Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Design and Access Statement

Doc Ref: **7.04**

Part 1

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

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Creating a cleaner, healthier River Thames

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Design and Access Statement

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Part 1

Executive Summary

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Section 1

Executive summary

1.1.1 The purpose of this statement is to describe the design of the permanent above ground elements (including landscape design) of the Thames Tideway Tunnel. The statement sets out the background to the project and our approach to and development of good design on a project-wide and site-by-site basis.

1.1.2 Sections 2-4 of the statement set out the need for good design (as stated within the National Policy Statement for Waste Water (NPS)), framed within an acceptance of the functional requirements and physical constraints which a project of this nature is bound by. The statement then sets out our approach to good design and outlines the public phases of consultation and how we have engaged with the Design Council CABE (formerly CABE (Commission for Architecture and the Built Environment)) and our other pan-London stakeholders to ensure continued engagement in the design development process. They go on to explain our tiered approach to seeking different levels of approval on the various elements/sites.

1.1.3 Section 5 outlines our design objectives and provides an overview on how we have integrated the project-wide functional components in our designs as well as our over-arching approach to sustainability and accessibility. The statement then describes the project-wide design principles which are used to underpin the design of the permanent above-ground elements of the Thames Tideway Tunnel and establish parameters that must be met in the final detailed design. It goes on to describe the design and development of the "signature" ventilation column and other project-wide elements.

1.1.4 Sections 6-29 provide detailed description of our design development on a site-specific basis. Each section sets the context for the project development and charts the design evolution and alternative options considered through phases of consultation and Design Council CABE reviews. Each site-specific section shows how the functional components have influenced the above-ground appearance. The site-specific design objectives are introduced and these frame the future appearance of the site which is set out at varying levels of detail, depending on outcomes of discussion and engagement with the relevant local authority.

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Part 1

Introduction

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Section 2

Introduction

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2.1 Purpose of this report

2.1.1 This *Design and Access Statement* (DAS) is one of the supporting documents submitted as part of the application for development consent (the 'application') for the Thames Tideway Tunnel project (the 'project').

2.1.2 The DAS sets out the designs for the permanent spaces and above-ground structures and the permanent access arrangements for each of the 24 proposed development sites. It sets out the site context and explains how this was taken into account in developing the designs. It also describes the main alternatives to the designs that were considered, how the designs evolved in response to the public and stakeholder consultation process and the reasons for selecting the proposed designs.

2.1.3 This DAS is submitted for information to inform the consideration of the application with respect to design matters.

2.1.4 The designs outlined in this DAS have been framed by the design principles which set out fixed principles on both a project-wide and site-specific level. These are contained uin the *Design Principles* document which accompanies the application and is submitted for approval. The draft Development Consent Order (DCO) contains a number of proposed requirements (similar to planning conditions) to be attached to approval. The purpose of the DCO requirements is to ensure that any subsequent detailed design work complies with the Site works parameter plans and the Design principles.

2.2 DAS requirements

2.2.1 There is no specific statutory requirement for a DAS for applications for development consent under thePlanning Act 2008 (as amended by the Localism Act 2011) (the '2008 Act'); however, Regulation 5(2)(q) of the Applications: Prescribed Forms and Procedure Regulations 2009 does provide for any other documents considered necessary to support such applications. Appendix 1 to Planning Inspectorate Advice Note 6 (June 2012) includes reference to a DAS under 'other documents'.

2.2.2 The requirements that apply to a DAS prepared for conventional planning applications under the Town and Country Planning Act 1990 are set out in Article 8 of the Town and Country Planning (Development Management Procedure) (England) Order 2010 (DMPO). Associated guidance is set out in section 3 of DCLG Circular 01/2006. The DMPO provides that certain categories of development do not require a DAS, including engineering and mining operations, and the erection of certain categories of buildings for non-domestic purposes and on operational land. Therefore the requirements of the DMPO and Circular 01/2006 do not strictly apply to this application for development consent because the project is an engineering operation.

2.2.3 This DAS is provided to demonstrate how we took account of the criteria for good design contained in the National Policy Statement for Waste Water (the 'NPS'). It also seeks to demonstrate that the proposed development would be as attractive, durable and adaptable as possible, taking account of regulatory and other constraints.

2.2.4 The structure and content of this DAS reflects the special characteristics of the project. It is a Nationally Significant Infrastructure Project (NSIP) and would predominantly be constructed below ground. The requirements of Article 8 of the DMPO and the standard guidance relating to the form and content of the DAS were therefore used as a guide in this context.

2.2.5 The scale and amount of the development was determined largely by the functional and hydraulic requirements. The *Engineering Design Statement*, which accompanies the application, deals with the technical aspects of the project and explains how it complies with relevant EU or UK technical standards for design, construction, installation and maintenance.

2.2.6 This DAS is concerned primarily with the physical aspects of the above-ground permanent works. However, it is important to note that the position, scale and layout of the proposed above-ground structures is closely related to the alignment of the main tunnel, the position of the below-ground structures and the functional requirements of the project as a whole.

2.3 Structure of the DAS

2.3.1 This document is structured as follows:

a. Section 1 Executive Summary

b. Section 2 Introduction states the purpose of this DAS

c. Section 3 The Thames Tideway Tunnel project: this section provides an overview of the proposed development.

d. Section 4 Project approach to good design: this section is sub-divided into two:

i Section 4.1 Need for good design: this section explains the policy context requiring good design set out in the NPS.

ii Section 4.2 Achieving good design: this section describes the processes we have followed to date to ensure good design.

e. Section 5 Project-wide design principles and components: this section explains the design approach and the key design principles that were applied across the whole scheme. It considers the project-wide design context and its operational and functional requirements. It also sets out how sustainability considerations were incorporated into the designs and design process. It is subdivided into four as follows:

i Section 5.1 Project-wide design context: this section describes London-wide (non site-specific) factors that influenced our proposals across the project.

ii Section 5.2 Design evolution and alternatives: this section considers the evolution of project-wide design components and principles.

iii Section 5.3 Project-wide design proposals: this section outlines our design objectives and common design features.

iv Section 5.4 Project-wide components and themes.

f. Sections 6 to 29: These sections describe the present-day and historical context of each site and the existing status of access and movement in and around the sites. We analyse the constraints associated with the sites and the design opportunities that we identified.

We describe the evolution of the designs from the initial design concepts to the alternative solutions developed through engagement with the public, statutory stakeholders, landowners and the Design Council CABE. Some sites are more sensitive than others and the degree of engagement with stakeholders and the relevant local authorities varied. We then describe the proposed design, the integration of the functional components, and the landscaping and appearance, where relevant. Finally, we set out the permanent access arrangements and Thames Water's access requirements for on-going inspection and maintenance purposes.

2.3.2 In writing the site-specific sections we had regard to the guide *Design and access statements: How to write, read and use them published* by CABE(now the Design Council CABE). However, due to the nature of the project it was not possible to explicitly follow the key assessment areas set out in this guidance.

2.3.3 The physical, social, economic and planning policy context assessments are not explicitly identified in the DAS; however, key themes are drawn out where possible in the assessments of the context of each site.

2.3.4 In terms of planning policy, we had regard to relevant local and regional policies; however, the acceptability of our designs was not tested against these policies. The key test of the project's acceptability is the NPS. The *Planning Statement* provides a full assessment of the planning policy context for the project and the *Environmental Statement* addresses the economic context of the project.

2.3.5 CABE guidance suggests breaking down the key areas of design into five main themes: use, amount, layout, scale and landscaping. This approach is not necessarily practical for an engineering and landscape project such as this, where the sites are largely dictated by functional and operational requirements and above-ground structures are kept to a minimum. Each site-specific chapter tells the story of the development and evolution of the design. The five themes are not dealt with under separate headings, instead they are embedded into the description of the designs and landscaping, where appropriate.

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The project

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Section 3

The Thames Tideway Tunnel project

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3.1 Project context

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

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

3.1.3 Solutions to the problem of wastewater discharges into the tidal reaches of the River Thames have been under examination for more than ten years. As stated in the NPS, "A tunnel was identified as the best solution in 2007 following detailed studies including the Thames Tideway Strategic Study".

3.2 The proposed solution

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

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

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

3.3 Planning context

3.3.1 The NPS, which was designated on 26 March 2012, clearly states that the need for the project has been demonstrated. It concludes that "*detailed investigations have confirmed the case for a Thames Tunnel as the preferred solution*" (para. 2.6.33).

3.3.2 On 22 June 2012, the Secretary of State made the Infrastructure Planning (Waste Water Transfer and Storage) Order 2012 pursuant to Section14(3) of the 2008 Act. This order created a new category of NSIPs into which the project falls. Following the making of the order, the project formally became an NSIP to which the procedures under the 2008 Act apply.

3.3.3 The Planning Inspectorate is responsible for examining applications for NSIPs, which are granted in the form of DCOs. The Secretary of State has assumed responsibility under the 2008 Act for deciding such applications and will judge the application for development consent for the project primarily on the basis of the policies in the NPS.

3.3.4 Promoters of applications for development consent must undertake pre-application public consultation and publicity and have regard to feedback prior to submission of the application. The planning team has therefore carried out extensive consultation and publicity in accordance with the relevant statutory requirements.

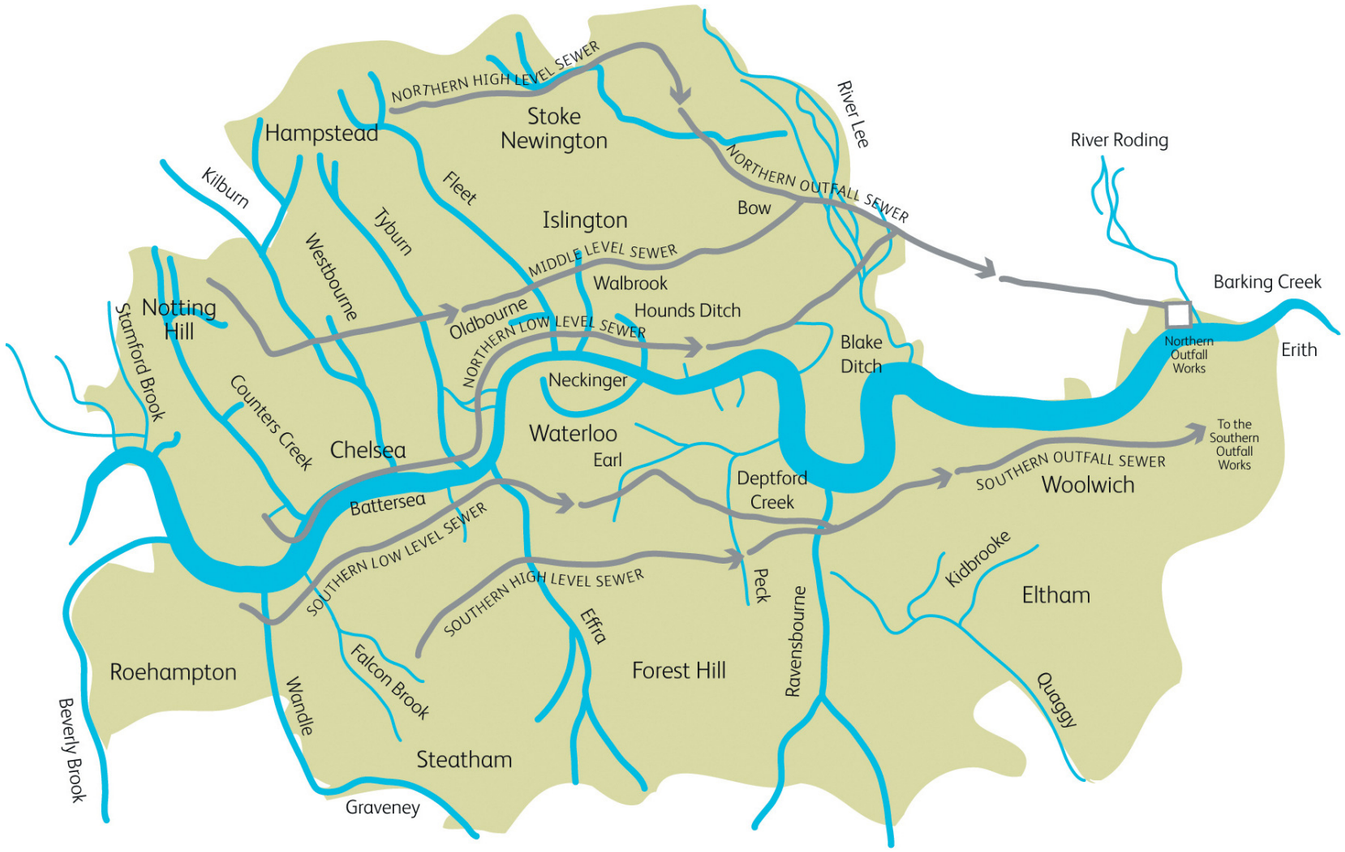

Figure 3.1: Diagram of London Showing Sir Joseph Bazelgettes Interceptor sewers

3.4 Project overview

3.4.1 The project comprises two principal elements:

a. tunnels:

i the main tunnel

ii connection tunnels.

b. sites:

i main tunnel sites

ii CSO sites

iii system modification sites

iv Beckton Sewage Treatment Works.

