Department
for Environment
Food & Rural Affairs

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# Creating a River Thames fit for our future

## An updated strategic and economic case for the Thames Tideway Tunnel

**October 2015**

This publication is available at www.gov.uk/government/publications

Cover photograph courtesy of Gary James.

Any enquiries regarding this publication should be sent to us at: Thames Tideway Tunnel Team thamestidewaytunnelteam@defra.gsi.gov.uk

## Contents

# 1. What is this document?

This document is designed to give you an overview of the Thames Tideway Tunnel project and why it is needed.

It summarises the strategic and economic case for addressing the problem of overflows of untreated sewage into the tidal Thames through central London that are causing environmental harm. It sets out why the Thames Tideway Tunnel is the chosen solution for dealing with this problem.

This updates the November 2011 document, "Creating a River Thames fit for our future: A strategic and economic case for the Thames Tunnel"[1] and takes into account data emerging since that time.

# 2. Roles and responsibilities

**Defra (the Department for Environment, Food and Rural Affairs)** is the Government department responsible for the framework of policy and legislation relating to the impact of Combined Sewer Overflow (CSO) discharges on the River Thames. We have a duty to make sure that a solution (such as the Thames Tideway Tunnel) meets our policy goals and EU legal obligations at a cost that is affordable and represents value for money. Therefore, we have a keen interest in ensuring that this project is delivered successfully.

**Thames Water Utilities Limited** has a statutory duty to provide an effective and efficient public sewer in London. It is required under an Ofwat licence to comply with relevant legislation and to comply with the obligations set out in the Urban Waste Water Treatment Directive (UWWTD)[2] for its area.

Specification of the Thames Tideway Tunnel project by the Secretary of State in June 2014 under The Water Industry (Specified Infrastructure Projects) (English Undertakers) Regulations 2013[3] relieved Thames Water from complying with that duty in relation to undertaking the project, and instead required it to procure a separate "Infrastructure Provider" to finance, design, build, own, operate and maintain the bulk of the Tunnel. That procurement process was completed in August 2015, with a new company called Bazalgette Tunnel Ltd being designated by Ofwat as the Infrastructure Provider for the project and being awarded a project licence.

**Ofwat** is the economic regulator of the water and sewerage industry in England and Wales. It is responsible for making sure that Thames Water and Bazalgette Tunnel comply

[1] www.gov.uk/government/publications/thames-tunnel-strategic-and-economic-case-costs-and-benefits
[2] Implemented by The Urban Waste Water Treatment (England and Wales) Regulations 1994 (as amended), which have the effect of supplementing s94 of the Water Industry Act 1991for relevant undertakers
[3] S.I. 2013/1582

with their licence conditions and meet statutory obligations with reference to the River Thames in a manner that is in the interests of customers. It also has a duty to ensure the company is able to finance the proper carrying out of this function.

**The Environment Agency (EA)** is the environmental regulator with principal responsibilities being to protect and improve the environment, and to promote sustainable development. As such, the EA is responsible for ensuring that Thames Water is compliant with environmental law, including sewer overflows into the River Thames. The EA is also the statutory environmental adviser to the Government.

# 3. What is the problem?

## Summary

In recent years an average of 39 million tonnes of untreated waste water containing raw sewage has overflowed from Combined Sewer Overflows (CSOs) around 50 to 60 times a year into the River Thames in London. Thames Water has recently upgraded the main sewage treatment works for London and by 2016 the Lee Tunnel will be operational. However even then it is estimated about 18 million tonnes of untreated waste water will still flow into the River Thames in London in a typical year.

The current network of major sewers was designed for a 19$^{th}$ century city of 4 million people and consists of combined sewers, which convey both foul sewage and rainwater surface run-off to sewage treatment works for treatment before being discharged. When they reach capacity, these CSOs are designed to discharge excess untreated waste water into the River Thames to avoid the hydraulic capacity of sewage treatment works being exceeded, with sewage backing up and flooding buildings and roads.

Today this network is operating at 80% or more of its design capacity in dry weather conditions, which means that even light rainfall can trigger spills of untreated sewage into the River Thames from the CSOs. In the future, sewage may overflow into the river even on dry days unless action is taken.

