacity to treat the stored flows from the Lee Tunnel and Thames Tunnel projects.

2.3.4 For transfer of flows to Beckton STW for treatment, three main tunnel routes were considered: The River Thames Route, the Rotherhithe route and the Abbey Mills route. The three routes, which are described below and shown in Figure 2.1, were those presented at phase one consultation.
2 Scope of the project

The River Thames route

2.3.5 The alignment of this route largely follows the river from west London to Beckton STW but cuts across the Greenwich Peninsula, where there are no CSOs to be intercepted along the river. This route, which has a length of approximately 32km and a depth of 40m in west London and 75m in east London, is derived from the 2006 Option Development Report² (Option 1c).

The Rotherhithe route

2.3.6 The alignment of this route is similar to the River Thames alignment but it also cuts across the Rotherhithe Peninsula, reducing the length of the main tunnel by approximately 1.8km but requiring longer connection tunnels from some CSOs. This route also has a depth of 40m in west London and 75m in east London.

The Abbey Mills route

2.3.7 The alignment of this route follows the River Thames route between west London and Rotherhithe, but then moves away from the River Thames north-eastwards to terminate at Abbey Mills Pumping Station, reducing the length of the main tunnel by approximately 9km. This route also has a depth of 40m in west London, but 65m in east London. The length of the connection tunnels increases east of where the tunnel diverges from the river towards Abbey Mills. The flows from the Thames Tunnel main tunnel would be transferred to Beckton STW via the Lee Tunnel. With this route, Charlton SR CSO would not be connected to the main tunnel but indirectly controlled by system modifications including improvements to Crossness STW.

2.3.8 The Abbey Mills route was presented as the preferred route at phase one consultation. The Report on Phase One Consultation reported on the feedback from phase one consultation and concluded that the Abbey Mills route remains the preferred route. Consequently, the main tunnel referred to in the remainder of this Site selection background technical paper is the main tunnel associated with the Abbey Mills route, and the Rotherhithe and River Thames routes are not considered further.

2 Scope of the project

Figure 2.1 Routes considered

Key
- Route common to all three options
- Connection Tunnels (all routes)
- Abbey Mills Route (preferred)
- Abbey Mills Route Connection Tunnels
- River Thames Route
- River Thames Route Connection Tunnels
- Rotherhithe Route
- Rotherhithe Route Connection Tunnels
2.4 Type of sites required

2.4.1 Two principal types of sites would be required to construct and operate the project:
   a. CSO sites (CSO interception works including the connection tunnels)
   b. Main tunnel sites.

2.4.2 The selection of CSO sites and main tunnel sites will be carried out in accordance with the Site selection methodology paper.

2.4.3 Other types of sites would also be required where the location of the site is determined by the permanent works to be undertaken. These include:
   a. extension of the pumping capacity by the addition of two pumps in the Tideway Pumping Station and works to transfer the flows from the Tideway Pumping Station to the inlet works at Beckton STW
   b. installation of additional mechanical and electrical equipment at the inlet works of Beckton STW
   c. a siphon tunnel in Beckton STW to transfer tunnel overflows to the Lee Tunnel overflow shaft.
   d. local in-sewer modifications which would be accessed, where possible, via existing sewer manholes
   e. pumping station modification of the operating strategies would occur at existing pumping stations.

2.4.4 It is likely that there would also be other areas which contractors would use that are required for temporary construction activities which are not part of the project’s permanent works and operations. These areas could include:
   a. a concrete segment factory for the primary tunnel lining
   b. logistics hubs/assembly areas for the co-ordination of materials and associated transport
   c. vehicle marshalling areas for security and to limit traffic queuing
   d. in-river areas for temporary mooring of barges, and trans-shipment areas to transfer materials between large and small barges and transfer materials between river and land
   e. areas above the line of the tunnels for ground treatment
   f. other similar construction facilities.
3 Combined sewer overflows

3.1 Components – CSO interception

3.1.1 For the CSOs where direct control by interception works would be required, the objectives for the interception of flows are to be able to:
   a. redirect and control flows from the combined sewer
   b. transfer flows from the combined sewer down into the main tunnel
   c. continue to use the existing river outfall, or construct new outfalls to use when the tunnel is full, to direct residual flow to the River Thames.

3.1.2 Typical components of CSO interception works are shown diagrammatically in Figure 3.1 and comprise:
   a. an interception chamber
   b. valve chambers
   c. ventilation structures
   d. a connection culvert
   e. a drop shaft containing a vortex drop structure
   f. a connection tunnel.

Figure 3.1 Isometric view of CSO interception arrangements
3.1.3 There are five basic arrangements for connections between the main tunnel and existing combined sewers. A CSO could be connected to the main tunnel via:

a. a connection tunnel that is connected to a shaft on the main tunnel (Type A)

b. a connection tunnel that is connected to the main tunnel (Type B)

c. a connection tunnel that is connected to another CSO drop shaft (Type C)

d. a drop shaft that lies directly adjacent to the main tunnel so that a connection tunnel is not required (Type D)

e. a shaft on the main tunnel so that a connection tunnel is not required (Type E) and this arrangement has two possibilities:
   i. the shaft is a main tunnel shaft
   ii. the shaft is a CSO drop shaft.

**Interception chamber**

3.1.4 The interception chamber intercepts flows en route to the outfall to transfer them to the main tunnel. When the tunnel system is full, the chamber would revert to existing conditions and allow overflow to the river.

3.1.5 Provision would be made at interception chambers to provide safe working within the downstream system. Safe working would be aided by locking penstocks shut during periods of access to the tunnel system.

3.1.6 To protect the tunnel system from inflow as the result of high water levels in the River Thames, backflow protection would be provided by new one-way flap valves. Secondary protection would be provided by existing tide gates and, if necessary, by closure of the control penstocks.

3.1.7 Flow control equipment and penstocks would be incorporated into the interception chamber where practicable, but may need to be housed in separate valve chambers. The electrical or hydraulic components of the flow control equipment would be housed in an industrial kiosk/cabinet.

**Ventilation structures**

3.1.8 When the system fills with CSO discharges, the air in the tunnels would be displaced, and when the flow is removed from the tunnels, air would need to return. When the tunnels are empty, the design also includes a means of refreshing the air within the tunnels. Therefore, the interaction of combined sewage inflow and management of air requirements are considered and addressed.

3.1.9 The air management system would involve a combination of air extraction, air intake structures, and buildings to house air treatment equipment. The size and configuration of the structures would depend primarily on how air moves through the system and the amount of air to be moved.

3.1.10 At most sites, passive air management facilities would be provided. There would be some active mechanical ventilation plants provided as part of the
3 Combined sewer overflows

Thames Tunnel project. All the active mechanical ventilation plants along the whole tunnel system would work in conjunction to provide ventilation for the entire tunnel system to avoid nuisance odours from occurring.

3.1.11 Air management facilities and air releases would be monitored, and most aspects of the air management system would be designed to operate automatically. Therefore, no on-site personnel would be required to operate the air management facilities, but access to the facilities would be needed for maintenance.

Connection culvert

3.1.12 The connection culvert takes flows from the interception chamber into a drop shaft. The connection culvert can have several sections, depending on the location of valves and penstocks. The connection culvert would contain depth measurement access points to enable flow control and closure of penstocks when required.

Drop shaft

3.1.13 The drop shaft transfers flows vertically from the connection culvert to the deeper connection tunnel or main tunnel. The transfer of flow from the connection culvert down to the much deeper tunnel would be through a vortex drop structure inside the drop shaft. The vortex drop structure allows the dissipation of the energy created through the large drop height and de-aeration of the flow at the bottom of the shaft.