3.5 Tunnels

Main tunnel

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

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

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

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

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

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

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

Connection tunnels

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

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

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

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

3.6 Site types

3.6.1 The Environment Agency has identified 34 'unsatisfactory' CSOs that the project needs to address.

3.6.2 The 34 CSOs would be controlled by the following methods:

a. 15 CSOs would be controlled by flows being intercepted to divert them into the main tunnel

b. three other CSOs that would be controlled by diverting their flows into the main tunnel next to three connections which would be made to the existing northern Low Level Sewer No.1.

c. the flows from ten other CSOs would be controlled due to the extra capacity in the northern Low Level Sewer No.1 resulting from method (b) which would enable it to handle flows from other CSOs without needing to intercept them so that no worksites would be required at these ten CSOs

d. five CSOs would be controlled through modifications to change the operation of the existing sewerage system, including adjustments to existing pumping stations and local in-sewer modifications that allow flows to be stored and passed forward through the existing sewerage system to the sewage treatment works. Only two would require worksites.

e. local in-sewer modifications works have been carried out resulting in flows for one CSO already being controlled.

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

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

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

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

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

3.7 Above-ground permanent works

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

a. air management facilities including ventilation equipment buildings and ventilation columns

b. a kiosk structure to house electrical and control equipment

c. a means of access

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

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

3.7.3 Construction sites would be restored on completion of the works by means of levelling, in-filling, landscaping and making good.

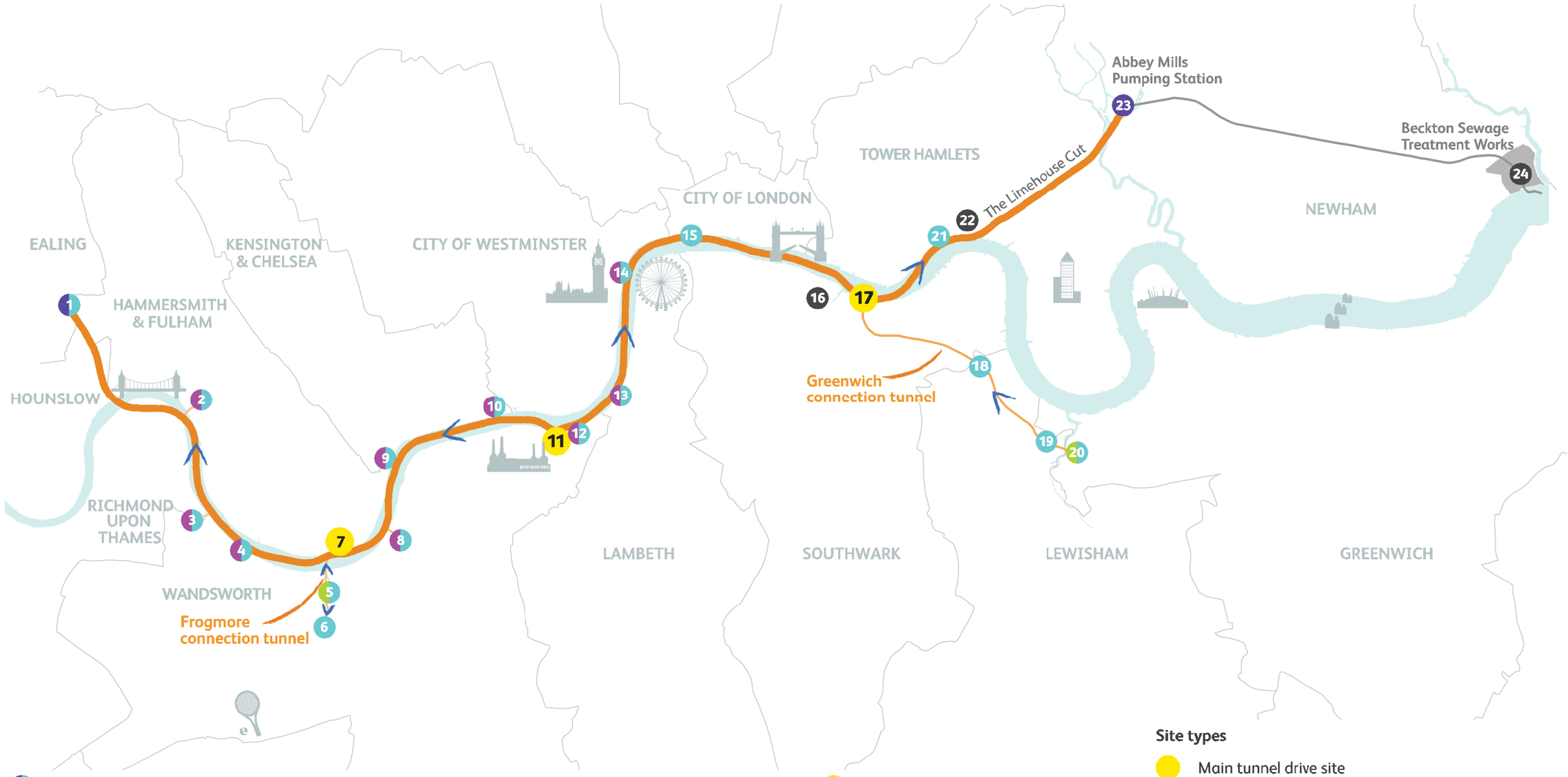

Figure 3.2: Thames Tideway Tunnel sites

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Good design

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Section 4

Project approach to good design

4.1 The need for good design

4.1.1 It is an established planning principle that good design is a fundamental component of sustainable development.

4.1.2 Section 3.5 of the NPS sets out the criteria for the 'good design' of wastewater infrastructure. It states the following:

"3.5.2 [T]he decision maker needs to be satisfied that waste water infrastructure developments are sustainable and, having regard to regulatory and other constraints, are as attractive, durable and adaptable (including taking account of natural hazards such as flooding) as they can be. In doing so, the decision maker should satisfy itself that the application has taken into account both aesthetics and functionality (including fitness for purpose). Applicants and the examining authority should consider taking independent professional advice on the design aspects of a proposal. In particular, Design Council CABE [...]

"3.5.2 The Development should, by the use of good architecture and appropriate landscaping, be as visually attractive as possible. While the application may have no, or very limited choice in the physical appearance of some waste water infrastructure, there may be opportunities for the applicant to demonstrate good design in terms of siting relative to existing and currently planned landscape character, landform and vegetation. Furthermore, the design and sensitive use of materials in any associated development such as control rooms and pumping stations will assist in ensuring that such development contributes to the quality of the area.

"3.5.3 Applicants should set out the main alternatives to the design that they have considered and the reasons why the favoured choice has been selected, demonstrating that all proposed and alternative infrastructure meets the relevant EU or UK technical standard for design, construction, installation and maintenance, where such standards exist, and where they do not, that these components of design are fully explained by the applicant. [...] [T]he decision maker should take into account the ultimate purpose of the infrastructure and bear in mind the operational, safety and security requirements which the design has to satisfy".

4.1.3 We have consistently striven to develop high quality designs that respond to the below-ground engineering constraints and take account of comments from our key stakeholders and the public. We are committed to leaving a positive legacy, improving spaces and movement where possible, and ensuring that the imprint across our sites is aesthetically pleasing and long lasting.

4.1.4 The design evolution was an iterative process. We consistently looked at ways to achieve good design by investigating alternative options and solutions at each site. The site-specific sections of this document illustrate the progression of our thinking and identify why particular options were brought forward. They demonstrate how our design development process responded to consultation and, where practical and beneficial, incorporated consultation responses into the designs. At phase two consultation, we also produced the Design development report, which illustrated how the scheme had evolved up to that stage and where alternative solutions were selected.

Figure 4.1: Example of good design in recent Thames Water projects at Pudding Mill Lane Pumping Station on the Olympic Site (Source: Olympic Delivery Authority)

4.2 Achieving good design

4.2.1 Developing good design, including good urban design, was an essential focus of the Thames Tideway Tunnel. We had regard to the policies of the NPS, seeking to achieve a good quality of design in all areas within the physical constraints associated with wastewater infrastructure projects. We engaged a number of strategies to develop and deliver design quality:

a. developing designs in an integrated team

b. public consultation and stakeholder engagement

c. design reviews

d. accommodation of future developments.

The integrated design team

4.2.2 The team responsible for developing the design includes Architects, Landscape Architects, town planners and engineers from a variety of specialisms including marine, hydraulic, structural and traffic engineering. The team also worked closely with environmental specialists who were undertaking the Environmental Impact Assessment (EIA). Achieving good design means weighing and balancing the requirements of these specialist disciplines along with the factors raised as part of consultation and engagement.

4.2.3 The landscape, architecture and engineering designs were developed concurrently since phase one consultation. This was the key to producing good design as innovative engineering approaches enabled architectural solutions to demanding townscape constraints and vice versa. The consultants were co-located in a single office along with other disciplines, which facilitated the interplay between them.

4.2.4 The design was also significantly influenced by active collaboration with the EIA team as part of an iterative design process. As an overarching principle, the project development team actively sought to prevent, avoid, reduce or off-set adverse environmental effects and seek beneficial effects. As a result sustainability and environmental mitigation measures are embedded into the designs.

Public consultation and stakeholder engagement

4.2.5 Throughout the design development process, we attempted to engage with all directly affected local planning authorities and our pan-London stakeholders in order to take account of their views and to gain a full understanding of local constraints and opportunities. We sought to build good working relationships and where local authorities were prepared to work with us, we were able to progress designs and agree the appropriate level of detail at the relevant sites.

Design reviews

4.2.6 In addition to the public and stakeholder engagement process, it was agreed that the project would benefit from an independent and transparent review of the designs. The use of design reviews is recommended in para. 3.5.2 of the NPS and is supported in national planning policy, including para. 62 of the *National Planning Policy Framework*. Consequently, we commissioned a series of design reviews that were hosted and chaired by the Design Council CABE.

4.2.7 CABE is identified as a statutory consultee for NSIPs, in common with bodies such as the Environment Agency and English Heritage. From 1999 to 2011, CABE was the Government's advisor on architecture, urban design and public space. On 1 April 2011, CABE merged with the Design Council to become the Design Council CABE which although in it's new form is not identified as a statutory consultee, has been treated as one for the purposes of our pre-application discussion and engagement.

4.2.8 As part of this merger, all of CABE's panel members were transferred to the Design Council, which created a large pool of national panel experts. The Design Council CABE has considerable experience reviewing citywide and Thames-side projects, having recently completed a number of reviews of Crossrail sites and major mixed-use development sites in the London Borough of Wandsworth, the Royal Borough of Greenwich, the City of London and the City of Westminster.

4.2.9 The Design Council CABE panel for the project design reviews comprised independent Architects, Landscape Architects, Engineers, Urban Planners and an Access Specialist. The reviews were observed and contributed to by affected local planning authorities and pan-London stakeholders to capture any of their concerns and aspirations in relation to the proposals.

4.2.10 In order to make the process meaningful, we undertook two rounds of design review: sketch reviews and scheme reviews. The sketch reviews focussed on urban design and were based on options and sketch designs produced in advance of the detailed engineering design and environmental surveys, which were in progress. They assisted in the design development process and influenced the designs produced for phase two consultation.

4.2.11 These reviews covering each site were held over three days in April and May 2011. Representatives of all the relevant stakeholders including local authorities, the Greater London Authority, Transport for London, Natural England, the Environment Agency and English Heritage were invited and attended where possible.

4.2.12 The reviews were undertaken in the following format:

a. short presentation by the designer

b. invitation for stakeholders to comment

c. review and discussion by the panel of experts.

4.2.13 The scheme reviews were held prior to phase two consultation in June 2011. Scheme reviews were only undertaken for sites that required design amendments following the sketch reviews. These reviews followed the same format as the sketch reviews but comprised a single, more compete and detailed option.

4.2.14 Following the scheme reviews, the Design Council CABE issued a full appraisal of the proposals that set out how the panel believed the designs should proceed.

4.2.15 Further reviews with Design Council CABE were undertaken with regard to the targeted consultation design developments at both Putney Embankment Foreshore and Victoria Embankment Forshore.

Figure 4.2: Photo from one of our public consultation events

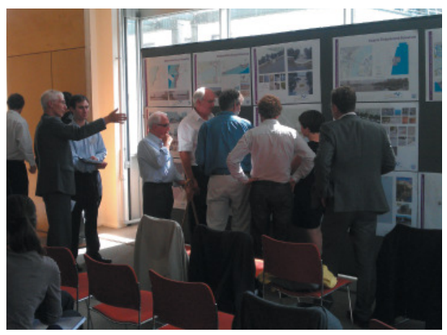

Figure 4.3: Photo from a Design Council CABE review

Flexibility to accommodate future Design development

4.2.16 The designs presented in sections 6 to 29 of this report are the result of the strategies set out above. In each section, we provide evidence of the process followed to produce good design. However, the design process is not yet complete. It is desirable to maintain some flexibility to continue design development after development consent is granted for a number of reasons, as follows:

a. It enables us to adapt to changes and possible improvements that might arise in the detailed design phase following any decision to grant development consent. For example, more detailed analysis and engagement might enable us to further reduce the footprint of the foreshore structures in the River Thames.

b. It enables us to respond to changed site conditions at the time of construction, particularly since several of the proposed development sites lie in or next to areas undergoing re-development.

c. It enables us to respond to further stakeholder feedback.

d. It enables us to use methodologies, plant and equipment selected by the contractors based on their experience and expertise, in order to construct the works as efficiently and safely as possible.

e. It enables us to develop designs and methodologies based on more detailed site and geological information available at the time of construction or in response to unforeseen circumstances.

f. It enables us to develop alternative procurement and contract packaging arrangements, which might, for example, change the current programme for the phases and duration of construction.