Increasing population and urbanisation has led to the sewer system being overloaded. The Lee Tunnel and sewage treatment works upgrades by themselves will reduce the problem of overflows, particularly in the lower reaches of the tidal Thames, but will still leave discharges of some 18 million tonnes per year typically in the upper and middle reaches. In 2014, 16 million tonnes of untreated sewage discharged into the River Thames from central London CSOs – just three of them (the Hammersmith, Lots Road, and Western Pumping Stations) contributed 11 million tonnes to that total. The recent upgrades of the sewage treatment works and the Lee Tunnel will have little impact on these discharges.

## Protecting our environment and health

There are regular pollution events as a result of the CSOs spilling untreated storm sewage into the Thames. Sewage discharges have a significant impact on the ecology of the river by reducing dissolved oxygen levels in the water. In extreme events this can result in the death of fish (especially juveniles) and other aquatic wildlife, sometimes in large numbers, as well as causing them to be displaced by the pollution, their reproductive cycles damaged or their migration patterns disrupted.

The polluted water increases health risks to recreational users of the Thames, and there is also a visual impact: the CSOs discharge offensive material into the river, such as faeces, toilet paper, wipes, sanitary products and other 'flushable' items, including hypodermic needles. This is sometimes referred to as 'aesthetic pollution'. All of this causes slicks of floating pollution which in turn can wash up on the foreshore.

When CSOs discharge the resulting sewage and litter flows up and down the river with the tide. In winter, when the river flow is highest, it takes about one month for non-biodegradable waste to get from the head of the estuary at Teddington to the sea, and in the summer when the river flow is lowest it can take up to three months. It is in the summer months that sewage discharges have the biggest impact.

The Thames Tideway Tunnel will ensure that the ecology of the Thames estuary in London continues to improve, and is no longer affected by regular crashes in dissolved oxygen levels. In combination with the other London Tideway improvements, the Tunnel will ensure that the estuary can become a fully-functioning natural ecosystem. As such, the River Thames' role as a nursery for juvenile fish, habitat for resident species, as well as a route for migratory fish, will be secured.

## Meeting our legal obligations

The UK is required by the Urban Waste Water Treatment Directive (UWWTD)[4] to have adequate systems in place for the collection and treatment of waste water to protect the environment. We also have to comply with the Water Framework Directive (WFD)[5] which aims to protect and enhance the quality of water in rivers, estuaries, coasts and aquifers through the implementation of river basin management plans.

There are no specific standards or targets set in the UWWTD, so it is up to Member States to demonstrate that the measures they take protect the environment adequately and to ensure that all urban waste water is collected and treated. The Directive acknowledges that pollution from overflows in combined systems may occur in exceptional circumstances (such as unusually heavy rainfall), but requires Member States to construct and maintain collecting systems using the best technical knowledge not entailing excessive cost.

[4] Directive 91/271/EEC.
[5] Directive 2000/60/EC.

The approach being taken to implementing the Directive in London is consistent with measures taken elsewhere in England and Wales. It includes the construction of the Lee Tunnel (due to be completed by the end of 2015), upgrades to the five main sewage treatment works (completed in 2014) and the Thames Tideway Tunnel (scheduled for completion by 2023). The Thames Tideway Tunnel is an integral part of the Thames River Basin Management Plan, which will help to achieve the WFD objectives for the tidal Thames.

Despite our clear commitment to major improvements to London's waste water collection and treatment system, the European Commission took the position that the current magnitude of CSO spills meant that it was inadequate and referred the UK to the Court of Justice of the European Union (CJEU). In October 2012, the CJEU found the UK to be in breach of the UWWTD in London, but noted that the UK was proposing the Thames Tideway Tunnel as a solution to the problem.

The UK is now under a legal obligation to take the necessary measures to comply with the judgment of the Court, and the Commission can apply to the Court for a fines action if it is not satisfied with our progress in doing so. Such fines are likely to be very significant. Section 5 of this document considers the likely level of fines in more detail.