3.1.14 It is not possible to connect interception chambers directly into the main tunnel or connection tunnel because the tunnel is much deeper. Therefore, deep drop shafts would be introduced to give an acceptable gradient for the connection tunnels, and an operationally safe means of hydraulic transfer of flows from the relatively shallow surface facilities to depth.

3.1.15 It is envisaged that drop shaft diameters would generally range from 6m to 15m internal diameter, with a few ranging between 15m and 25m. The drop shaft size would be dependent on:
   a. the arrangement for dropping the flow and associated de-aeration method (vertical or horizontal)
   b. the rate of flow down the drop shaft, and hence the vortex structure dimensions
   c. the ground conditions affecting the method of construction
   d. the size of the associated connection tunnel
   e. whether the drop shaft is constructed along the line of the main tunnel or a connection tunnel, or offset to these tunnels.

Connection tunnel

3.1.16 Connection tunnels take flows either between two drop shafts or from one drop shaft to the main tunnel.
3.1.17 Connection tunnel tunnels can join the main tunnel system either at shafts on the main tunnel or directly into the main tunnel. Connection tunnel to main tunnel junctions are possible in competent ground conditions, such as London Clay. However, in deep water-bearing ground such as Chalk, it is preferable to use connection tunnel to main tunnel shaft junctions. The construction of a connection directly into the main tunnel is more difficult to build and the connection works at a shaft would not interfere with the progress of the main tunnel construction.

3.1.18 Connection tunnels between CSO drop shafts combine flows from two or more CSOs before a connection tunnel connects to the main tunnel. The depth of the connection tunnels between drop shafts would be determined according to ground conditions and whether or not there is a need to avoid underground obstructions or sensitive infrastructure. The depth of the ultimate connection tunnel that connects to the main tunnel is also dependent upon the depth of the main tunnel. The circumstances in which such a tunnel might be adopted include:

a. where two interception chambers are close together, such that the length of the tunnels connecting the CSOs and then connecting to the main tunnel at one point would be less than the length of two separate tunnels directly connecting the CSOs with the main tunnel

b. where it would be considered prudent to reduce the number of connections into the main tunnel; for example, because of difficult ground conditions, proximity to sensitive infrastructure or underground obstructions.

3.2 Components – local modifications

3.2.1 Of the CSOs that are currently planned to be indirectly controlled with no direct interception, some of them incorporate local modifications but others require none. It is anticipated that where modifications are required, they would differ for each CSO as follows:

a. Stamford Brook Storm Relief CS02X – none required, as control measures at other CSOs indirectly control the Stamford Brook Storm Relief CSO flows.

b. North West Storm Relief CS03X – none required, as modifications to the operation of Hammersmith Pumping Station and the interception of the Hammersmith Pumping Station CSO would be sufficient.

c. Jews Row (Wandle Valley Storm Relief CS08A) and Jews Row (Falconbrook Storm Relief CS08B) – none required, as modifications previously undertaken are sufficient.

d. Church Street CS11X – none required, as three new connections made between the northern Low Level Sewer No.1 and the main tunnel at Ranelagh, Regent Street and Fleet Main CSOs would be sufficient to control a number of other CSOs. The connection at Ranelagh CSO contributes the most to the control of the Church Street CSO flows.
e. Queen Street CS12X – none required, as three new connections made between the northern Low Level Sewer No.1 and the main tunnel at Ranelagh, Regent Street and Fleet Main CSOs would be sufficient to control a number of other CSOs. The connection at Ranelagh CSO contributes the most to the control of the Queen Street CSO flows.

f. Smith Street (Main Line CS13A and Storm Relief CS13B) – none required, as three new connections made between the northern Low Level Sewer No.1 and the main tunnel at Ranelagh, Regent Street and Fleet Main CSOs would be sufficient to control a number of other CSOs. The connection at Ranelagh CSO contributes the most to the control of the Smith Street CSO flows.

g. Western Pumping Station CS15X – the control and operation of the pumps would be altered, and the new connection made between the northern Low Level Sewer No.1 and the main tunnel at Ranelagh CSO would be sufficient to control the Western Pumping Station CSO flows.

h. Kings Scholars Pond CS18X – none required, as three new connections made between the northern Low Level Sewer No.1 and the main tunnel at Ranelagh, Regent Street and Fleet Main CSOs would be sufficient to control a number of other CSOs. The connections at Ranelagh and Regent Street CSOs contribute the most to the control of the Kings Scholars Pond CSO flows.

i. Grosvenor Ditch CS21X – none required, as three new connections made between the northern Low Level Sewer No.1 and the main tunnel at Ranelagh, Regent Street and Fleet Main CSOs would be sufficient to control a number of other CSOs. The connections at Ranelagh and Regent Street CSOs contribute the most to the control of the Grosvenor Ditch CSO flows.

j. Northumberland Street CS23X – none required, as the adjacent interception of the Regent Street CSO and three new connections made between the northern Low Level Sewer No.1 and the main tunnel at Ranelagh, Regent Street and Fleet Main CSOs would be sufficient to control a number of other CSOs. The connection at Regent Street CSO contributes the most to the control of the Northumberland Street CSO flows.

k. Savoy Street CS24X – no interception required, as three new connections made between the northern Low Level Sewer No.1 and the main tunnel at Ranelagh, Regent Street and Fleet Main CSOs would be sufficient to control a number of other CSOs. The connections at Regent Street and Fleet Main CSOs contribute the most to the control of the Savoy Street CSO flows.

l. Norfolk Street CS25X – none required, as three new connections made between the northern Low Level Sewer No.1 and the main tunnel at Ranelagh, Regent Street and Fleet Main CSOs would be sufficient to control a number of other CSOs. The connections at Regent Street and Fleet Main CSOs contribute the most to the control of the Norfolk Street CSO flows.
m. Essex Street CS26X – none required, as three new connections made between the northern Low Level Sewer No.1 and the main tunnel at Ranelagh, Regent Street and Fleet Main CSOs would be sufficient to control a number of other CSOs. The connections at Regent Street and Fleet Main CSOs contribute the most to the control of the Essex Street CSO flows.

n. Shad Thames Pumping Station CS28X – modifications at Shad Thames Pumping Station are proposed to improve the use of the existing sewerage network. The works include modifications to the pumps and internal pipework, demolition of a building and construction of a new building to house electrical equipment, and modifications to the existing sewers outside the pumping station.

o. Holloway Storm Relief CS30X – a new penstock and valve chamber are proposed to be provided and existing weir enhanced in Bekesbourne Street.

p. Charlton Storm Relief CS34X – none required, as modifications being carried out in a separate project at Crossness STW (as part of the Sewage Works Upgrades) and modified operation of Greenwich Pumping Station would be sufficient.

### 3.3 CSO Sites – construction phase

#### Purpose

3.3.1 The CSO sites are required to construct the CSO interception system of structures, described in Section 3.1.2.

3.3.2 Ideally, the CSO interception sites would include all the facilities from the interception chamber to the drop shaft within the same site. However, where suitable sites are not on the line of the existing sewers, it would not be possible for the interception chamber and drop shaft to be located together, and the interception chamber would need to be constructed in a separate but smaller site.

#### Timing

3.3.3 The period that CSO sites would be required for construction would differ widely between CSOs because the construction activity would vary, depending on:

a. the diameter and length of the associated connection tunnels

b. the diameter of the drop shaft

c. the method of connection tunnel and drop shaft construction

d. the space available for the construction activities

e. the constraints to site access

f. whether the drop shaft is used as a drive shaft or reception shaft for the connection tunnel
g. whether the drop shaft is directly on the line of the main tunnel or a connection tunnel
h. whether the site is in the river foreshore.