4.2.17 While it is important to maintain the ability to improve and develop the designs of the spaces and permanent above-ground structures going forward, we must also ensure that the final proposals reflect what has been consulted on with the public and agreed with stakeholders, particularly at sensitive sites where works have the potential to impact on listed structures.

4.2.18 We sought to achieve an appropriate balance between certainty and flexibility in relation to the designs. Therefore, the scheme for which approval is sought in the application falls within defined parameters and design principles, which would be secured (where appropriate) through DCO requirements. The project-wide design principles are set out in Section 5.7 and the site-specific design principles in Sections 6 to 29. The purpose of the design principles is to establish some fixed guidelines on the final design of the sites. They also formed part of the basis for the environmental assessments undertaken in relation to the project.

4.2.19 Where necessary, details of matters such as external appearance of above-ground structures and buildings will be submitted for future approval through DCO requirements. The details submitted will be required to be in accordance with the *Design Principles* and *Site Works Parameter Plan* for that site and where appropriate the indicative Landscape Plan. The *Planning Statement* provides further detail on the draft requirements included within the Draft DCO, both of which accompany the application.

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

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

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

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

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

4.2.20 The status of the designs was determined on a site-by-site basis and is covered in more detail in Sections 6 to 29.

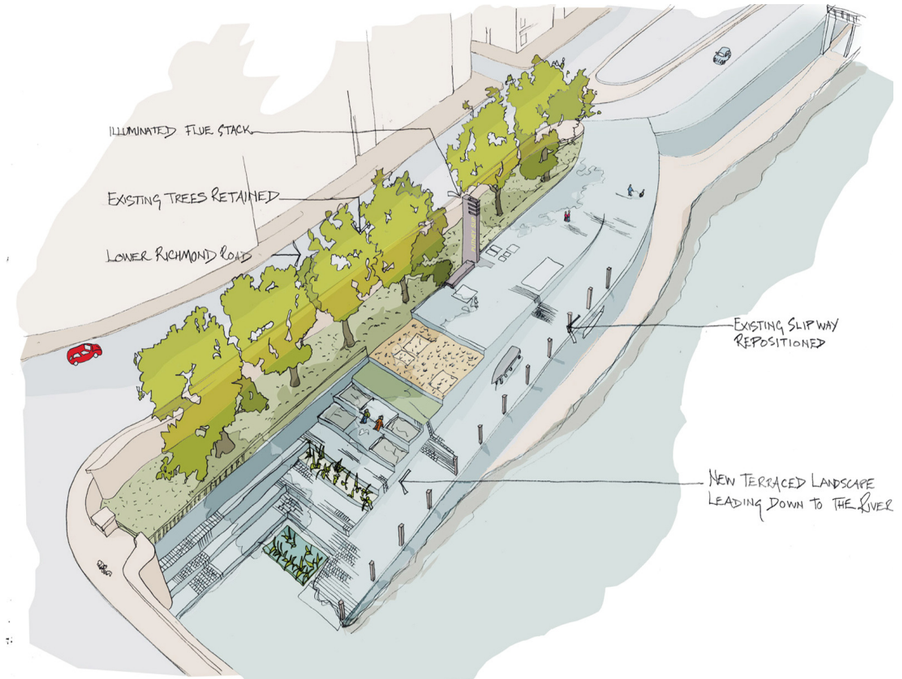

Figure 4.4: Flexibility in the design allows for future design development

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Part 1

Design Principles and components

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Section 5

Project-wide design principles and components

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5.1 Project-wide design context

5.1.1 The project requires 24 sites located throughout London. The context of each site varies dramatically and to the casual observer there is very little to link them. They are, however, linked together by two common factors.

5.1.2 Firstly, they would be linked by the proposed below-ground infrastructure in the form of the main tunnel and connection tunnels. This is the unseen infrastructure that physically ties them together. The tunnel system would extend and work in tandem with the existing sewerage system that has developed over the years to support the city's changing needs.

5.1.3 The second common factor is the River Thames itself. The river is one of London's most important resources for transport, ecology, commerce and leisure. Approximately two-thirds of the proposed development sites are located adjacent to or in the foreshore of the River Thames and its tributaries. However, even the sites that are physically remote from the river would play an important role in making it cleaner and healthier.

5.1.4 This section will explore how these 'London-wide' and 'project-wide' factors influenced the designs of the project.

Figure 5.1: Aerial photograph looking over Greenwich and the Isle of Dogs. King Edward Memorial Park is in the foreground

London's existing wastewater infrastructure

5.1.5 In order to understand the proposed works, it is important to put them in the context of London's wastewater infrastructure and the vital role it has played in enabling in the city's growth and development to date.

5.1.6 London's sewerage system is a vast and complicated network and whole rivers were enclosed within culverts as part of its development. Yet the below-ground network is largely unseen and unrecognised and its above-ground features are generally anonymous. For those who know what to look for, there are numerous ventilation columns, manhole covers and kiosks throughout the city. However, they are generally so understated as to be barely noticeable and form part of the urban background. Some of these structures have been listed by the Department for Media Culture and Sport (DCMS).

5.1.7 Some larger elements of the system, such as the various pumping stations are visible but, perhaps the most prominent elements in London's landscape are the embankments. These Victorian structures dramatically changed the character of the riverside at the time of construction. Victoria Embankment, in particular, lent a monumental scale and formality to the riverside promenade and created new areas of public realm. Most Londoners do not know that the embankments were constructed to accommodate sewers, cable subways and below-ground railways.

History and development of London's wastewater infrastructure

5.1.8 Roman London did not require the stone aqueducts found in other cities, as its gravel terraces provided plentiful natural springs which, with the addition of wells, provided sufficient resources. Storm water and effluent was mainly carried in timber culverts and box drains that flowed into individual timber cess pits or canalised streams. Stone structures that were large enough to access and maintain were rare.

5.1.9 The Roman water system was not maintained in later periods, during which foul sewage was generally diverted into private cesspits that were emptied by 'nightsoil men'. The concentration of sewage in cesspits contaminated the river system and resulted in public health problems.

5.1.10 From the 13th century, the City Corporation made efforts to secure fresh water supplies from the River Tyburn via an organised system of conduits, cisterns and lead and wooden pipes. This system was primarily for the wealthy, and most people continued to draw drinking water from communal wells and pumps in the street or from the River Thames. Although the causal link to disease was not recognised at this time, the continuing pollution of tributaries with sewage and refuse became a matter of public concern from the 15th century.

5.1.11 London's effluent disposal system developed around the natural watercourses (the so called 'lost rivers') that flowed into the River Thames, such as Stamford Brook, the rivers Tyburn, Fleet and Walbrook on the northern bank and Beverley Brook, and the rivers Wandle and Ravensbourne on the southern bank.

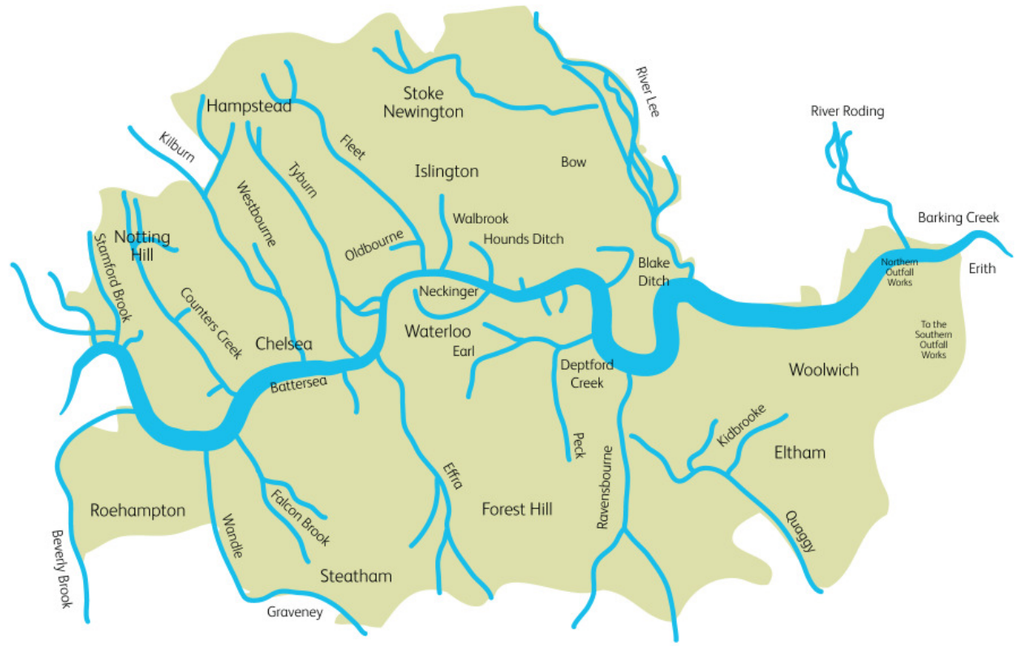

Figure 5.2: Diagram showing London's "Lost Rivers"

Figure 5.3: Diagram showing London's sewerage system in 1856 including the culverted "Lost Rivers"

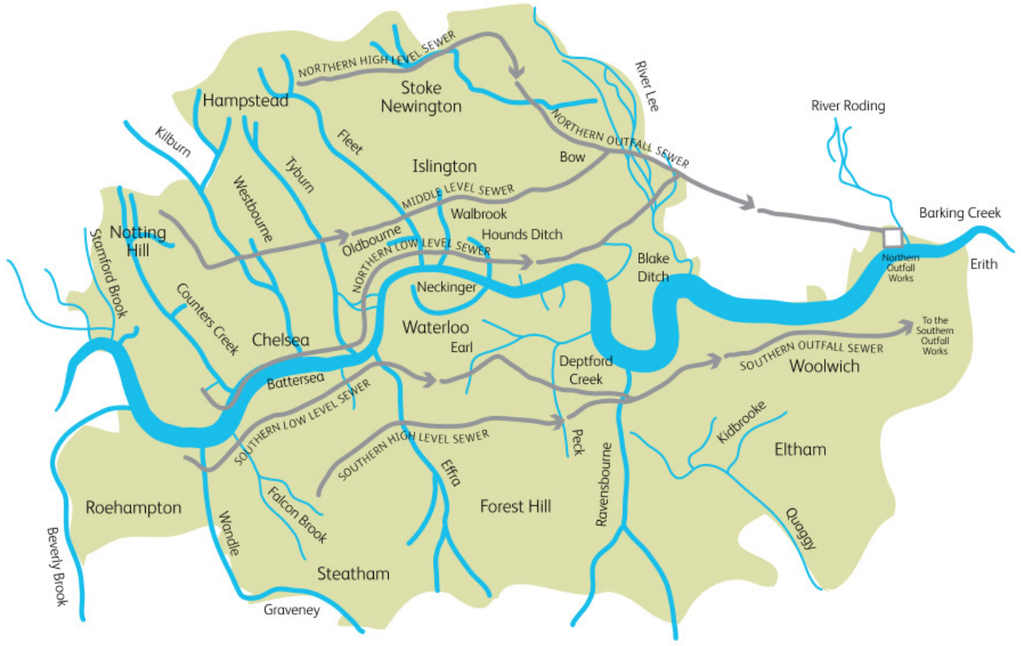

Figure 5.4: Diagram of London showing Sir Joseph Bazelgettes interceptor sewers

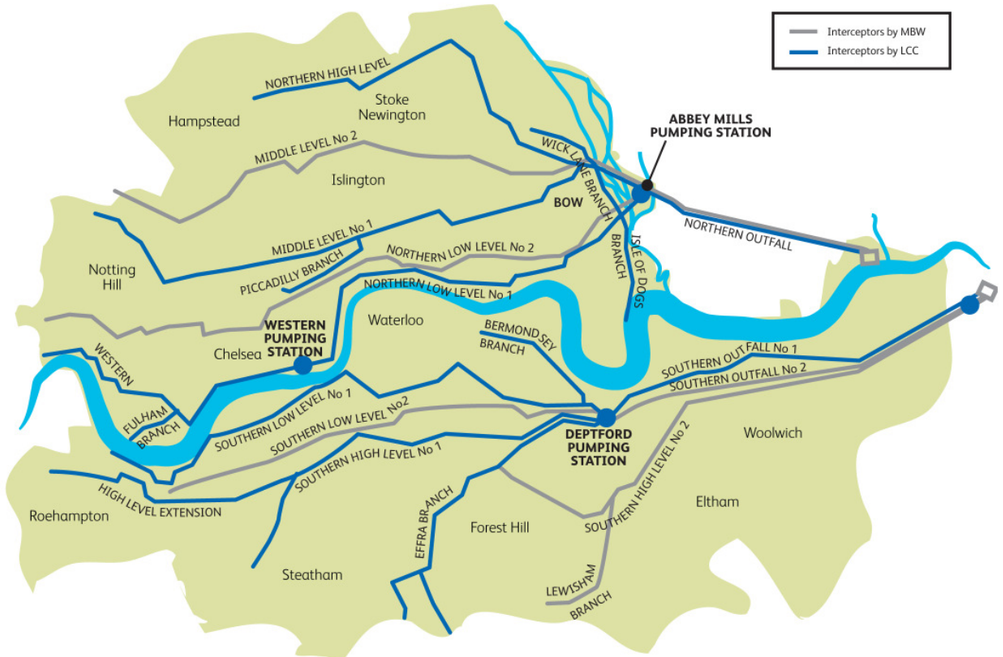

Figure 5.5: Diagram showing London's additional interceptor sewers by 1976

5.1.12 Regulation of waste disposal from the 17th century was undermined by rapid population growth, and the tributaries became more polluted. Once the lost rivers were culverted, covered and out of sight the problem was largely transferred to the River Thames, which itself became an open sewer that failed to clear at each low tide. However, water companies continued to extract its untreated water and distribute it as drinking water.