## Coping with changing climate and a growing population

London's existing sewerage system is under pressure with little spare capacity to deal with heavy showers because in places it is operating at around 80% capacity at certain times of the day, even when it is dry. An increasing resident population is leading to more houses, and London's growth as a business centre is leading to an increasing daily working population, while increasing urbanisation is leading to a loss of green space to help water drain away. As a result, the system quickly becomes overloaded when it rains leading to frequent large discharges of untreated combined sewage entering the River Thames. Without action the situation will continue to get worse.

In addition, climate change predictions indicate lower summer river flows and warmer water temperatures. These are likely to affect dissolved oxygen levels in the river. The warmer the water is, the less oxygen can dissolve and the quicker organic matter in sewage will break down and consume oxygen. This in turn would make aquatic life more sensitive to any pollution.

Increasing population and urbanisation has led to the sewer system being overloaded. The Lee Tunnel and sewage treatment works upgrades by themselves will reduce the problem of overflows, particularly in the lower reaches of the affected section of the Thames, but will still leave discharges amounting to around 18 million tonnes in the upper and middles reaches.

# 4. What alternatives have been considered?

## Researching possible solutions

Extensive studies have taken place over many years exploring a wide range of possible solutions to address these untreated waste water problems in the Thames. These have included both tunnel- and non-tunnel-based options.

In 2000, the Thames Tideway Strategic Study[6] was set up to consider the environmental impact of combined sewer discharges to the tidal River Thames and to propose potential solutions that would ensure continued compliance with the UWWTD. The main report (produced in February 2005[7] with a supplementary report in November 2005[8]) recommended a major tunnel under the Thames to intercept CSO discharges.

This study also led to the London Tideway Improvements Scheme, which identified three integrated solutions:

- The Thames Tideway Tunnel.
- The Lee Tunnel between Abbey Mills pumping station near Stratford and Beckton to pick up the large discharges at Abbey Mills CSO. Work on the Lee Tunnel is almost completed and it is due to become operational by the end of 2015.
- Improvements to five sewage treatment works (Beckton, Crossness, Long Reach, Riverside and Mogden). This work was completed in 2014. The improvements to Beckton involved a major extension to the works, which included capacity to meet future dry weather flow requirements and to treat the contents of the Thames Tideway and Lee Tunnels, and to generate renewable energy from the sludge resulting from the treatment process.

## Alternative options considered

The Thames Tideway Strategic Study considered a number of approaches to the sewerage problems in London. These included, for example, screening of discharges, local storage and treatment and a shorter tunnel in West London. The table at Annex 1 summarises the main options considered, assessing each option in terms of compliance with the environmental and legal drivers for the project, along with associated costs for each option.

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[6] Thames Water, the Environment Agency, the Greater London Authority, Defra and Ofwat (as an observer) all contributed to the study, chaired independently by engineering consultant, Professor Chris Binnie.
[7] *Thames Tideway Strategic Study Steering Group Report*, February 2005.
[8] *Thames Tideway Strategic Study Steering Group Report: Supplementary Report to Government*. November 2005.

***Jacobs Babtie Report***

Ofwat commissioned consultants Jacobs Babtie to review the work and reports of the Thames Tideway Strategic Study.[9] Their report was published in February 2006 and proposed additional options for dealing with the CSO discharges at a potentially lower cost, but with lower CSO control. It proposed constructing a 9 km tunnel to intercept discharges in West London (Hammersmith to Heathwall CSOs), a screening plant to reduce sewage-derived litter and faecal matter discharged to the River Thames, and an enhanced primary treatment plant at Abbey Mills pumping station in East London. These were in addition to the proposed upgrades at Crossness, Mogden, Beckton, Long Reach and Riverside sewage treatment works, litter skimmer boats, and oxygenation measures ('bubblers' and hydrogen peroxide dosing plants). The report also suggested that sustainable drainage systems (SuDS) should be implemented over the medium term where appropriate in London's suburban fringes.

However, Defra's 2007 regulatory impact assessment[10] concluded that these recommendations would not meet the objectives set within the Thames Tideway Strategic Study, and so were not accepted. This was on the grounds that these recommendations would still leave frequent discharges from 19 CSOs between Vauxhall Bridge and the tidal barrier (which would continue to discharge around 10 million cubic metres per year) and ultimately dissolved oxygen targets for the River Thames would not be met. Also, skimmer and bubbler boats could not be considered an effective strategy under the UWWTD as they would not prevent pollution entering the river.