3.3.4 It is anticipated that the construction at CSO sites would typically take two and a half to three and a half years, but may range from two to five years (excluding advance works such as utility connections and utility diversions).

**Location and search area**

3.3.5 The location of CSO sites is governed by the location of the existing combined sewers, because the interception chambers have to be built on the existing sewers. Therefore, the search area for the CSO sites was localised around the vicinity of the existing CSO.

3.3.6 The number of interception chambers can be minimised if they are located on the last section of sewer, where they converge before the overflow into the river. If the combined sewers were intercepted prior to convergence, several interception chambers would be required, as one interception chamber would be needed for each branch.

3.3.7 Consideration was also given to the feasibility of in-river CSO interception and drop shaft sites located on the foreshore, adjacent to the point of the existing overflow.

3.3.8 The search area for CSO sites varied with each CSO, as it depended on the sewer network upstream and downstream of the current overflow structure and the river outfall/outlet location. Therefore, each search area was defined once the local network characteristics had been determined.

**Construction method and site activities**

3.3.9 Interception chambers would be constructed via open excavations.

3.3.10 Connection culverts would be constructed using either cut-and-cover (open trench) or tunnelling techniques.

3.3.11 Drop shafts would be lined with concrete and may be constructed in different ways, such as:

a. a diaphragm wall (concrete walls constructed in the ground before the ground in the centre is excavated)
b. a caisson (precast concrete walls constructed at surface level and, as excavation progresses, they sink by combination of self-weight, ballast placed on top, or by hydraulic jacks)
c. underpinning (precast concrete walls constructed at the bottom of the shaft as excavation progresses)
d. sprayed concrete linings
e. other methods, such as secant piled support.

3.3.12 The construction method chosen for each shaft would depend on ground conditions, shaft diameter, shaft depth and space constraints. Diaphragm
wall construction typically requires more space than caisson or underpinning construction techniques.

3.3.13 Typically, diaphragm walls are necessary for deep shafts with high groundwater pressures; caissons are used in water-bearing ground; and underpinning and sprayed concrete are used in cohesive non or low water-bearing ground. A combination of these and other techniques may be appropriate to construct a shaft. For instance, where gravels are above London Clay, a caisson could be used for the gravel section, followed by underpinning or sprayed concrete lining in the London Clay.

3.3.14 The construction methods for connection tunnels are covered in Section 4 on tunnels.

3.3.15 Opportunities to co-locate CSO interception works with main tunnel sites are considered at the stage of moving from the shortlist of sites to preferred sites.

3.3.16 The activities and facilities required for CSO interception sites can be divided into core activities and ancillary activities which could be located on a site area away from the CSO site. The following list of typical core and ancillary activities is illustrative and not exhaustive:

**Core activities**

a. Space to build the interception chamber over and adjacent to the existing sewer, penstock/valve chambers, connection culvert, ventilation structures and drop shaft
b. Primary crane and secondary crane
c. Generator, compressor and diesel tank
d. Pipe-jack machine control cabin (if the site is a pipe-jack drive site)
e. Pipe store, slurry pipe store and bentonite shed (if the site is a pipe-jack drive site)
f. Concrete segment store (if the site is a tunnel boring machine (TBM) drive site)
g. Excavated material handling/storage area for the shaft construction
h. Excavated material handling/storage area for the connection tunnel construction (if the drop shaft is a drive shaft)
i. Access roads and facilities to secure the site

**Ancillary activities**

j. Construction traffic parking
k. Offices and welfare facilities
l. Vehicle and pedestrian circulation areas
m. Workshop.
Transport of materials

3.3.17 CSO sites vary in size and situation. In most cases, the number and nature of the deliveries to and from the sites would be relatively small, compared to the main tunnel drive sites.

3.3.18 For CSO sites, materials would be transported by road.

Site size

3.3.19 CSO site areas are expected to range in size due to the following factors:

a. The location and size of the interception structures (eg, interception chamber, valve chamber, ventilation structures and connection culvert).

b. Physical constraints presented by the existing layout, such as proximity of buildings, other surface structures and underground infrastructure.

c. The location of access/egress available to the site, and ensuring that there is sufficient area to move vehicles to avoid conflicts with people and other vehicles.

d. Where there is a group of CSO sites close together, ancillary items such as welfare facilities can be shared by being located at only one of the sites in the group. This allows the other sites in the group to have smaller site areas.

e. The drop shaft diameter and depth.

f. The ground conditions and hence method of construction of the drop shaft. If the drop shaft needs to be constructed using diaphragm walling, the area would be larger than if other shaft construction techniques are used.

g. If the drop shaft is used as a tunnel reception shaft, the area would be smaller than CSOs sites where the drop shaft is used as a drive shaft for the connection tunnel.

h. The size of the connection tunnel where the drop shaft is used as a drive shaft for the connection tunnel.

i. The ground conditions, and hence method of construction, of the connection tunnel where the drop shaft is used as a drive shaft for the connection tunnel. If the connection tunnel is constructed using a slurry TBM, such as in Chalk ground conditions, larger excavated material handling facilities are required.

j. Where the connection tunnels are pipe-jacked, the CSO site area would be smaller than that of a TBM-driven tunnel site.

3.3.20 The largest CSO site areas would be those where the drop shaft is large, deep, used as a drive shaft, is constructed using diaphragm wall techniques, and where the connection tunnel is large and is in Chalk so a slurry TBM is required.
3.3.21 The smallest CSO site areas would be those where the drop shaft is small, not deep, is used as a reception shaft and is not constructed using diaphragm wall techniques.

3.3.22 CSO site size requirements would vary depending on the combination of circumstances at each site. In order to provide space for both core and ancillary activities, it is anticipated that CSO sites, where drop shafts need to be constructed in London Clay/Lambeth Group/Thanet Sand Formation, may need to range from 1,500m² for reception sites to 5,000m² for sites where drop shafts are constructed by diaphragm wall techniques. In Chalk ground conditions, CSO sites may need to range from 1,500m² to 7,500m² as the excavated material handling facilities require larger areas. However, if all the circumstances in Paragraph 3.3.20 occur, the site area would need to be approximately 12,000m².

3.3.23 Site sizes may conceivably be smaller if no suitable sites are available that match these guidelines, but the smaller the site, the more constrained the construction activities become, with potential to adversely affect factors including transport of materials, construction periods, cost, and health and safety mitigation.

3.3.24 A CSO site layout with a site area of 1,500m² is indicated in Figure 3.2. Note that the ‘rectangular’ shape in plan is indicative only as individual site boundaries and constraints will affect the layout of facilities needed at each site. CSO sites requiring areas of 5,000m² or 7,500m² would need similar layouts to the main tunnel reception sites illustrated in Section 4.6.

Figure 3.2 Example of a CSO site layout, site area 1,500m²

3.4 CSO Sites – operational phase

3.4.1 The operational phase is the period after construction when the new CSO control system is working, i.e., the equipment and structures would be operated and maintained.
3.4.2 It is anticipated that the following air management ventilation structures would be required:

a. All CSO sites would require an interception chamber ventilation column approximately 6m high.

b. Most CSO sites would require a passive filter chamber comprising below-ground odour treatment equipment.

c. Most CSO sites would require an above-ground ventilation structure, approximately 4m high, to control air movement out of and into the drop shaft and tunnels. Architectural design will influence whether this is provided as a single wider structure or a series of narrower structures.

d. Some CSO sites would require a ventilation building (to house active mechanical ventilation plant for air extraction/intake and air treatment/odour control) and a ventilation column, approximately 15m high.