5.1.13 Into the first half of the 19th century, sewage was drained into cesspits, of which there were at least 30,000 in the area now covered by Greater London. Indeed, it was illegal to allow sewage to enter the sewer system, which was predominantly reserved for water drainage.

5.1.14 During the post-medieval period, the growing population and the use of untreated River Thames water for drinking culminated in the cholera and typhoid epidemics of the mid-19th century. From 1847, cess-pools were connected to the sewer system following orders from the Metropolitan Commissioner of Sewers . In the hot summer of 1858, it lead to the 'Great Stink', which forced Parliament to re-locate from beside the River Thames to a more pleasant location in Oxford. This created the political will for change and in the 1860s and 1870s the visionary solution of the Chief Engineer of the Metropolitan Board of Works, Sir Joseph Bazalgette, was constructed. This pioneering scheme consisted of an integrated system of interception sewers, pumping stations and treatment works that still serve London today. It also involved reclaiming land from the River Thames to construct the Victoria, Albert and Chelsea Embankments.

5.1.15 Like the proposed project, Bazalgette's sewerage system was an interception system, designed to catch wastewater flows and limit sewers from discharging directly into the River Thames. There were three main interceptor sewers to the north of the river and two to the south, which operated by means of a mixture of gravity and interspersed pumping stations.

5.1.16 The Northern Outfall Sewer system consisted of three main sections: the high level sewer runs from Hampstead, the two sections of the mid-level sewer run from Kilburn and Kensal Green, and the low level sections run from Ravenscourt Park and Hammersmith. The three sections merge at Abbey Mills Pumping Station where the flows pass on to Beckton Sewage Treatment Works.

5.1.17 The Southern Outfall Sewer is similarly divided into high, mid and low level sections, which run from Herne Hill, Balham and Putney respectively to Deptford (now Greenwich) Pumping Station before merging and flowing on to Crossness Sewage Treatment Works.

5.1.18 The overflow points into the River Thames were retained as relief structures when the system became overloaded with excessive rainfall, these became combined sewer overflows,or CSOs.

5.1.19 In addition to the sewer pipes themselves, the scheme involved a number of above-ground structures that are of heritage significance as individual assets, including Victoria Embankment (opened to the public in 1869), Albert Embankment (1868) and parts of Chelsea Embankment (1874) as well as the pumping stations.

5.1.20 The embankments were constructed on the land reclaimed for the sewers and other infrastructure (such as the District Line) and improved circulation by providing new roads and steamer piers. They also left a legacy of new public gardens and promenades for Londoners.

The tidal Thames

5.1.20 Describing the 'character' of the River Thames is beyond the scope of this report. Historian Peter Ackroyd in recent years devoted an entire book entitled *Thames: Sacred River*, in which he described it as follows:

"*The general riverscape of the Thames is varied without being in any sense spectacular, the paraphernalia of life ancient and modern clustering around its banks. It is in large part now a domesticated river having been tamed and controlled by many generations [...] Yet of course every stretch has its own character and atmosphere and every zone has its own history*".

5.1.21 Even when we confine our analysis to the tidal stretch of the River Thames, its context and character vary greatly. Its width changes from 200m at Putney to 288m at King Edward Memorial Park. While the river walls are generally aligned with the course of the river, the character of the walls varies enormously – from the monumental articulation of Victoria Embankment, to the rural sloping banks of Barn Elms, and the rugged utilitarianism of the wharf sites. Projections into the river mainly consist of jetties and piers that serve active or redundant wharfs and very few are solid projections. Yet, with all this variation along its banks, the River Thames remains the largest continuous open space in London.

5.1.22 The character of the river also changes over time; it has a tidal range of approximately 7m, which changes its height and flow on a hourly basis. The river is also undergoing a long-term transformation from an instrument for cargo handling to a leisure and transit resource. To the east of Tower Bridge, the river was a major port in the 1950s. There was also domestic trade along the river. The increase in road traffic from the 1950s and industrial decline after the 1960s decreased the amount of river traffic.

5.1.23 Limited cargo handling on the river continues and it is protected by Greater London Authority policy (London Plan Policy 7.26) in order to safeguard specific wharfs from redevelopment. Although the numbers of businesses and boats that use the river have dramatically reduced in the last century, it remains an important route for navigation.

Figure 5.6: The river at Chelsea Embankment Foreshore

Figure 5.7: The river at Putney Embankment Foreshore

Figure 5.8: The river at Battersea Bridge looking towards Cremorne Wharf Depot

Figure 5.9: The river at Albert Embankment Foreshore

Figure 5.10: The river at Victoria Embankment Foreshore

Figure 5.11: The river at Carnwath Road Riverside

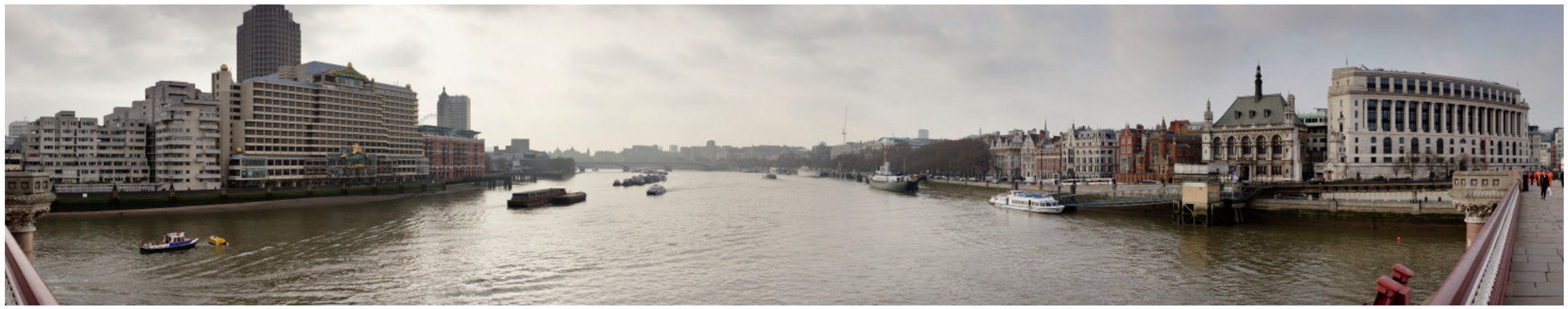

Figure 5.12: The river at Blackfriars Bridge Foreshore

Figure 5.13: The river at King Edward Memorial Park Foreshore

5.1.24 Local and regional planning policy promotes a pedestrian riverside walkway and seeks to extend it along the whole of the River Thames. The policy is being slowly implemented across the city via countless separate planning approvals. The resulting walkways are generally well used and valued by residents, workers and tourists alike.

5.1.25 The quality of the views available both from the river and the shore is high. Because of its open nature, the river affords views over a range and distance that is rare in London's urban environment and unachievable among its built-up streets. For this reason, many vistas along its length are protected in the London View Management Framework. In central London, many passers-by pause to enjoy iconic views of the city's skyline.

5.1.26 These factors have combined to change the focus of the city in the last 20 to 30 years. The city's buildings once turned their backs on the muck and bustle of the River Thames; now, river-facing residential and commercial development is highly prized.

River ecology

5.1.27 Although the volume of industrial pollutants in the River Thames has decreased in recent years, the presence of sewage in the aquatic environment continues to have an adverse effect on aquatic habitats, mammals, fish, invertebrates and algae. In particular, discharges of untreated sewage from the CSOs can result in low levels of dissolved oxygen, which can cause mass fish mortalities known as hypoxia events.

5.1.28 The purpose of the project is to limit these CSO discharges, yet this requires the construction of new structures within the River Thames that would impact on the amount of intertidal habitat available. Encroachment onto the foreshore for non-river dependent uses is restricted by London Plan Policy 7.28 (Restoration of the Blue Ribbon Network), which states that development should "protect the value of the foreshore of the Thames and tidal rivers". The Environment Agency's Tidal Thames Encroachment Policy also discourages developments riverward of the existing flood defences which could, individually or cumulatively, change flows, affect fisheries or cause loss or damage to habitat.

5.1.29 There have been moves in recent years to further enhance aquatic habitat in the tidal River Thames. New developments have been encouraged through documents such as the Environment Agency's Estuary Edges guidance, which seeks to set back flood defences and incorporate measures in the provision of river walls that positively contribute to the aquatic environment. Such measures range from the use of timber fendering and vertical beaches to the provision of intertidal terraces.

Figure 5.14: Putney CSO

Figure 5.16: Examples of intertidal terrace on Foreshore of River Thames

Figure 5.17: Examples of intertidal terrace on Foreshore of River Thames

Figure 5.18: Examples of intertidal terrace on Foreshore of River Thames (Source www.gold.ac.uk)

Flood defences

5.1.30 The river walls through central London form part of the city's flood defences. Generally, the flood levels within the tidal Thames are expected to rise due to climate change. New flood levels for the year 2100 are predicted in the Thames Estuary 2100 Plan (TE 2100) and the Tidal Thames Joint Probability Extreme Water Levels Study, which are approximately 600mm to 1m higher than existing levels.

Figure 5.15: Results of a fish kill in Barnes June 2011

Figure 5.19: Examples of intertidal terrace on Foreshore of River Thames

5.2 Design evolution and alternatives

Introduction

5.2.1 The majority of the infrastructure for the project would be located below ground. Our key design objective for the permanent above-ground works was to integrate them successfully into their surroundings. However, as the tunnel system operates similarly at most of the sites along its length, there is a fairly generic 'kit of parts', (refer to Section 3).

5.2.2 The visual appearance of each of these elements is closely tied to the engineering requirements, which determine the scale of the structures and constrain their location. Refer to the *Engineering Design Statement* for further details.

5.2.3 All of our design proposals were significantly influenced by an extensive process of stakeholder engagement and design reviews with Design Council CABE. We have a number of pan-London stakeholders who are concerned with the cumulative effect of each site on the city as a whole. We also recognise the opportunities presented by such a large project to create visual continuity between the separate sites. This is particularly important due to the project's prominence in London's most central and open public space: the River Thames.

5.2.4 In developing the designs, it became essential to strike an appropriate balance between generic solutions and site-specific considerations. This section describes the evolution of the above-ground components and the project-wide factors and feedback that influenced them. (Refer to Sections 6 to 29 for details of site-specific design development).

Figure 5.20: Design development images for a phase one consultation combined kiosk and ventilation structure

November 2010

Phase one consultation

5.2.5 The proposals presented at phase one consultation were based on three generic structures that were modified or combined to suit the site or system requirements. All of the above-ground structures were similar in scale to buildings. At this stage, according to the project-wide air management strategy, the ventilation columns needed to be between 10m and 15m high. This would make them prominent features at each sites. In general, the electrical and control equipment was housed within the ventilation column structure.

5.2.6 Active (fan-assisted) ventilation was also planned at nine sites, which required the inclusion of a building to accommodate the fan equipment. A ventilation outlet was generally incorporated into this building along with the electrical and control equipment.

5.2.7 We explored how to maintain visual continuity between the structures across all sites through the selection of materials, based on riverine architecture (features such as boats and jetties).

5.2.8 The design of the foreshore structures was also broadly generic. The initial design was outlined before detailed fluvial modelling had been carried out. Therefore the shape was based on assumptions regarding the optimum shape of in-river structures. As a result, most of the structures were straight-sided with large radiuses to the corners. No indication of materials for the new sections of river wall was given. Terraces were introduced to the sides of the structures at several sites, seeking to increase the amount intertidal habitat in the river.

5.2.9 The feedback received at phase one consultation generally expressed concern in relation to the scale of the ventilation structures. We received a mixture of comments on their appearance – some supportive and some concerned or opposed. In general, the feedback suggested making the designs fit better with the specific context of the sites.

5.2.10 In its phase one consultation response, the Environment Agency clearly indicated that encroachment into the River Thames should be avoided and reduced as far as possible – even when such encroachment was to create intertidal habitat.

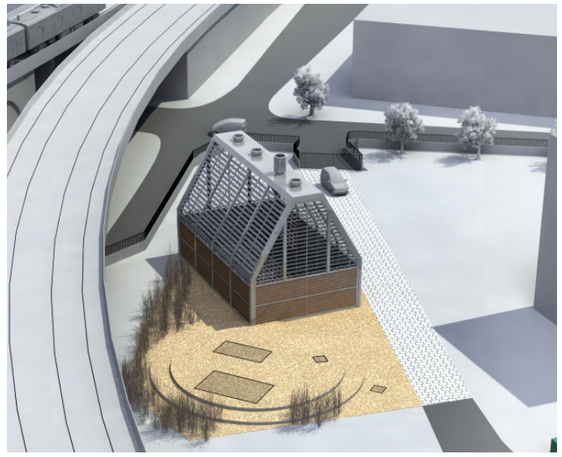

Figure 5.21: Phase one : ventilation building in Thames water compound

Figure 5.22: Phase one: kiosk and ventilation column

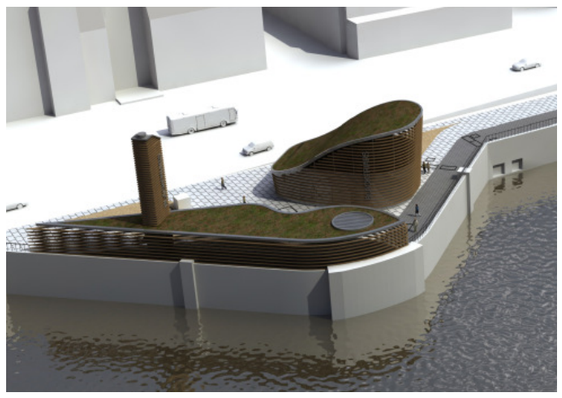

Figure 5.23: Phase one: ventilation column and building in public area

Design development

5.2.11 In response to phase one consultation feedback, we reconsidered our generic design approach and proceeded to conduct individual analyses of the separate sites and develop contextual proposals for the landscape design and functional components. We began to identify and record site-specific opportunities and constraints and explored ways in which to reduce or obscure the visual impact of the ventilation columns.