A later review by Thames Water of a twin tunnel approach has confirmed that these problems remain and, this approach assumes a certain level of headroom within the existing sewerage network which does not exist. This would create difficulties in pumping back into the main sewerage network any volumes from within a western tunnel. Any wait for capacity within the main network would also result in sewage sitting within the western tunnel for long periods and becoming septic and odorous.

## Ongoing review of data

The Government considers that detailed studies, which have been kept under review since the original decision to support a tunnel-based solution in 2007, continue to confirm the case for a Thames Tideway Tunnel.

[9] *Independent review to assess whether there are economic partial solutions to problems caused by intermittent storm discharges to the Thames Tideway*, 2006.
[10] *Regulatory impact assessment – sewage collection and treatment for London*, Defra, 2007

In March 2007, Defra undertook a regulatory impact assessment on sewage collection and treatment for London[11]. This considered various approaches to meeting the UWWTD requirements, mainly focusing on tunnel-based solutions but also reviewing work that had been carried out on alternative approaches, e.g. separate sewer systems and SuDS[12]. Options were assessed in terms of their ability to meet environmental objectives, agreed as part of the Thames Tideway Strategic Study and confirmed by the EA as appropriate.

Following this assessment, Ian Pearson, the then Minister of State for Climate Change and Environment, concluded that Thames Water should proceed with a tunnel-based approach to address unsatisfactory discharges into the Thames Tideway. No alternative solutions had been identified which would comply with both the environmental objectives set by the Thames Tideway Strategic Study and the requirements of the Directive. Neither would any alternative approach provide a quicker or more cost-effective solution.

At the time of these considerations, estimated discharge volumes were available but firm data on some of the CSO discharges were lacking. Therefore, it was acknowledged that further investigation into the development and design of a single tunnel approach was needed to refine further the solution and the costs. The ministerial agreement at that stage was to a tunnel-based solution on an 'in principle' basis, with a view to further work being completed and reviewed. Subsequently, Thames Water carried out detailed investigations leading to refinements in the preferred route for a Thames Tideway Tunnel and to improved knowledge of the level of discharges from CSOs into the Thames.

The following studies (since 2011) consider the proposed solutions:

- the 'National Policy Statement for Waste Water' (NPS), published by Defra in February 2012[13]
    - This clarifies the policy framework for projects identified as Nationally Significant Infrastructure Projects, including the Thames Tideway Tunnel, and explains their need. The NPS reviews alternatives to the Thames Tideway Tunnel and established its need following Parliamentary debate and approval of the NPS in March 2012.
- the 'Thames Tunnel Evidence Assessment', published by Defra in February 2012[14]
    - This considers the full range of evidence available on all the proposed options to address sewage in the Thames and provides an assessment of that evidence. An Annex lists the supporting studies and reports.

[11] *Regulatory impact assessment – sewage collection and treatment for London*, Defra, 2007
[12] SuDS can help to reduce the volume of water that London's sewer network has to deal with. SuDS involve using permeable surfaces to allow water to infiltrate the ground where storage systems collect and store excess water in lagoons. There, evaporation and ground infiltration take place.
[13] www.gov.uk/government/publications/national-policy-statement-for-waste-water
[14] www.gov.uk/government/publications/thames-tunnel-evidence-assessment-final-report

- ‘An assessment of evidence on Sustainable Drainage Systems and the Thames Tideway Standards’, published by the Environment Agency in October 2013[15]

    - This uses a Rapid Evidence Assessment (REA) approach to review the available evidence and concludes that SuDS alone would not reduce spills from CSOs sufficiently to meet the Thames Tideway Strategic Study environmental standards for the River Thames.

# 5. What is the economic case for change?

## Public support for finding a solution

In 2014, Defra commissioned environmental economic consultants Eftec to update a study that they had conducted in 2006 for Thames Water. This assessed people’s preferences in relation to the Thames Tideway Tunnel and therefore the value they placed on particular benefits arising from the project. This is expressed as their ‘willingness to pay’ or WTP. The benefits were defined as reductions in fish deaths, adverse health impacts, sewage litter and odour (to a level consistent with complying with the UWWTD).