3.4.3 All CSO sites would require the following:

a. Space adjacent to the drop shaft to provide an access point to accommodate mobile cranes for moving people and materials in and out for inspections and maintenance.

b. Adequate access from the highway to allow cranes and other vehicles to enter the site. Access routes/areas could be shared with others or be part of the existing road network.

c. An electrical and control kiosk to house the telemetry communications unit and control equipment for the underground penstocks and ancillary equipment.

d. CSO interception chambers would be finished at ground/road level. The top structure of drop shafts, and possibly valve chambers, may need to be at about 104.5m above tunnel datum (ATD) (equivalent to 4.5m above Ordnance Datum (AOD)) and therefore could be visible above ground level, depending on existing ground levels. Interception chambers, valve chambers and drop shafts would have manhole covers. All drop shafts may have manhole covers capable of being accessible by mobile cranes so that periodic inspections can be carried out.

3.4.4 Thames Water operational personnel would require access periodically for inspection and maintenance purposes. It is anticipated that this would include:

a. connection tunnel and drop shaft inspections, once every ten years (the first inspection within the first few years of operation is possible)

b. equipment inspections or maintenance (eg, ventilation equipment, penstocks) once every three to six months. Such equipment would be located in chambers or connection culverts and not deep drop shafts

c. visits for unplanned maintenance or repairs; for example, if there is a blockage or equipment failure.
3.4.5 Due to the depth of the drop shafts, for health and safety reasons, access into the shafts would be via man-riders lowered from cranes. Man-riders are cages that are specifically designed for people to stand in while they are moved by crane.

3.4.6 Depending on the length of the connection tunnels, it may be necessary to provide ‘safety access points’ on the longer connection tunnels to ensure a safe distance between access/egress points.
4 Tunnels

4.1 Main tunnel components

4.1.1 For the CSOs where direct interception would be required, the objectives for the main tunnel are to collect, store and transfer the intercepted flows for treatment at Beckton STW.

4.1.2 The tunnel components include:
   a. shafts on the main tunnel
   b. the main tunnel
   c. CSO connection tunnels.

4.1.3 It is anticipated that two types of sites would be required to construct and operate the main tunnel and its shafts, comprising:
   a. main tunnel drive sites
   b. main tunnel reception sites.

4.1.4 Main tunnel intermediate sites may also be required.

4.1.5 The CSO connection tunnels would be constructed and operated from either main tunnel sites or CSO sites.

4.1.6 A main tunnel drive site would be used to install and then drive the TBM (the tunnel construction method is described from Paragraph 4.2.8) and hence deal with excavated material, all support facilities for the TBM and the primary lining of the main tunnel. It would also provide access for secondary lining installation, should this be required (secondary lining is described from Paragraph 4.2.6).

4.1.7 A main tunnel reception site would be used to remove the TBM from the tunnel at the end of a drive. It would also provide access for installing secondary lining, should this be required.

4.1.8 The TBM would drive through an intermediate shaft. A main tunnel intermediate site would be used to gain access to the tunnel bore during construction, either to inspect and/or maintain the TBM, or to provide access for installing a secondary lining, should this be required.

Main tunnel shafts (drive and reception)

4.1.9 All main tunnel shafts would need to be excavated down to the level at which the tunnel is to be driven.

4.1.10 Main tunnel sites with drive shafts require more space than those with reception shafts. This is because drive shafts are used to:
   a. install the TBM in the tunnel
   b. extract and store excavated material from the tunnel until it is transported elsewhere
   c. store and supply tunnel segments for the primary concrete tunnel lining
d. provide access for the workforce.

4.1.11 Reception shafts, on the other hand, are used to remove the TBM from the tunnel and have no need for space to store tunnel excavated material or tunnel segments.

4.1.12 Both the main tunnel drive and reception shafts are anticipated to range typically from 20m to 25m in internal diameter, but may be 30m. The internal diameter would be sized to ensure that the connection between the shaft and the main tunnel is structurally sound, and that the entry and exit of the construction equipment, such as the TBM, can be safely accommodated. The larger 30m diameter may be needed if the shaft receives flows from CSO connection tunnels, in order to incorporate the hydraulic vortex structures to drop the flow down the shafts, or if the shaft has to service double tunnel drives.

4.1.13 The number of tunnel drives and the number and type of shafts on the main tunnel would be dependent on the following factors:

a. Programme constraints.

b. Differing geological ground conditions expected. Matching TBMs to ground conditions increases productivity and minimises risk. It is likely that a slurry machine would be more suited to Chalk conditions and an earth pressure balance (EPB) machine more suited to London Clay conditions.

c. Length of drives and the risk of TBM breakdowns (the severity and frequency of breakdowns increase with the length of the drive).

d. Health and safety reasons associated with emergency egress of the workforce.

4.1.14 The number of TBMs, and hence the number of main tunnel drive and reception sites actually needed, would be based on a balance between type of TBM, available location of main tunnel sites, geology, programme, environment, amenity, health and safety, risk, and cost considerations.

4.1.15 Construction of CSO connection tunnels would, where possible, be constructed from main tunnel drive or main tunnel reception sites. This means that the associated CSO site would then act as a smaller CSO reception site to receive the connection tunnel instead of a larger CSO drive site.

4.1.16 Main tunnel drive and reception shafts are lined with concrete and may be constructed in different ways, as described for CSO drop shafts (see Paragraph 3.3.11).

**Intermediate shafts**

4.1.17 For a tunnel, there would be a drive shaft and a reception shaft, i.e., a shaft at either end of the tunnel. There may be no need for an intermediate shaft, however they could be needed to:

a. gain access to undertake planned inspections of TBM faces partway along tunnel drives to allow repairs in safe conditions
4.1.18 By undertaking secondary lining from intermediate shafts as well as from other shafts, the tunnel would be completed earlier than if only shafts at either end of the drive were used and hence reduce overall construction time.

4.1.19 In Chalk ground conditions, it is preferable for CSO connection tunnels to be connected to the main tunnel via a shaft and not via a tunnel-to-tunnel junction.

4.1.20 The intermediate shafts are assumed to range from 20m to 25m internal diameter.

4.1.21 Main tunnel intermediate shafts are lined with concrete and may be constructed in different ways, as described for CSO drop shafts (see Paragraph 3.3.11).

**Potential uses of main tunnel sites**

4.1.22 Main tunnel drive sites could be used in the following combinations:

a. Driving the main tunnel in one direction (single main tunnel drive site).

b. Driving the main tunnel in one direction and receiving the main tunnel from the opposite direction (single main tunnel drive site).

c. Sequentially driving the main tunnel in two directions – the first drive would be completed before the second drive started (single main tunnel drive site).

d. Concurrently driving the main tunnel in two directions (double main tunnel drive site).

e. Any of the above, with the driving or receiving of one or more CSO connection tunnels.
4.1.23 Main tunnel reception sites could be used in the following combinations:
   a. Receiving the main tunnel from one direction.
   b. Receiving the main tunnel from two directions.
   c. Either of the above, with the driving or receiving of one or more CSO connection tunnels.

4.1.24 Main tunnel intermediate sites could be used in the following combinations:
   a. Driving the main tunnel straight through the shaft.
   b. As above, with the driving or receiving of one or more CSO connection tunnels.

4.1.25 These sites need to be able to satisfy construction requirements (ie, allow the project to be built) and operational requirements (ie, enable the completed project to be operated and maintained).