5.2.12 In parallel with this process, the project-wide air management strategy was reviewed and futher design development enabled us to omit many of the ventilation and control buildings and reduce the height of the ventilation columns. However, the heights and cross-sectional areas were not yet fixed. This aspect of the design development continued throughout the Design Council CABE sketch review period.

5.2.13 In response to stakeholders' site-specific concerns, we reviewed our site selection and replaced two of our foreshore sites (Cremorne Wharf Foreshore and Borthwick Wharf Foreshore) with in-land sites. This had the effect of reducing encroachment into the River Thames. Intertidal habitat was also generally omitted from the schemes in an attempt to reduce encroachment as far as possible.

5.2.14 Initial fluvial modelling studies showed that (on some sites) there would likely be more flexibility to shape the foreshore structures with tight radiuses and sharp corners than previously assumed. Through our continual engagement process, it became clear that a generic approach to the shaping of the foreshore structures and selection of river wall finishes would not be acceptable. This was particularly evident at the most prominent and sensitive sites, where it was imperative for the new structures to tie in with the surroundings.

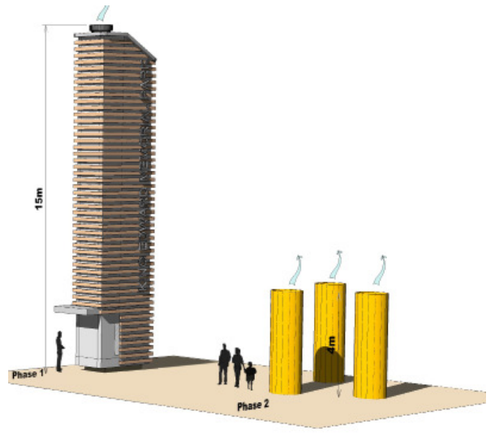

Figure 5.24: Comparison of phase one ventilation column with sizes required for air management strategy

Figure 5.25: Fluvial modelling of 'square' shaped foreshore structure at Victoria Embankment

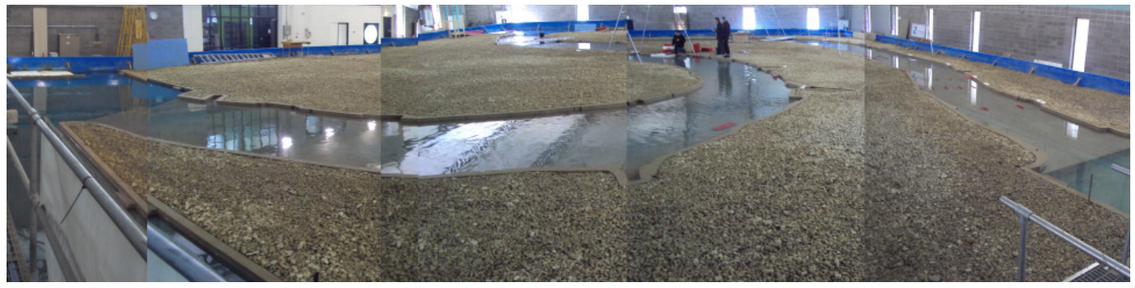

Figure 5.26: Photograph of physical model of the River Thames at HR Wallingford

Summer 2011

CABE reviews

5.2.15 The Design Council CABE made a number of generic project-wide comments during their reviews that influenced all the designs. The reviews highlighted the value of investing time in developing common design components, such as ventilation columns and manhole covers, similar to the components of the Bazalgette scheme and the London County Council's works. The panel noted that this approach could lend the project a strong identity, which would unify the above-ground structures and celebrate Thames Water's commitment to improving the river.

5.2.16 Other relevant project-wide comments included:

a. The designs should improve accessibility to new areas of public realm where possible.

b. The designs should seek to enhance local amenity in the form of new spaces. The community and local authorities should participate in the design process.

5.2.17 The panel commented that the use of the River Thames was important in encouraging access and enjoyment of the riverside and enhancing its special character with creative, site-specific solutions for public spaces. These spaces should preserve existing views and vistas and open up new ones.

5.2.18 In response to the panel's comments, we began to develop a 'signature' design for the ventilation columns. We produced multiple proposals for internal discussion and developed ideas for an appropriate expression for the project.

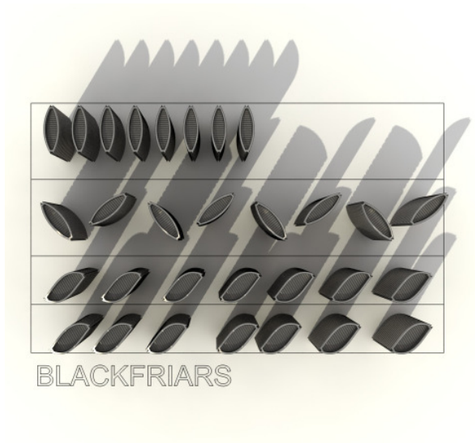

Figure 5.27: Study looking at possible multiple of ventilation at Blackfriars Bridge Foreshore

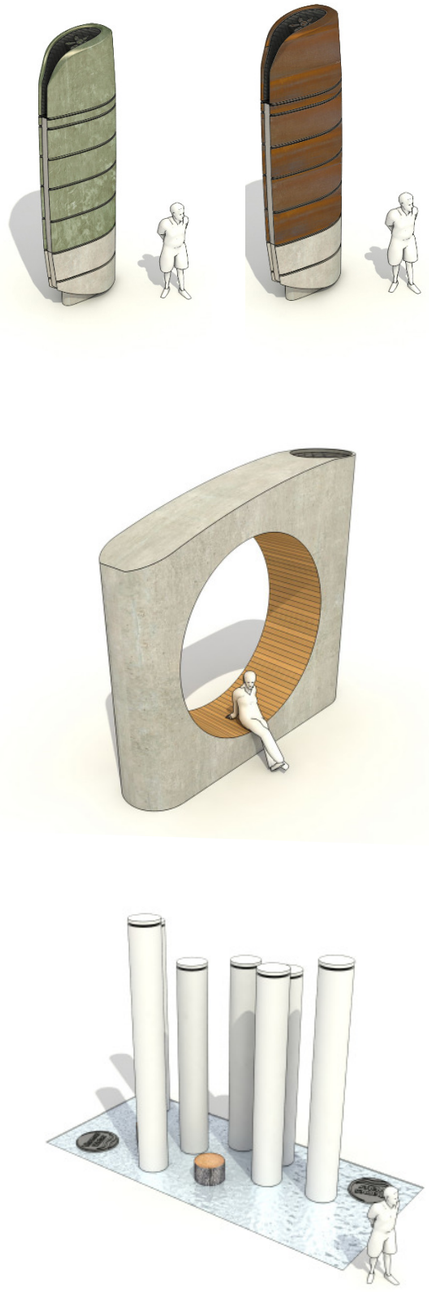

Figure 5.28: Prototype ventilation columns

Phase two consultation

5.2.19 At phase two consultation we presented our updated and tailored site specific designs and published our high-level common design principles that outlined our approach to delivering good design. This included a signature ventilation column.

5.2.20 Site design had progressed significantly in comparison to the proposals presented at phase one consultation, although the amount of development depended on the degree to which the relevant local authority had engaged with our consultation process.

5.2.21 The designs reflected the previous stages of design development including: the updated air management strategy, which greatly reduced the number and scale of the above-ground structures at most sites; the signature ventilation column design; fluvial modelling, the results of which allowed us to tailor the foreshore structures to their context; phase one consultation responses; the Design Council CABE reviews; and outputs from on-going discussions with key stakeholders. The *Design Development Report,* which we published at phase two consultation, outlined the design progression on a site-by-site basis.

5.2.22 We received no significant objections to the signature ventilation column design. English Heritage commented:

"English Heritage supports the notion of a structural signature across the project and considers that the design for the ventilation columns could achieve this effectively. However, we note the sites at Acton Storm Tanks, Barn Elms, King George's Park, Hammersmith Pumping Station and Carnwath Road do not use this signature. Consequently, we recommend that thought is given to which elements are common to all sites and how these might be designed to provide an appropriate signature for the project. We are very keen to ensure that there is an element of interpretation of the project and the heritage of the development site at each location and this may provide a useful opportunity to develop a signature element as well".

5.2.23 Following phase two consultation, we further developed the generic and site-specific design principles. In May 2012, we consulted the local authorities and our pan-London stakeholders on these principles. We invited them to engage in discussion with the project team.

Figure 5.29: Sketch Proposal

Figure 5.30: Type B Column

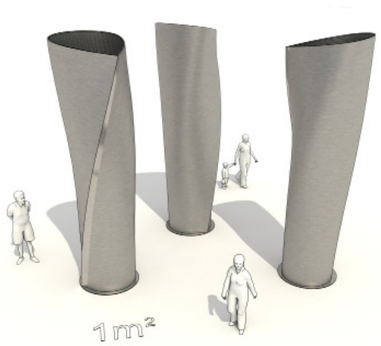

Figure 5.31:Type C Column

November 2010

Targeted consultation

5.2.24 We undertook a formal consultation with the Design Council CABE on the ventilation column design. In response to our presentation of the ventilation columns, the panel commented:

"We support the design approach to the ventilation columns which we think has the potential to create a strong identity for the project that unifies the above ground works along the length of the tunnel [...] Specifically we welcome the proposed heights, shapes and pairings of the columns which successfully addressed both functional and architectural proportions. We also support the proposed metallic materiality and suggest, for example, an approach employing a cast metal to achieve the necessary combination of durability and long term architectural quality [...]

"Whist taking the detailed design of each site forward it is important to ensure the overarching design vision for the columns is maintained. We suggest the design team produce a master plan diagram for the columns across the whole length of the scheme to provide this overarching view".

5.2.25 Further to the Design Council CABE's endorsement of the signature ventilation column design, we proposed to include them in our design for approval.

5.2.26 Our designs then continued to evolve as we undertook further technical work, considered new information and received further feedback from consultees. As a result, there were changes at four of our sites that required a further phase of targeted consultation.

Figure 5.32: Ventilation columns at Chelsea Embankment Foreshore

Section 48 publicity

5.2.27 In July 2012 we published our proposals as required under Section 48 of the 2008 Act. By this time, however, our designs were significantly more permanent. Section 48 consultation is a statutory requirement of any application made under that Act and requires the promoter (Thames Water) to publicise the proposed application.

5.2.28 No significant design development occurred after this stage.

5.3 Project-wide design proposals

Design objectives: 'Our Vision'

5.3.1 The project would be a major, city-wide investment in London's wastewater infrastructure for the 21st century. It would build on Bazalgette's legacy, maintain London's long-term sustainability as a world-class city, and improve the quality of its largest open space: the River Thames. This vision is enshrined in the high level design objectives that have guided the development of the scheme to date. The generic and site-specific design principles set out in the following sections were also used to test the acceptability of more detailed elements of the designs to be agreed at a later stage.

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

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

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

5.3.5 The project's vision shall be achieved by:

a. being responsible

i respecting and contributing positively to each site's individual context and surroundings

ii reducing the impacts of operations on local communities, the environment and third party interests as much as possible

iii listening to and working with stakeholders, being open to new ideas and identifying areas of mutual interest with others

iv challenging operational and functional requirements to create sites that meet the functional requirements, work within the day-to-day life of the city, and reflect local community and environmental considerations

v ensuring that the principles of sustainability are integral to designs by incorporating environmental solutions and environmental mitigation

b. developing a signature across the sites that recognises the collective importance of the project and the sites to the river

i being flexible and creative

ii where opportunities arise, we shall seek to create new, high quality, public spaces and enhance habitats and biodiversity

iii where there is existing site development, we shall work with known developers to find solutions that are conducive to both parties. Where development proposals are less certain, we shall provide flexible solutions to meet operational needs that are also able to respond to changing future circumstances

iv at Thames Water operational sites, designs shall be an expression of the functional requirements that respect the context and enhance the wider surroundings

c. meeting functional requirements

i developing high quality, well-designed and durable solutions that protect and respect the environment and amenity of the areas in which they are located

ii providing safe sites for operations staff and (where relevant) the public that are accessible to all

iii developing low maintenance solutions that meet operational and functional requirements using existing Thames Water assets wherever possible

iv ensuring that spaces that would be handed over to others could be maintained to a good standard in the long term, having due regard to planning policy and best practice

v reinstating and extending the Thames Path where practicable.

Operational and functional requirements

5.3.6 Each site is different and we sought to respond to the context and location of each. Nevertheless the operational and functional requirements were critical to design development and formed the basis of the design work.

5.3.7 The proposed CSO interception works and the works at the main tunnel sites involve a range of permanent engineering structures. The technical details are provided in the *Engineering Design Statement.* The permanent engineering works are governed by a range of safety, functional maintenance and access requirements, such as: the need to size the system to achieve the necessary CSO control; the need to provide a hydraulically robust and operationally safe system; the need to control impacts on river flows and minimise bed scour; hydraulic capacity; de-aeration, system ventilation and odour control requirements; safe inspection, access and egress provisions; electronic control and instrumentation requirements; and structural and durability requirements.