The updated Eftec study[16] suggests that people’s willingness to pay for these benefits is within a £7.4 billion to £12.7 billion range (updated to 2014 prices) in present value terms. This is an aggregate for England, and compares with a range of £3 billion to £5 billion estimated by Defra using Eftec’s earlier study and which was used in Defra’s 2011 assessment of the project benefits[17].

One significant reason for the increase in the aggregate benefit estimate relates to new information on the impact of the Lee Tunnel on the original benefit survey results. In 2011 a conservative estimate was used to separate benefits of the Thames Tideway Tunnel from the combined benefits for both the Lee and Thames Tideway Tunnels. Although both are necessary to achieve the full benefits, it was felt necessary to separate them to account clearly for the individual value of the Thames Tideway Tunnel as the Lee Tunnel was nearing completion. In 2011, the Thames Tideway Tunnel was assumed to provide a notional 60% of the total benefits (i.e. with the Lee Tunnel providing the other 40%), based on the tonnage of sewage to be handled by each tunnel. However, the updated study considers that the Lee Tunnel in isolation will have little impact on the specific benefits contributing to WTP in the upper and middle reaches of the Thames Tideway, namely concentrations of dissolved oxygen, sewage litter and health impacts.

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[15] http://webarchive.nationalarchives.gov.uk/20140328084622/http://www.environment-agency.gov.uk/static/documents/Research/SuDS_and_the_Thames_Tunnel_Assessment_Final_Report_Oct_2013.pdf

[16] *Update of the Economic Valuation of Thames Tideway Tunnel Environmental Benefits*, Eftec, 2015 (available at http://randd.defra.gov.uk/ and search for “WT1570”)

[17] *Creating a River Thames Fit for our Future – A Strategic and Economic Case for the Thames Tunnel” and “Cost and Benefits of the Thames Tunnel*, Defra, November 2011.

Another significant reason for the increase in aggregate benefits in the updated Eftec study is the use of income level instead of Socio-Economic Group (SEG) to estimate aggregate WTP for the Thames Water customer group and England as a whole, based on the individual survey results. Income level is a key determinant of WTP, but SEG had to be used as a proxy in the earlier study, being the only statistic available at the geography required (local census areas) at that time. However, SEG tends to mask variation in income and it is now apparent that its use led to an underestimate of aggregate WTP for the key Thames Water customer area. Now that income level data is available for local census areas, this issue has now been resolved.

The updated Cost-Benefits Analysis (published alongside this one) considers for comparison what the effect would be on the cost-benefit ratio even if the more conservative 2011 position on the Lee Tunnel was assumed. It also sets out other differences between the latest cost-benefit analysis and those issued in 2011.

## Other benefits

There are other, unquantifiable, benefits that we expect to result from the Thames Tideway Tunnel. These include employment and regeneration benefits, reputational issues, the protection of habitats and species, and the reduction in sewer flooding risks.

Improvements to the water quality in the River Thames through the construction of the Tunnel should lead to wider, long-term benefits to London's reputation (e.g. as a tourist destination) and economy. Equally, the lack of an effective and timely solution could be damaging.

For example, the Thames Tideway Tunnel project should help to maintain the attractiveness of London for inward investment. We need to ensure that our infrastructure is maintained, and that includes ensuring that the River Thames meets adequate environmental standards at least comparable to other major western cities.

It is unlikely at present that businesses are put off locating in London due to sewer overflows into the River Thames. However, it is likely at some stage in the future that there will be a more prolonged and detectable impact if no further action is taken - given that London's sewers by the Thames are already operating close to capacity, more waste water is predicted to enter the river over time and there may be more frequent low flows during the summer due to climate change. An impact on London's attractiveness to new businesses may therefore arise, particularly as competing capitals and large cities continue to put in place schemes to address their similar problems.