Common features

4.1.26 During construction, the sites would host various construction activities that are required to build the facility, and such activities dictate the requirements for site size. Site activities and facilities can be divided into core activities and ancillary activities. Space for core activities is essential at each site and space for ancillary activities would ideally be located at the same site, but could be located at another site remote from the principal site if the ancillary site is within a reasonable distance.

4.1.27 Site layouts would be configured to reflect local constraints. Devising possible layouts for individual sites is carried out when sites have been shortlisted, and these layouts would be finalised by the contractor to suit its method of working, subject to any controls on layout imposed through the planning submission and approval process.

4.1.28 If sites of sufficient size are not available or identified, it may be possible to link two smaller sites. It is less desirable to have two smaller linked sites for logistical reasons, as it may generate more pedestrian and vehicular movements and, potentially, more effects on the area between and/or adjacent to the two separate locations. Possible site configurations and combinations of sites form part of the consideration of shortlisted sites for the selection of preferred sites.
4.2 Main tunnel

Main tunnel horizontal alignment

4.2.1 The horizontal alignment of the main tunnel would generally follow the River Thames. This is because:
   a. it is an efficient route to connect the CSOs that are located on both the north and south sides of the river
   b. it would minimise the physical structures that the tunnel would pass beneath
   c. it would minimise the number of third-parties affected by the tunnel
   d. it would allow the use of the river for construction transport where practicable and cost-effective.

4.2.2 The main tunnel route would be constructed beneath urban land only to the extent that:
   a. shafts on the main tunnel are located inland (so the tunnel would be beneath urban land from river to the shaft and back)
   b. it is impracticable to follow the line of the river because there are overriding engineering or environmental constraints along the river alignment
   c. it is most practicable, efficient and cost-effective to go across rather than around a peninsula
   d. a section of main tunnel runs between Abbey Mills Pumping Station and the River Thames
   e. a section of main tunnel runs between Acton Storm Tanks and the River Thames.

Main tunnel vertical alignment

4.2.3 The intercepted flows from the CSOs would flow west to east under gravity to Tideway Pumping Station in Beckton STW. Therefore the tunnel is shallower in the west and deeper in the east. The main tunnel would be constructed on a shallow gradient and would be approximately 30m deep at its western end and approximately 65m deep at the eastern end of the Abbey Mills route.

4.2.4 The geology through which the main tunnel traverses changes from west to east and it is expected that:
   a. to the west of the Battersea area, the tunnel would be in London Clay
   b. between the Battersea area and Tower Bridge, the tunnel would be in mixed material of the Lambeth Group and Thanet Sand Formation (ie, gravels, sand and silty clay)
   c. to the east of Tower Bridge, the tunnel would be in Chalk.
**Size**

4.2.5 At this stage, it is anticipated that the main tunnel would:

a. extend from Acton Storm Tanks to Abbey Mills Pumping Station

b. be 25km long

c. be 7.2m internal diameter for the majority of the tunnel, but the diameter of the most westerly tunnel drive would be smaller, depending on the length of the most westerly tunnel drive.

**Secondary lining**

4.2.6 At this stage, it is assumed that a secondary lining would be required, but this will be clarified by future design work.

4.2.7 Secondary lining is an additional layer of concrete added to the inside of the tunnel against the face of the primary concrete segment lining. It is placed by erecting shutters within a short length of tunnel and pumping concrete into the gap between the shutter and the primary lining. Once the concrete has hardened enough, the shutters are removed and erected in the next stretch of tunnel.

**Tunnel construction method**

4.2.8 The main tunnel would be constructed using TBMs. The TBMs would start from drive shafts and stop at reception shafts, where TBMs are removed.

4.2.9 A TBM consists of a rotating cutter face, the same diameter as the tunnel, on the front of a steel cylinder (shield) containing drive motors, gearboxes and control equipment. Behind the TBM shield is a series of towed trailers carrying backup equipment and material handling facilities.

4.2.10 As the tunnel is excavated, the primary precast concrete tunnel segmental lining is installed at the back of the shield. The primary tunnel lining consists of a set of concrete segments that are erected to form a complete ring and fastened to the lining segments previously assembled. Grout is injected behind the ring to fill any voids between the concrete segments and the excavated ground surface. The TBM moves forward, using hydraulic rams, thrusting off this newly assembled primary lining.

4.2.11 It is anticipated that two types of TBMs would be used: EPB TBMs and slurry TBMs (diagrams are provided in Figure 4.1 and Figure 4.2 respectively).

4.2.12 With an EPB TBM, the advancing face of the excavation is supported by the previously excavated material within the head of the machine. As the machine advances, the excavated material is removed using a large screw and then transported out of the tunnel, either by conveyor or a train.

4.2.13 With a slurry TBM, as material is excavated, it is mixed with a fluid or slurry circulating back to the ground surface via a pipeline. The face of the excavation is supported by hydraulic pressure from the slurry and the excavated material is removed from the circulating slurry by a treatment plane at the surface.
4.2.14 The selection of type of TBM for a particular tunnel drive depends on the ground conditions to be encountered over that drive. The tunnel would be constructed beneath the water table through varying ground conditions of clay, gravels, sand, silty clay and chalk.

Figure 4.1 EPB TBM diagram

Figure 4.2 Slurry TBM diagram

4.2.15 In each case, excavated material or slurry would be passed back from the tunnel face to the drive shaft, either by conveyor, pipeline or by a railway system. Tunnel lining materials would be passed forward to the tunnel face from the drive shaft by a railway system. Therefore, the majority of site logistics for main tunnel drive sites are associated with the delivery of the tunnel lining segments and the removal of the excavated materials.

4.2.16 The type of TBM to be used for a particular drive would have implications for the drive site which serves it, because the site set-up must handle excavated material in the form that it is removed from the face of the TBM. For example:

a. An EPB machine produces excavated material that is dryer than a slurry machine and can be removed from the tunnel by either conveyor or construction train.
b. With a slurry TBM, slurry (usually bentonite) is supplied to the excavated face, where it both supports the face of the ground and combines with the excavated material to allow it to be pumped to the surface. The pumped mixture is then treated, by a processing plant, to separate the slurry from the excavated material, such that the excavated material can be removed from site.

4.2.17 TBMs require large electrical power supplies to be provided to the site. It is currently expected that this supply would be provided from the local electrical high-voltage supply network, which may need new substations at some locations to meet the power requirements of this project.

4.3 CSO connection tunnel

4.3.1 CSO connection tunnels are expected to range from 2.2m to 5m internal diameter. The minimum internal diameter to allow access and inspection is 2.2m. The long and larger diameter connection tunnels are expected to be constructed using TBMs, ie, constructed in the same way that the main tunnel would be constructed, but using smaller diameter TBMs.

4.3.2 For short connection tunnels in cohesive ground conditions, it may be appropriate to install sprayed concrete linings rather than concrete segments, or to use a different construction technique, such as traditional hand-dig methods.

4.3.3 Smaller connection tunnels of less than 2.5m internal diameter may be constructed using pipe-jacking techniques.

4.3.4 The pipe-jacking technique uses a small slurry or EPB TBM to excavate the ground. However, instead of the lining being constructed from segments immediately behind the TBM, whole concrete pipes are in-line at the drive shaft and the entire pipe string is 'jacked' (pushed) forward, using steerable, remote controlled, hydraulic rams located at the bottom of the shaft. The jacking force propels the TBM and installs the pipe. During tunnelling, bentonite slurry is injected along the line of the pipe as lubricant. When tunnelling is completed, grout is injected to support the ground.