5.3.8 As an essential piece of infrastructure, the structures must be durable and easy to maintain. Thames Water would carry out regular maintenance and inspection cycles, approximately every three to six months, which would require periodic access to the access covers and electrical and control kiosks by personnel in a light commercial vehicle.

5.3.9 More substantial infrequent access by cranes and heavy goods vehicles would also be required for long-term maintenance, approximately every ten years, or in emergencies. These visits would require plant set-up and lay-down space for equipment and possibly welfare facilities.

5.3.10 The designs also take account of local townscape issues and were undertaken to facilitate the access requirements. These general principles are explained at site level in Sections 6 to 29.

5.3.11 Where the surface structures would be situated in open public environments and could be subject to abuse and vandalism, it is important to ensure that they are secure, durable and robust.

5.3.12 We had to balance the structures' potential impact on the River Thames with the potential impacts to built heritage, townscapes, transport, safety and security on a site-specific basis.

Sustainability

5.3.13 Sustainability considerations were also integral to the development of the project; this is reflected in our approach to design and would be evident in the operational phase. *The Sustainability Statement,* which accompanies the application, describes the development of a series of sustainability objectives and how they would be achieved by means of design and construction practices. It also appraises the objectives at a project-wide and site-specific level. Refer to the *Sustainability Statement* and its appendices for details.

Accessibility

5.3.14 We sought to improve accessibility to and within the sites and to create inclusive environments for those with impaired mobility. The designs were influenced by the engagement with stakeholders and the community. This process, combined with the results of our socio-economic surveys, identified various community and accessibility requirements at a number of sites. These requirements were addressed in the designs on a site-by-site basis. In addition, we developed generic design principles that set out basic commitments as to the design of sites to ensure that they are safe and usable by all.

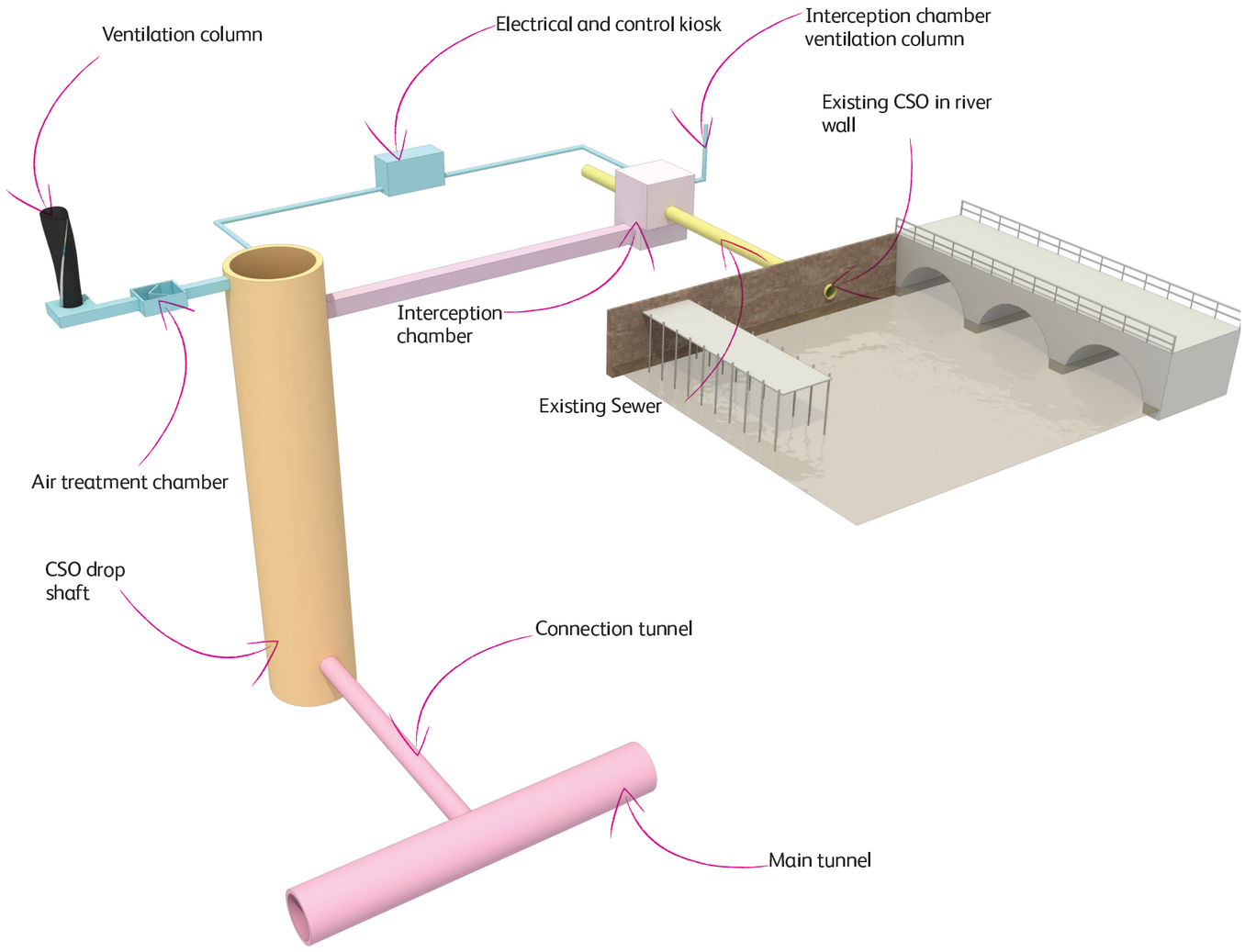

Figure 5.33: View of the typical functional components at an interception site

Generic design principles

5.3.15 We developed a series of design principles that establish some fixed guidelines on the final design of the permanent above-ground elements and spaces of the project. Refer to the Design Principles document, which accompanies the application, for more details. The principles are split into two types: generic (project-wide) and site-specific. They enshrine parameters that must be met in the final detailed designs. The generic principles should be read in conjunction with the site-specific principles.

5.3.16 The principles fall within the framework provided by the Site works parameter plans, Landscape plans and other plans submitted as part of the application. The plans provide a greater level detail yet retain some flexibility to further develop the detailed designs at a later stage, in the light of the prevailing circumstances when the project is implemented.

5.3.17 The generic design principles are sub-divided into six categories as set out below, followed by a short description of some of the factors that influenced the development of each category of principles.

Integration of the functional components

5.3.18 One of our high-level design objectives was to design any new public spaces to enhance the environment and provide a lasting legacy. The functional components would therefore be integrated in a way that supports and reinforces the visual success of the overall design. We developed the Integration of the function components principles to address how to achieve this objective. They include principles relating to the positioning and visual appearance of elements such as the ventilation columns and access covers.

Heritage design principles

5.3.19 A number of the proposed development sites would directly interact with London's historic environment. The NPS recognises the desirability of sustaining and, where appropriate, enhancing the significance of heritage assets and their settings and the positive contribution they can make to sustainable communities and economic vitality.

5.3.20 The Heritage design principles set out our commitment to providing sensitive design solutions and interpretive historic material. They also cover practical aspects such as the alteration or removal of fabric from listed structures. Refer to the Heritage Statement and Code of Construction Practice, which accompany the application, for further details.

Figure 5.34: Photograph of the Historic Abbey Mills Pumping Station A

In-river structure principles

5.3.21 We propose to construct a number of permanent structures in the foreshore of the River Thames. This is a sensitive and demanding environment in respect of the needs of ecology, townscape, archaeology, river navigation and design for flood. Our In-river structure principles apply to foreshore structures, new flood defence walls and reinstated flood defences.

Figure 5.35: View of a bird in the River Thames after a sewage spill

Landscape design principles

5.3.22 A number of the proposed development sites would be carefully integrated into the surrounding area of public realm. The Landscape design principles seek to ensure that these spaces would be sustainable, attractive, inclusive and safe to use. In addition, they address aspects of the design relating to terrestrial ecology, such as the provision of native tree species. These principles apply to all sites unless stated otherwise in the site-specific principles.

Lighting design principles

5.3.23 In general, no new operational lighting would be provided as part of the project. The Lighting design principles apply specifically to sites at which newly-created areas of public realm would be accessible at night. They do not apply to the reinstatement of existing lighting. The principles set out our approach to addressing ecology, townscape, heritage, accessibility and safety issues in the lighting designs. They principles apply to all sites unless stated otherwise in the site-specific principles.

Figure 5.36: Example of a landscape/lighting treatment

Site drainage principles

5.3.24 The design of the project is underpinned by the responsible management of surface water run-off. The Site drainage principles enshrine our commitment to minimising the impact of the project structures on existing drainage systems. These principles apply to all sites unless stated otherwise in the site-specific principles. At sites that would be incorporated into new developments by others, the third-party developer shall determine the final site drainage arrangement, subject to obtaining a separate consent.

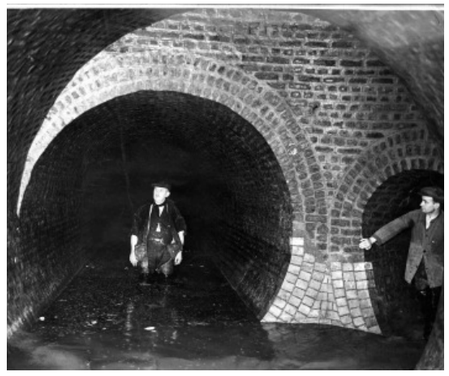

Figure 5.37: Historic photograph of sewer inspection and maintenance being undertaken

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5.4 Project-wide components and themes

The signature ventilation column

5.4.1 As stated in design principle FNCC.03: "*The project shall use the 'signature' design for all ventilation columns serving shafts, except where stated otherwise in site-specific principles. The ventilation columns shall stand a maximum of 8m high and have a minimum proportion of 1:5 (girth to height). Multiples of the signature design shall be used to achieve the cross-sectional areas required for ventilation*".

5.4.2 Given that the ventilation column would be present on several sites within various London boroughs, the 'signature' ventilation column design described here is submitted 'for approval'.

5.4.3 The ventilation columns are generally the most noticeable element of the permanent works, except for the new sections of river wall. The signature column would be approximately 5.5m tall. This is taller than the minimum 4m generally required by the air management strategy. The additional height gives the columns a more elegant proportion between height and girth, while maintaining a scale similar to street furniture (such as lamp posts) rather than buildings.

5.4.4 Although we propose that the ventilation columns across the project would be a standard height, there is great variance in the required cross-sectional area from site to site (from approximately 0.4m^2 to 5m^2). The ventilation area generally increases from west to east and is determined by the volume of air that would be drawn in or expelled.

5.4.5 The variation in the required cross-sectional area made it difficult to develop a standard ventilation column design. Therefore we developed a 'family' of column designs that would be employed at different sizes. Multiples of these columns would be used, where necessary, to achieve the required cross-sectional area. By analysing the sizes required by the air management strategy, we established three standard sizes with cross-sectional areas of 0.35m^2 (Type A) , 0.6m^2 (Type B) and 1m^2 (Type C).

Figure 5.38: Type B ventilation columns at Chelsea Embankment Foreshore

Figure 5.39: Type C ventilation columns at Chambers Wharf

Figure 5.40: Type A ventilation column at King Georges Park

5.4.6 The signature ventilation columns would serve to mark the project across the various sites. They would be located on very different sites and must integrate equally well with a depot site as with the formal setting of Victoria Embankment. We sought to create a distinctive but subtle expression of the project, with no gimmicks or signage, that would have a stature and dignity appropriate to an essential piece of urban infrastructure.

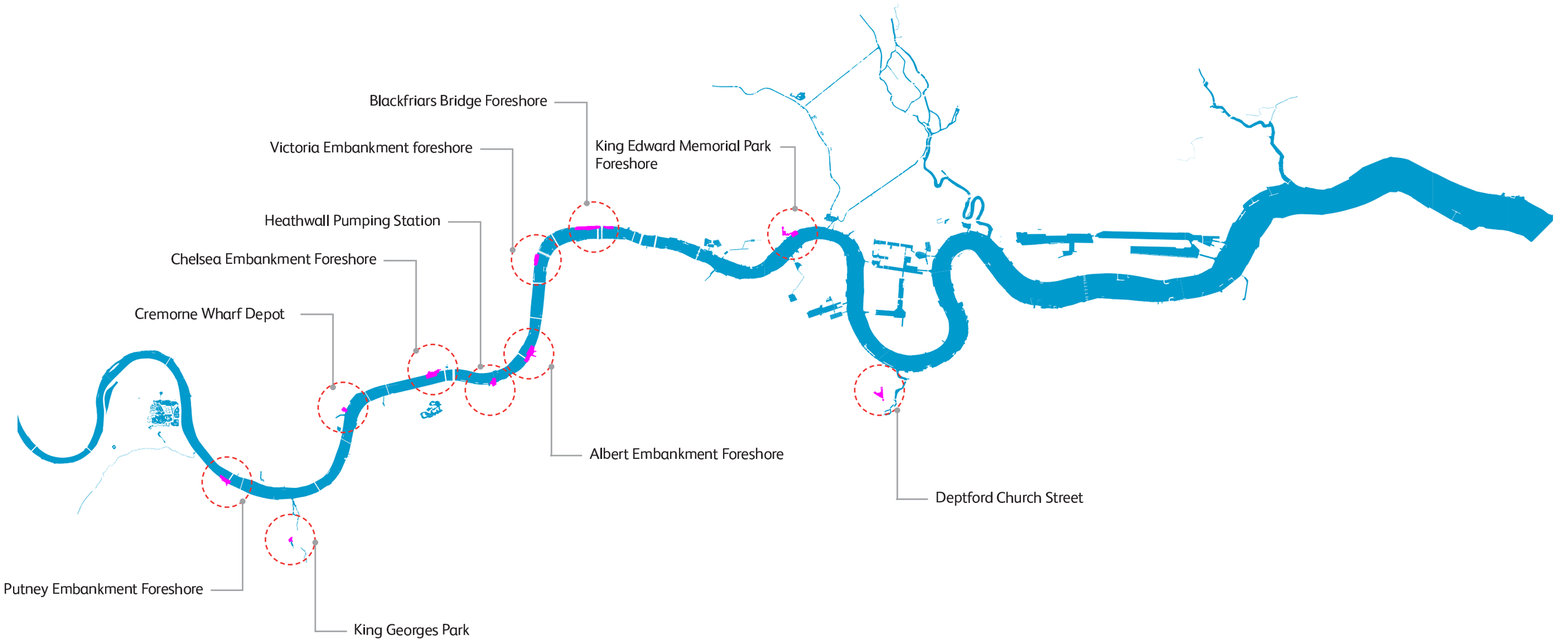

Figure 5.41: Location of the signature ventilation columns

5.4.7 We considered a number of factors in developing an appropriate aesthetic for these columns, from the marine architecture of boats (which influenced earlier designs) to iconic pieces of British design such as the traditional 'K2' phone box or the 'Routemaster' bus.