4.4 Main tunnel drive sites – construction phase

Purpose

4.4.1 The main tunnel drive sites are required for constructing the main tunnel and would be used to facilitate:

a. construction of the drive shaft
b. assembly of TBMs at the beginning of tunnel sections
c. construction of the main tunnel
d. removal of excavated material in solid or slurry form from the tunnel
e. short-term storage of excavated material
f. short-term storage of material such as concrete segments for primary tunnel lining
g. access to the tunnel for workers during construction  
h. ventilation for workers in the tunnel  
i. pumping out any water ingress from the tunnel during excavations  
j. connection to a power supply for the TBM and other underground construction equipment  
k. access for secondary lining construction, if required  
l. permanent access to the tunnels when the project is operational  
m. possible CSO connection tunnel construction  
n. possible CSO interception works construction.

Timing

4.4.2 It is anticipated that main tunnel drive sites would be required as construction sites for six years (excluding advance works such as utility connections and utility diversions).

Location

4.4.3 Engineering requirements for the locations of main tunnel drive sites are that they:

a. are directly above the main tunnel  
b. have ground conditions that are suitable for a shaft of the requisite depth to be constructed safely  
c. optimise the tunnel drive lengths to allow efficient construction (ie, matching drive lengths with TBM type and risks, such as possible breakdowns posed by different ground conditions, and matching drive lengths to points that would be convenient to connect multiple CSOs)  
d. provide an area that can accommodate the construction related activities given in Section 4.4.11  
e. allow opportunities for access to the river for the supply and removal of materials where practicable and cost-effective  
f. are on land, because the size of the main tunnel drive sites required during construction means it would not be practical to accommodate them on platforms entirely in the river, and because the main tunnel drive shaft would be used to provide access to the tunnel network once the system is operational  
g. provide access for construction of the secondary lining, if required  
h. satisfy health and safety requirements regarding safe egress from the tunnel by the workforce in an emergency.

4.4.4 There are also planning, environmental, community and property considerations which are addressed in the site selection process as set out in the Site selection methodology paper.
Main tunnel site search area

4.4.5 The main tunnel search area applies to all site types: drive, reception and intermediate.

4.4.6 The limit of the search area for the most westerly main tunnel site is in the vicinity of the most westerly of the CSOs to be intercepted, which is the Acton Storm Relief CSO.

4.4.7 The limit of the search area for the most easterly main tunnel site is in the vicinity of Abbey Mills Pumping Station.

4.4.8 The general limit to the width of the site search area was 500m on both the north and south sides of the river, measured from the river edge, because:

a. the main tunnel is intended to generally follow the route of the river and the shafts on the main tunnel need to be close to the river

b. the further away from the river that main tunnel sites are located, the more likely it is that the potential benefit of using river transport would be significantly reduced. The opportunity to be able to use the river to transport materials (where practicable and cost-effective) is considered to be an important consideration of the project

c. the further away from the river that main tunnel sites are located, the more the main tunnel would have to pass under built-up land

d. it is likely that the CSO interception chambers would be close to the river and there would be interception chambers on both sides of the river, so the closer the main tunnel follows the route of the river, the shorter the CSO connection tunnels would be.

4.4.9 It was, however, recognised that sites outside a 500m limit would be required. The search area was extended to encompass two areas away from the river – the area around Acton Storm Tanks and the area around Abbey Mills Pumping Station – in order to investigate the potential for sites with which to construct the main tunnel on the Abbey Mills route.

Main tunnel drive site activities

4.4.10 Typical activities, facilities and space requirements associated with a main tunnel drive site situated on a single site are illustrated in Figure 4.3 and Figure 4.4.

4.4.11 The following list of typical core and ancillary activities is illustrative and not exhaustive:

Core activities

a. Construction of the shaft and tunnel

b. Deliveries of construction materials for shaft excavation, TBM assembly and tunnelling

c. Storage, treatment and removal of excavated material arising from the shaft excavation and the tunnel excavation
d. Material stockyard for tunnel segments and accessories, including loading/unloading area (double handling would be required if this was not a core activity)

e. Cranage of materials within the worksite into and out of the tunnel shaft

f. Secondary lining equipment, materials and resources, if required

Ancillary activities

g. Where practicable and cost-effective, river access comprising a wharf/jetty to service barges

h. Workshops to maintain all the mechanical and electrical plant, large stores for spare parts, stockyard for rails, pipes, grease, foam/flocculants, cable drums, timber, cooling plant, generators, backup equipment and TBM power supply installations

i. Construction offices, welfare facilities and medical facilities

j. Parking for construction traffic, which would be kept to a minimum in accordance with the Green Travel Plan

k. Incoming and outgoing goods/materials consolidation/marshalling

l. Vehicle and pedestrian circulation areas.

4.4.12 A concrete batching plant for the secondary lining may be required. A concrete batching plant mixes aggregate, sand, cement and water to produce concrete on the site, but an alternative would be to use ready-mixed concrete, delivered to site by concrete mixer lorries. Such a facility would not be required until after tunnel excavation had been completed and therefore would not require additional space, but could be located on site areas released from other completed activities.

Transport of materials

4.4.13 The main tunnel drive sites would be used for construction of the shaft and the main tunnel. It would be necessary to transport excavated material away from the main tunnel drive shaft sites and to deliver a wide variety of materials, including the precast concrete segments for the primary lining of the tunnel. Other logistical activities would include workforce arrival/departure, equipment deliveries/return, consumables delivery and waste removal.

4.4.14 Due to the large volume of materials to be transported, the objectives are to use river transport to:

a. transport main tunnel excavated material where shafts are adjacent to the River Thames

b. import and export backfill material for cofferdam construction

c. enable construction contractors to move other materials by river where practicable and cost-effective.
4.4.15 A barge operation would only be practical if:
   a. the material can easily be conveyed between the shaft and the river
   b. a staging area can be located at the barge sites
   c. the river can accommodate barges of adequate capacity
   d. the barge operations would not conflict with other uses and users of the river
   e. it is commercially viable.

4.4.16 It is currently assumed that:
   a. the main tunnel drive sites are currently anticipated to be near the river and hence such river transport is possible. Where river transport is used, wharfs and/or jetties would need to be able to accommodate barge-type vessels, ideally within a wide tidal range
   b. materials delivered to the sites would be transported by road as river transport may not be cost-effective or logistically efficient.

4.4.17 The practicality of rail transportation would depend on the proximity of the main tunnel drive sites to suitable rail sidings and the local network capacity for freight movements.

4.4.18 Highway access routes would be identified as part of the project development for materials delivered to site. Major deliveries/removals would be subject to specific movement restrictions and conditions imposed by the police and traffic authorities.

**Site size**

4.4.19 In order to provide space for both core and ancillary activities, it is anticipated that main tunnel drive sites:
   a. from which slurry TBMs would be driven would need approximately 20,000m²
   b. from which EPB TBMs would be driven would need approximately 18,000m².

4.4.20 The difference in site size is due to the excavated material handling activity of EPB TBMs requiring less space than that for a slurry TBM.

4.4.21 These approximate site areas have been based on assumptions concerning tunnelling construction rates, working hours, excavated material processing requirements, excavated material storage duration and concrete segment storage duration.

4.4.22 These areas assume that all facilities would be provided on one site and on land. Structures and storage areas would generally be low-level buildings, with cranes being the only high feature. If core and ancillary activities are spilt across two sites, it is likely that the combined area would be larger.

4.4.23 If the activities have to be constrained onto a smaller site, this could be accommodated by raising the height of buildings and structures, and by reducing the time that excavated material is stored on site. For example,
by adopting such measures, a main tunnel drive site from which an EPB TBM would be driven could reduce in size from approximately 18,000m$^2$ to approximately 15,000m$^2$. However, the more constrained construction activities become, the more likely there would be adverse impacts on factors such as transport of materials, construction periods, cost, and health and safety.

4.4.24 Typical areas used for the slurry TBM and EPB TBM site set-ups are indicated in Figure 4.3 and Figure 4.4 respectively. Note that the ‘rectangular’ shape in the plan is indicative only as individual site boundaries and constraints will affect the layout of facilities needed at each site.

**Figure 4.3 Main tunnel drive site for a slurry TBM, site area 20,000m$^2$**
4.4.25 It may be necessary to drive the main tunnel in two directions from the same location where the tunnel would either be:

a. tunnelled in one direction first and the other direction second (ie, sequentially)

b. tunnelled in both directions at the same time (ie, concurrently).

4.4.26 If tunnelled sequentially:

a. the site size would be the same as a single main tunnel drive site, because only one tunnel would be constructed at a time

b. the construction duration would be longer as the second tunnel would start after the first tunnel had been excavated.

4.4.27 If tunnelled concurrently:

a. the site size would be larger than a single main tunnel drive site, because two tunnels would be constructed at the same time

b. the construction duration would be longer as the tunnels would not start together, but the duration would be shorter than if the tunnels are constructed sequentially.

4.4.28 If double main tunnel drive sites are required, then consideration would be given to sharing facilities in order to reduce the overall site area required, and to making the most efficient use of transportation facilities to minimise disruption from delivery and removal operations.
4.4.29 Depending on the potential for facilities to be shared, double main tunnel drive sites could range in size from 20,000m² in space constrained areas using one contractor, to 40,000m² in unconstrained areas using more than one contractor.

4.5 Main tunnel sites – operational phase

4.5.1 The structures and equipment required at main tunnel sites for the operational phase is not dependent on whether the site is used as a drive, reception or intermediate site at the construction phase.

4.5.2 It is anticipated that the following air management structures would be required:

a. Most main tunnel sites would require a passive filter chamber comprising below-ground odour treatment equipment.

b. Most main tunnel sites would require an above-ground ventilation structure, approximately 4m high, to control air movement out of and into the shaft and tunnels. Architectural design will influence whether this is provided as a single wider structure or a series of narrower structures.

c. Some main tunnel sites would require a ventilation building (to house active mechanical ventilation plant for air extraction/intake and air treatment/odour control) and a ventilation column, approximately 15m high.

4.5.3 All main tunnel sites would require the following:

a. Space adjacent to the shaft would be required to accommodate mobile cranes for moving people and materials in and out of the shaft for inspections and maintenance.

b. Adequate access from the highway to allow cranes and other vehicles to enter the site. Access routes/areas could be shared with others or be part of the existing road network.

4.5.4 The top structure of shafts may need to be about 104.5mATD (4.5mAOD) and therefore could be visible above ground level, depending on existing ground levels. All shafts may have manhole covers capable of being accessible by mobile cranes so that periodic inspections can be carried out.

4.5.5 Thames Water operational personnel would require access periodically for inspection and maintenance purposes. It is anticipated that this would include:

a. main tunnel and shaft inspections once every ten years

b. equipment inspections or maintenance (eg, ventilation equipment, penstocks) once every three to six months. Such equipment would be located in chambers and not deep drop shafts

c. visits for unplanned maintenance or repairs; for example, if there is a blockage or equipment failure.
4.5.6 Due to the depth of the shafts, for health and safety reasons, access into the shafts would be via man-riders lowered from cranes.

4.6 **Main tunnel reception sites – construction phase**

**Purpose**

4.6.1 Main tunnel reception sites would be used to facilitate:
- construction of the reception shaft
- dismantling and removal of TBMs at the end of tunnel sections
- access for secondary lining construction, if required
- possible CSO connection tunnel construction
- permanent access to the tunnels when the project is operational.

**Timing**

4.6.2 It is anticipated that main tunnel reception sites would be required as construction sites for four to five years (excluding advance works such as utility connections and utility diversions).

**Location**

4.6.3 Engineering requirements for the locations of main tunnel reception sites are that they:
- are directly above the main tunnel
- have ground conditions which are sufficiently good for a shaft of the requisite depth to be constructed safely
- optimise the tunnel drive lengths to allow efficient construction
- provide an area that can accommodate the construction related activities given in Section 4.6.6
- are on land, because the shaft would be used to provide access to the tunnel network once the system is operational
- provide access for construction of the secondary lining, if required
- satisfy health and safety requirements regarding safe egress from the tunnel by the workforce in an emergency.

4.6.4 There are also planning, environmental, community and property considerations, which are addressed in the site selection methodology and process as set out in the *Site selection methodology paper*.

**Main tunnel reception site activities**

4.6.5 Typical activities, facilities and space requirements associated with a main tunnel reception site situated on a single site are illustrated in Figure 4.5 and Figure 4.6.
4.6.6 The following list of typical core and ancillary activities is illustrative and not exhaustive:

**Core activities**

a. Construction of the shaft  
b. Delivery of construction materials for shaft excavation and TBM removal  
c. Storage, treatment and removal of excavated material arising from the shaft excavation  
d. Cranage of shaft excavation material and workforce access  
e. Secondary lining equipment, materials and resources, if required

**Ancillary activities**

f. Workshop and stores  
g. Construction office, parking and welfare facilities  
h. Vehicle and pedestrian circulation areas.

4.6.7 If secondary lining is required, a concrete batching plant for secondary lining may be used instead of ready-mix concrete. Such a facility would not be required until after shaft excavation was completed and therefore would not need additional space.

**Transport of materials**

4.6.8 River transport at main tunnel reception sites is not likely as the volume of materials handled at these sites would be much lower than at main tunnel drive sites. This is because neither excavated material from the tunnel nor primary lining concrete segments would be handled at main tunnel reception sites. However, the opportunity for barge facilities at such sites would be considered.

4.6.9 Deliveries and shaft excavated material are expected to be transported by road, and the highway access routes would be developed as part of the project development.

**Site size**

4.6.10 In order to provide space for both core and ancillary activities, it is anticipated that an area approximately 7,500m² would be required for main tunnel reception sites where shafts need to be constructed in Chalk ground conditions. For other ground conditions, sites would need to be approximately 5,000m².

4.6.11 More space is required for sites where shafts are constructed in Chalk ground conditions, because the shaft is likely to be constructed using the diaphragm wall technique, which takes more space than other shaft construction techniques.

4.6.12 Typical areas used for the above activities are indicated in Figure 4.5 and Figure 4.6. Note that the ‘rectangular’ shape in the plan is indicative only
as individual site boundaries and constraints will affect the layout of facilities needed at each site.

Figure 4.5 Main tunnel reception site, site area 7,500m²

Figure 4.6 Main tunnel reception site, site area 5,000m²

4.7 Main tunnel intermediate sites – construction phase

Purpose

4.7.1 If required, intermediate sites for the main tunnel would be used to facilitate:

a. construction of the intermediate shaft
b. planned inspections and maintenance of the TBMs
c. access for secondary lining construction
4 Tunnels

d. possible CSO connection tunnel construction
e. possible access to the tunnels when the project is operational.

Timing

4.7.2 It is anticipated that main tunnel intermediate sites would be required as construction sites for four to five years (excluding advance works, such as utility connections and utility diversions).