5.4.8 Ultimately we were inspired by the movement of water. The design evokes the patterns of flowing water that moves in gentle spirals down the shaft of the column.

5.4.9 Spiral forms are already associated elsewhere with the way water moves in a river. As Peter Ackroyd writes in Thames: Sacred River:

"The main thrust of the river is known to hydrologists as the 'thalweg'; it does not move in a straight forward line but, mingling with the inner flow and the variegated flow of the surface and bottom waters, takes the form of a spiral or helix".

5.4.10 Spiral motifs can also be found in London's existing streetscape. For example, the historic 'sturgeon' lamp standards that adorn the Bazalgette embankments feature 'mythical creatures' i.e. the sturgeons, twisting around the central pillar.

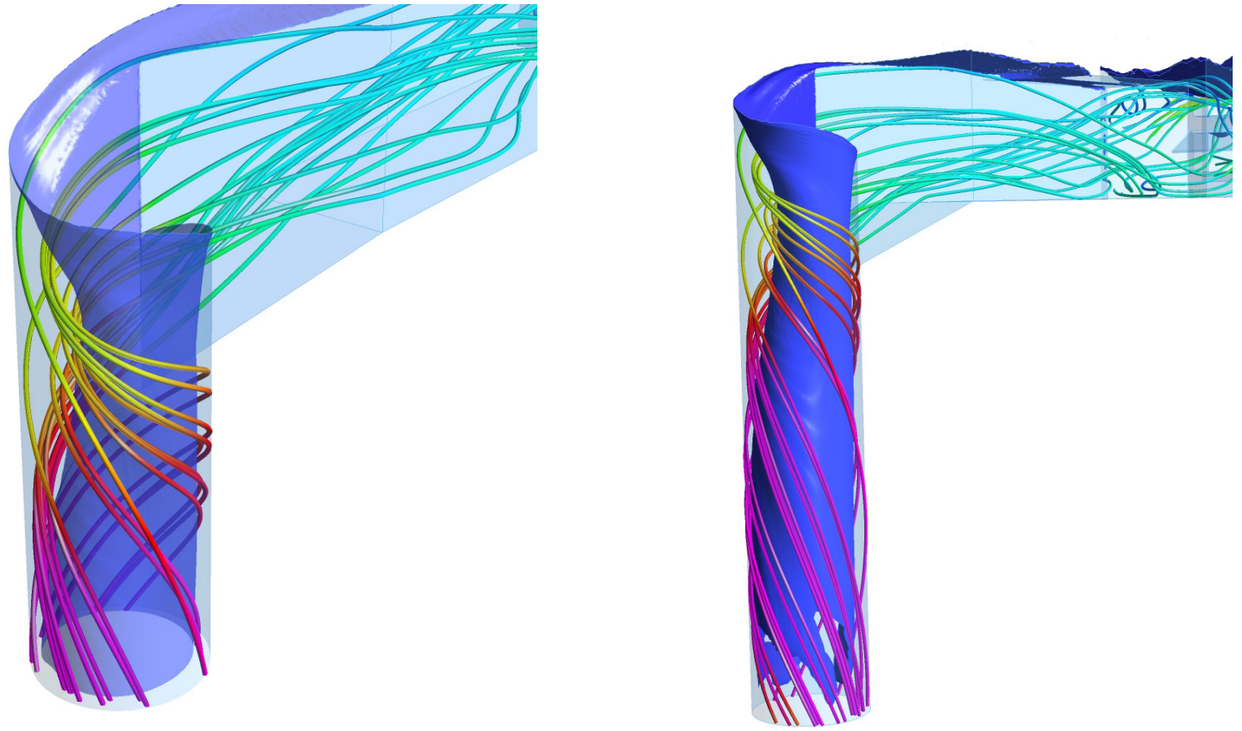

Figure 5.42: Computational fluid dynamic modelling of the vortex drop strucuture proposed in each of the CSO drop shafts

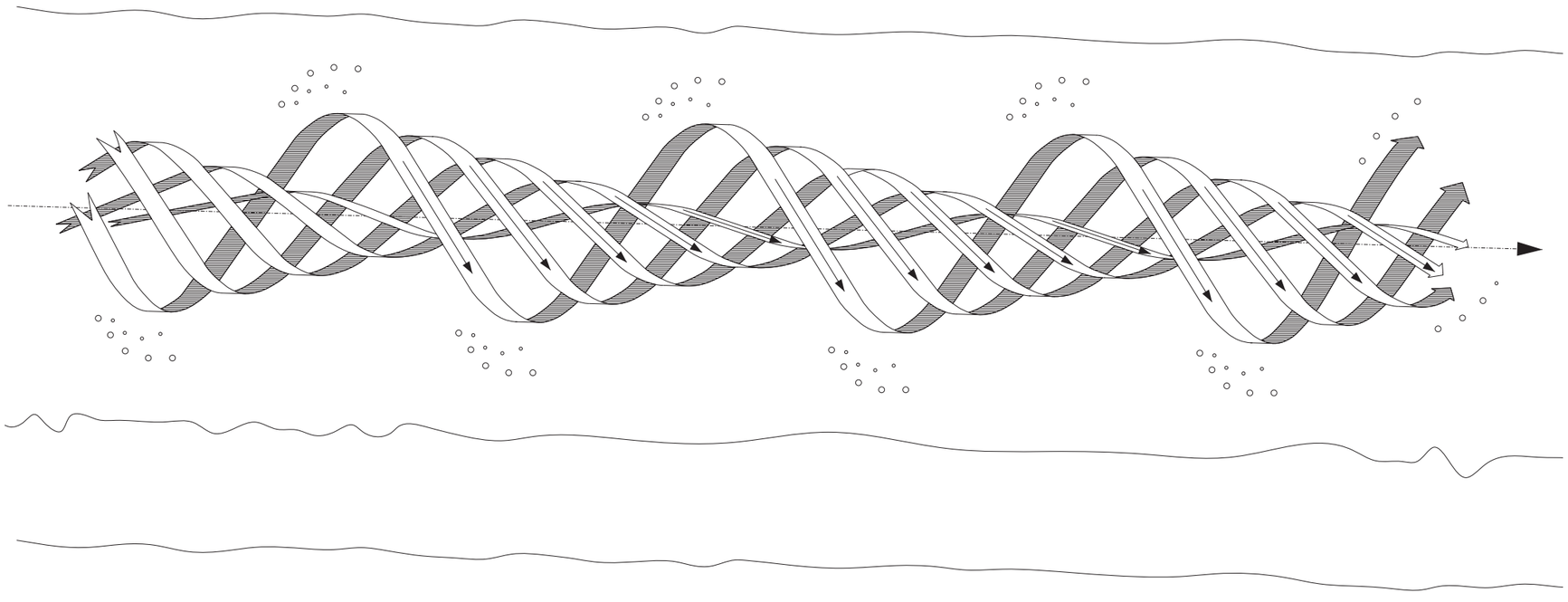

Figure 5.43: A longitudinal vortex showing laminar flows ("Thalweg")

5.4.11 The proposed material for the column is cast metal with a matte or brushed finish, for a number of reasons, as follows:

a. It creates a strong, self-supporting structure that can have relatively thin walls, allowing an elegant and non-bulky appearance, and is therefore used for such structures throughout London and marine environments.

b. It is appropriate to sites near existing built heritage assets, as it was used extensively in the Victorian sewer works.

c. It is evocative of the large, cast metal structures used in the sewers, such as flap valves and penstocks.

5.4.12 The form of the ventilation column funnels down from the top to the bottom to mirror the way water flows into the vortex tube inside the CSO drop shaft. The 'twist' in the structure is expressed through a flat ridge along its length that would be polished and possibly inlaid or engraved with information about the location. For example, if the site is located at the confluence of a 'lost river' and the River Thames, it could state the name of the river.

5.4.13 The base of the ventilation column would be surrounded by a collar of LED lights that would wash the surface with light at night time, drawing attention down to the ground, within which the majority of the engineering components are located. A grille could be included in the top rim to prevent matter entering the column if required.

5.4.14 The metal finish of the ventilation column would change from site to site to fit in with the context. The final finishes would be agreed with the local authority at a later date.

5.4.15 At several sites, it is necessary or desirable to have multiples of the columns. Combining types of column (Types A, B and C) could reduce the overall impact of the size of the structures. Their layout on the site could respond to site-specific considerations and invite a degree of play, interpretation and interaction between and around the columns.

5.4.16 At two sites (Acton Storm Tanks and Carnwath Road Riverside), the ventilation columns would need to be significantly larger than the standard size. These columns would be different in materials, proportion and finish; however, the same 'twist' motif would be applied to their form as a visual reference to the signature design.

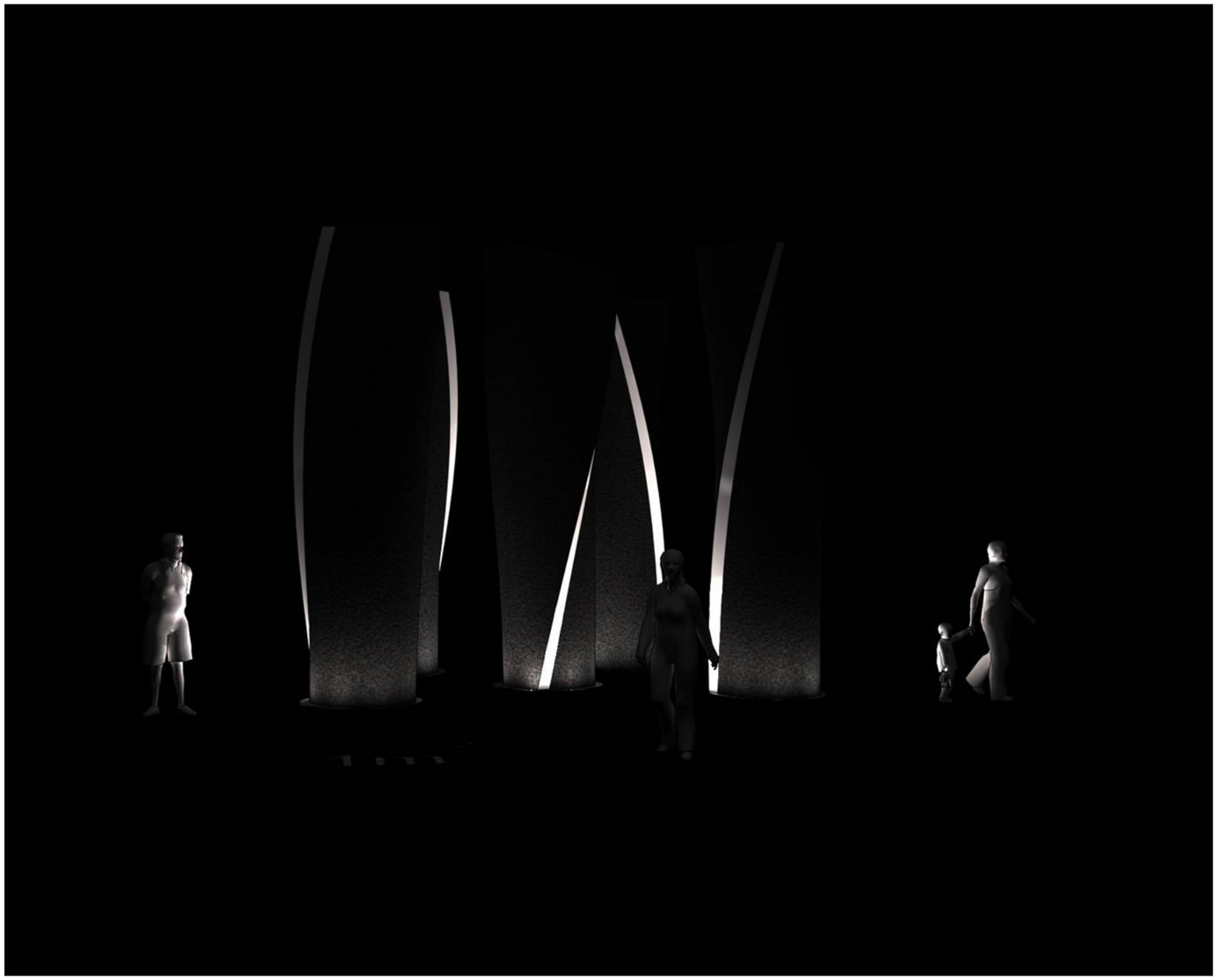

Figure 5.44: Artists impression of lighting on the signature ventilation column illuminating the polished strip

River walls

5.4.17 The largest above-ground vertical surface area created by the project would be the new river walls, which would also form part of the flood defences. The following factors were considered in developing the design of the river walls:

a. local context, heritage and townscape issues

b. the risk of damage to the foreshore structures from passing vessels and vice versa (refer to the *Engineering Design Statement*, which accompanies the application, for more information)

c. the need to maintain existing flood defence levels and ensure that they can be adapted and raised to meet the TE2100 requirements

d. the need to limit ecological impacts and explore opportunities for mitigation

e. the need to limit loss of flood storage volume

f. the need to ensure personal safety by providing adequate guarding and life-saving equipment where relevant

g. river access and passage over flood defence levels

h. visual access from shore to river and vice versa.

5.4.18 Designing the new river walls is a complex task and design development would continue after any decision to grant development consent. However, proposed designs are submitted as part of the application to illustrate our design intent for the appearance of the walls.

5.4.19 The character of the river walls along the River Thames varies from the formal, granite-faced Victorian walls with their Lion's Head mooring rings, to concrete and sheet-piled walls and timber fenders.

5.4.20 Soon after phase one consultation, it was determined that no single finish would be appropriate to all of the foreshore sites. However, as with the design of the signature ventilation columns, we sought to develop a common design that could be adapted as necessary to each site.

5.4.21 The River Thames is an ever-changing but constant part of London. Accordingly, we chose to draw attention to its ebb and flow by providing information on its tidal levels. Inscribing levels on bridges and on the hulls of ships has long been a quick and informative way of assessing the current height of water. Therefore, a series of horizontal lines on the river walls would be engraved, cast or marked with fenders to illustrate current mean high and low water levels and flood defence levels. Where possible, the TE2100 flood defence level could also be included.

5.4.22 In line with the Environment Agency's Estuary Edges guidance, fenders would be applied to river walls where possible. Roughening the surface of the walls would provide enhanced habitat for river ecology. In addition, we propose to include 'aquatic habitat features' at the base of some of the new walls. A similar feature was recently installed in Deptford Creek. It comprises 'planters' filled with foreshore-type habitat at the base of the river walls. The planters might require a mesh to prevent loss of rubble; plastic strips could also be added to the base level to facilitate fish egg-laying, if sufficiently anchored and submerged for enough time during the tidal cycle.

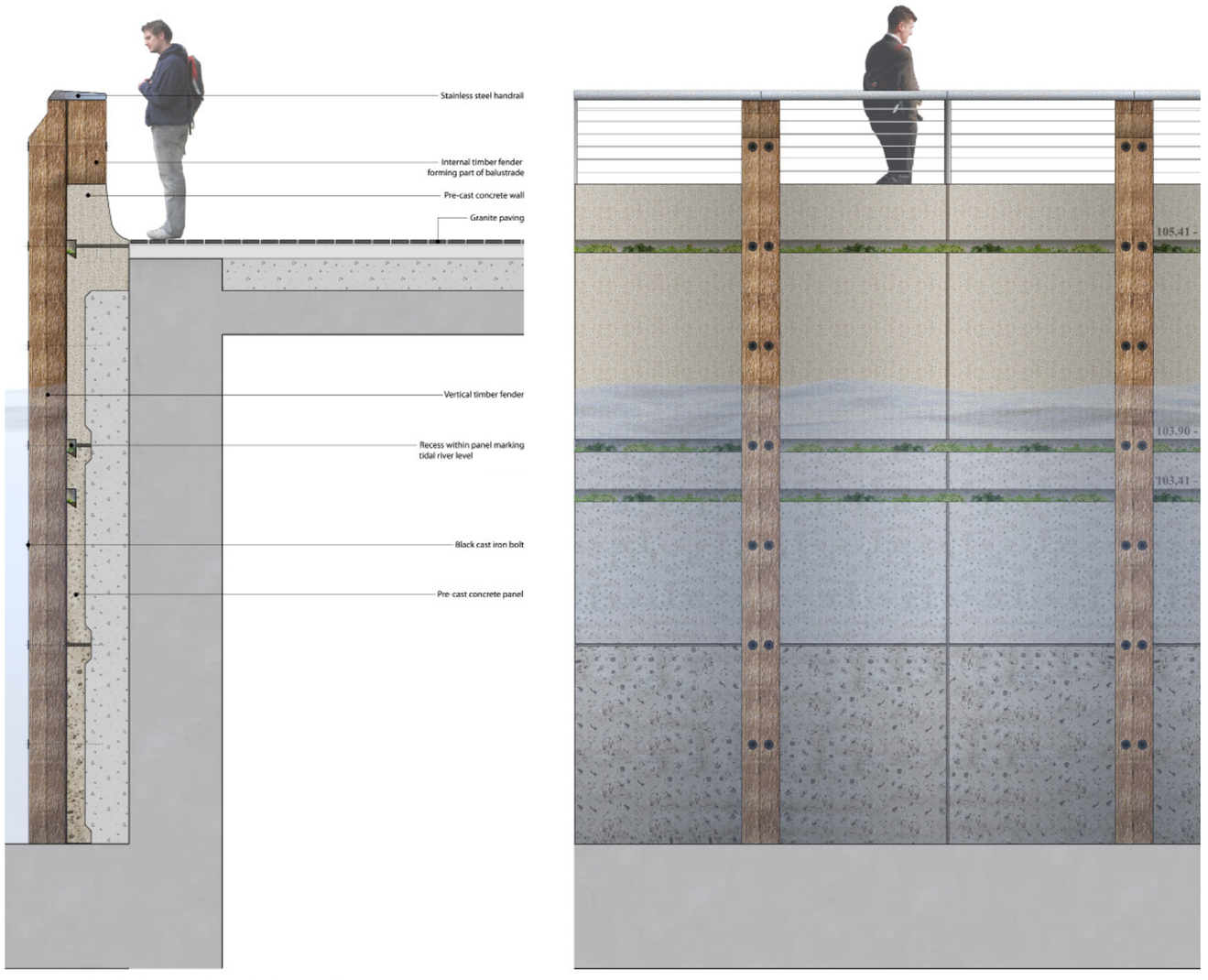

Figure 5.45: Sketch of proposed "standard" river wall treatment with horizontal grooves

Banded paving and cladding

5.4.23 Like the ventilation column design, the patterns created by the movement of water also influenced the design of paving treatments and electrical and control kiosk cladding at several sites. It is based on the broadly parallel but slightly eccentric movement of plants in the currents of water, and also evokes the way in which different strata build up in the river bed over time.

5.4.24 Flowing bands of paving would be used in the areas of public realm at several sites to draw pedestrian flows to key view points. Lighting strips embedded in the ground would reinforce this motif at night. This approach lends interest to the large areas of hardstanding required for inspection and maintenance of the tunnel system. It is also flexible enough to be adapted to the final arrangement of required access covers to the below-ground equipment.

5.4.25 The motif would also be used in the cladding of several electrical and control kiosks, where the design is not over-ridden by site-specific concerns. It would form an attractive, simple and robust treatment to the kiosk envelope.

Access covers

5.4.26 Access covers were also identified as a potential 'signature' element of the designs to unobtrusively mark the project sites and help Thames Water personnel identify the correct covers. The layout of the below-ground works would be site-specific and the covers vary according to the capacity and layout of the main tunnel shaft, CSO drop shaft or the CSO itself.

5.4.27 Some covers would be smaller and would enable the removal and replacement of functional components. Larger covers would be installed over the main tunnel shafts and CSO drop shafts, which would be removed to enable access into the shaft for inspection and maintenance activities.

5.4.28 The covers would be either be inset covers inlaid with the surrounding paving materials or be buried. The final design for the access covers would be agreed with the local authority at a later stage, following any decision to grant development consent, and might be the result of community involvement or a design competition.

Figure 5.46: Plants bending with a water current (Source: lovetextures.com)

Figure 5.47: Examples of commemorative or bespoke access covers

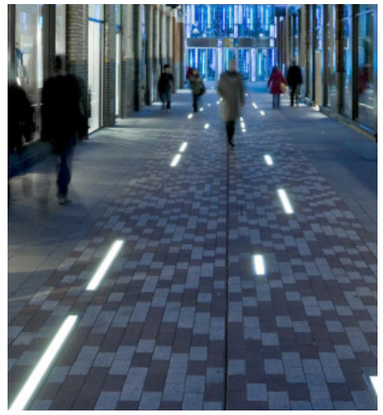

Figure 5.48: Example of lighting strips

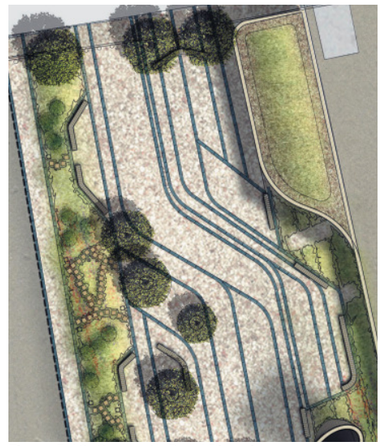

Figure 5.49: Carnwath Road Riverside

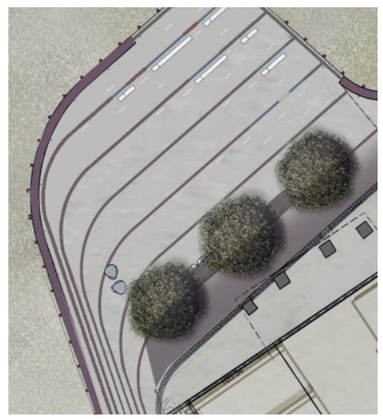

Figure 5.50: Albert Embankment Foreshore

Opportunities for interpretive material

5.4.29 Design principle HRTG.07 states:

5.4.30 "The project shall provide interpretive material at sites of heritage value where this would be of wider public benefit. The design of interpretation materials shall not lead to unacceptable visual clutter. Interpretation will be undertaken in line with a project-wide Interpretation Strategy and shall take account of any existing local interpretation strategies."

5.4.31 Given the proximity of many of our sites to both the River Thames and London's 'lost rivers', there is considerable scope to develop interpretive material that would provide information on the river, its history and the project to display on-site. The material would be informed by any archeological investigations carried out during construction.

5.4.32 The content of the interpretive material and the means of display would be agreed at a later stage.

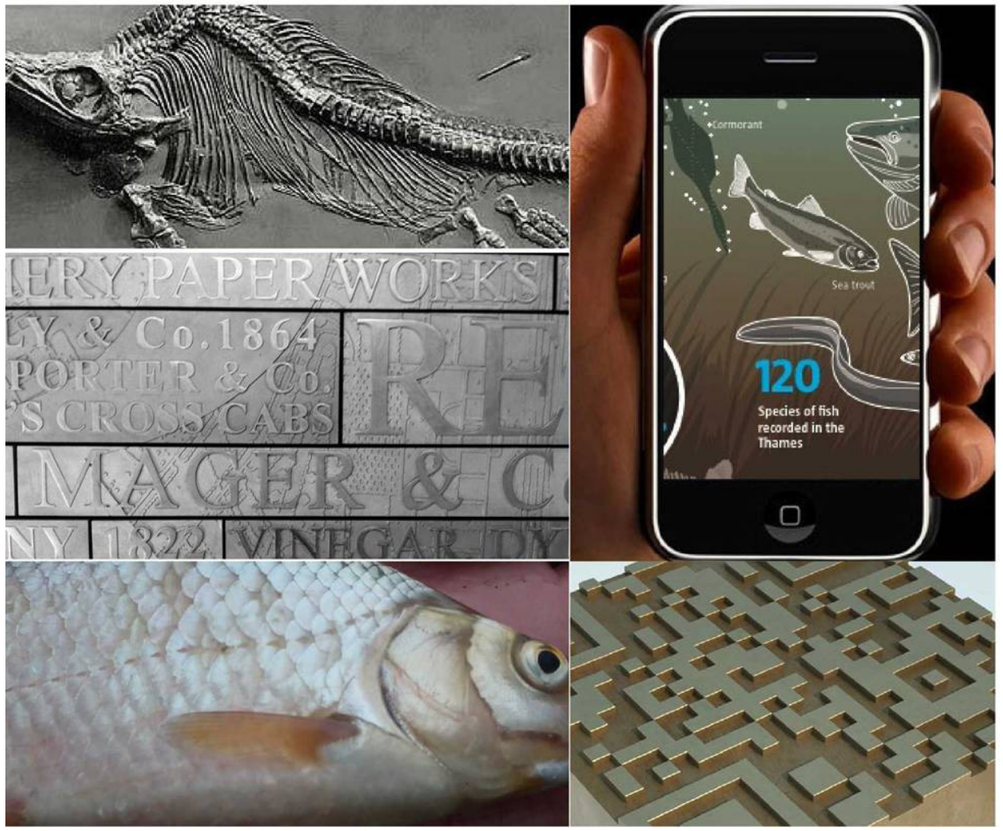

Figure 5.51: Examples of the type of interpretive material that might be included on the sites

Figure 5.52: Reeds in water (Source: Tom Wray)

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

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