Location

4.7.3 Engineering requirements for the locations of main tunnel intermediate sites are that they:
a. are directly above the main tunnel
b. have ground conditions which are sufficiently good for a shaft of the requisite depth to be constructed safely
c. enable strategic inspection and maintenance points for the TBM
d. provide an area that can accommodate the construction related activities given in Section 4.7.6
e. provide access for construction of the secondary lining
f. satisfy health and safety requirements regarding safe egress from the tunnel by the workforce in an emergency.

4.7.4 There are also planning, environmental, community and property considerations, which were addressed in the site selection process as set out in the Site selection methodology paper.

Main tunnel intermediate site activities

4.7.5 Typical activities and facilities associated with main tunnel intermediate sites are illustrated in Figure 4.7 and Figure 4.8.

4.7.6 The following list of typical core and ancillary activities is illustrative and not exhaustive:

Core activities
a. Construction of the shaft
b. Delivery of construction materials for shaft excavation and TBM maintenance
c. Storage, treatment and removal of excavated material arising from the shaft excavation
d. Cranage of shaft excavated material and workforce access
e. Secondary lining equipment, materials and resources, if required

Ancillary activities
f. Workshop and stores
g. Construction office, parking and welfare facilities
4 Tunnels

h. Vehicle and pedestrian circulation areas.

4.7.7 A concrete batching plant for secondary lining may be required instead of using ready-mix concrete. Such a facility would not be required until after shaft excavation was completed and therefore would not need additional space.

**Transport of materials**

4.7.8 The transport of materials for main tunnel intermediate sites would be similar to those for main tunnel reception sites.

**Site size**

4.7.9 The site size requirements for main tunnel intermediate sites would be similar to those for main tunnel reception sites, ie, for intermediate sites where shafts are constructed in Chalk ground conditions, the area would need to be approximately 7,500m²; for ground conditions other than Chalk, the site would need to be approximately 5,000m².

4.7.10 Typical areas used for the above activities are indicated in Figure 4.7 and Figure 4.8. Note that the ‘rectangular’ shape in the plan is indicative only as individual site boundaries and constraints would affect the layout of facilities needed at each site.

**Figure 4.7 Main tunnel intermediate site, site area 7,500m²**
4.8 Change in site selection nomenclature

4.8.1 There are potentially three types of sites required to construct the main tunnel:
   a. Main tunnel drive sites
   b. Main tunnel reception sites
   c. Main tunnel intermediate sites.

4.8.2 Sections 4.4 to 4.7 show that the site area requirements and site activities are similar for main tunnel reception sites and main tunnel intermediate sites. Therefore, the site selection methodology was used to identify and shortlist two different types of main tunnel sites:
   a. Main tunnel drive sites
   b. Main tunnel reception/intermediate sites.

4.8.3 At the start of the site selection process, these two site types were termed:
   a. ‘main shaft sites’ (later termed ‘main tunnel drive sites’)
   b. ‘intermediate shaft sites’ (later termed ‘main tunnel intermediate sites’ and also applicable for ‘main tunnel reception sites’).
<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>combined sewer overflow (CSO)</td>
<td>A structure, or series of structures, designed to allow spillage of excess wastewater from a combined sewer under increased rainfall conditions. Flows may discharge by gravity or by pumping.</td>
</tr>
<tr>
<td>connection culvert</td>
<td>A covered channel structure that connects an interception chamber to a drop shaft.</td>
</tr>
<tr>
<td>connection tunnel</td>
<td>A tunnel that connects a drop shaft to the main tunnel.</td>
</tr>
<tr>
<td>CSO site</td>
<td>A site that contains the CSO interception chambers, connection culverts and the drop shaft from which the connection tunnel is built. Each site needs to provide enough space for all construction related activities, which vary depending on the diameter of the shafts and the method of tunnel construction.</td>
</tr>
<tr>
<td>drive site</td>
<td>A main tunnel site containing the shaft from which the tunnel boring machine is ‘driven’ forward, ie, starts from. Excavated material is removed from and segments are fed into the tunnel via the shaft at the drive site.</td>
</tr>
<tr>
<td>drop shaft</td>
<td>A vertical, circular structure that connects a connection culvert to a connection tunnel. This is used to drop flow down to the main tunnel level.</td>
</tr>
<tr>
<td>intermediate site</td>
<td>A site that contains the intermediate shafts from which the construction of the main tunnel is supported by activities such as secondary lining. Each site needs to provide enough space for all construction related activities, which vary depending on whether the concrete for the secondary lining is made on the site or made elsewhere and delivered to the site by lorries.</td>
</tr>
<tr>
<td>Lee Tunnel</td>
<td>The Lee Tunnel comprises a storage and transfer tunnel from Abbey Mills Pumping Station to Beckton STW and the interception of the Abbey Mills CSO.</td>
</tr>
<tr>
<td>main tunnel</td>
<td>The tunnel from Abbey Mills to Acton Storm Tanks.</td>
</tr>
<tr>
<td>main tunnel site</td>
<td>A site from which the main tunnel is built. Each site needs to provide enough space for all construction related activities, which vary depending on the type of tunnel boring machine used and whether the site is a drive site, a double drive site or a reception site.</td>
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</tbody>
</table>
### Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
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<tbody>
<tr>
<td>mitigation measures</td>
<td>Actions proposed to moderate adverse impacts and to enhance beneficial impacts arising from the whole or specific elements of the development.</td>
</tr>
<tr>
<td>pumping station</td>
<td>A vertical, circular structure that has pumps located at the bottom. This is used to lift storm water flows up to the sewage treatment works.</td>
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<tr>
<td>receptors</td>
<td>People (both individually and communally) and the socio-economic systems they support.</td>
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<tr>
<td>reception site</td>
<td>A main tunnel site that contains the shaft from which the tunnel boring machine is ‘received’, ie, ends up. The tunnel boring machine is removed from the tunnel via the shaft at this reception site.</td>
</tr>
<tr>
<td>sewage or wastewater</td>
<td>Waterborne wastes from domestic uses of water, derived from households, trade and industry.</td>
</tr>
<tr>
<td>sewerage</td>
<td>A system of pipes for the collection and transportation of domestic and industrial wastewater.</td>
</tr>
<tr>
<td>shaft</td>
<td>Duct/pipe/vertical tunnel.</td>
</tr>
<tr>
<td>storm water</td>
<td>Rainwater that funnels into sewers to be mixed with sewage and is either treated at sewage works or overflows into rivers.</td>
</tr>
<tr>
<td>Thames Tideway Tunnel project</td>
<td>The Thames Tideway Tunnel project comprises a main tunnel, running from west to east London that is integrated with the existing sewerage system via connection tunnels in order to control 34 ‘unsatisfactory’ CSOs. These tunnels store and transfer the intercepted flows to Beckton STW. The project consists of two main elements:  - Works to design, construct and maintain the main tunnel, which provides the majority of the storage capacity and enables transfer of combined sewage to Beckton STW in east London.  - Works to control and intercept combined sewage overflows unsatisfactory CSOs and transfer them into the main tunnel. This includes connection tunnels to link intercepted CSOs to the main tunnel.</td>
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<tr>
<td>Tideway</td>
<td>The tidal area of the River Thames (ie, from Teddington to the Thames Estuary).</td>
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<tr>
<td>tunnel alignment</td>
<td>The horizontal and vertical route of the proposed tunnels, including connection tunnels and main tunnel sites.</td>
</tr>
<tr>
<td>tunnel boring machine</td>
<td>A machine with a circular cross-section that is used to excavate tunnels through a variety of ground conditions.</td>
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</tbody>
</table>
For further information or to comment on our proposals please see our website: www.thamestunnelconsultation.co.uk

It is very important that you understand the information we have provided. If you need further information in another language, braille, large print or audio format please contact us on 0800 0721 086.