Aside from businesses, there may be benefits to riverside development. Without a solution, the river is predicted to deteriorate and could have an impact on the value of existing property and limit future development. In 2012, Thames Water published analysis of the Thames Tideway Tunnel's wider economic impacts; namely, those on the "real

economy" in terms of growth in "value added" (income or GDP) and jobs[18]. This report argues that the Tunnel could remove potential constraints on future growth in London's economy, critical for wider UK growth, create and sustain construction jobs, and leave a positive skills legacy for London.

While Thames Water acknowledges that it is not possible to make a definitive assessment of the impact of removing future growth constraints, it presents an illustrative assessment. This suggests that over 20 years, the cumulative impact on UK Gross Domestic Product (GDP) of preventing development constraints arising because of sewerage capacity could be between £5 billion and £15 billion. This is based on an assumption that 40,000 homes (18% of those expected by 2031) are not built if the Thames Tideway Tunnel is not constructed, meaning a constraint on population growth of around 0.05 percentage points each year. The range of estimates reflects assumptions about the extent to which economic growth might be transferred elsewhere in the UK.

The Thames Water report also makes estimates of the employment impact of the Tunnel; some 4,250 workers would be directly employed at the height of construction activity, with a further 5,100 indirect jobs created as a knock-on impact. As well as the employment impact (totalling around 9,350 jobs), the Tunnel would build on the skills legacy already started by the Crossrail project, including the establishment of the Tunnelling and Underground Construction Academy and work in schools.

We have not included in the formal cost-benefit analysis for the Thames Tideway Tunnel these economic benefits as estimated by Thames Water due to their illustrative nature, but they highlight potential impacts on the economy which strengthen the case for the project further.

There are also benefits to upstream and downstream environmental assets, such as fishery nursery habitats and other designated habitats for wildlife, including a number of sensitive habitats of conservation importance. Fish stocks are sensitive to pollution, habitat changes and human activities, and are therefore a good indicator to assess river quality. Fish populations in the River Thames have improved significantly since the early 19th century when major industrial and polluting discharges limited the river's ability to sustain life. It now supports a diverse range of wildlife and provides a key fish nursery for many species such as sole, herring and bass which supports North Sea fish stocks.

Since 1964 the tidal River Thames has recorded 125 species of fish along its length, from Teddington to the outer estuary at Tilbury, including species such as eels, smelt, shad, lamprey and salmon. Each year around 40 of these species are regularly found in the river.[19] However, we believe that there is great potential for increased biodiversity and still greater abundance of fish, including sensitive species and species of conservation importance.

[18] See *Why does London's economy need the Thames Tideway Tunnel?* (Thames Water, 2012).
[19] *State of the Environment in London*, Environment Agency, 2011, February 2013 update, page 65

A specific problem relating to sewer flooding to properties in the Counters Creek area in West London is being addressed by a separate Thames Water project.[20] However, there may be synergies between the two projects: the Tunnel could potentially receive flows and form part of the solution to sewer flooding problems in this area and elsewhere.

A further benefit arises from compliance with EU law. Section 1 explains that the CJEU has found the UK in breach of the UWWTD and that this may result in fines being imposed on the UK. Putting a cost on UK non-compliance is difficult, but we estimate that the Commission could try to seek fines from around £100 million a year. This would be payable until such time that the Commission considered the UK to have complied with the Court's judgment.

In October 2013, the CJEU fined Belgium a lump sum of €10m and a daily penalty of €4,722 for breaches of the UWWTD, relating to non-compliance with an earlier Court judgment from 2004. In November 2013, the CJEU imposed on Luxembourg a lump sum penalty of €2m and a daily penalty of €2,800 for UWWTD breaches. The original judgment that Luxembourg was in breach was made in 2006. In April 2014, the European Commission brought a fines action against Greece for non-compliance with a Court judgment from October 2007, seeking a lump sum fine of over €12m plus a €47,462 daily penalty for UWWTD breaches.

## Costs

As the table on options at Annex 1 describes, the only options that meet the required environmental and legal standards are the Thames Tideway Tunnel and converting the current combined system into a new separate drainage system. The latter however would be more disruptive, take longer, and be more costly than the Tunnel. SuDS while leading to significant reductions in overflows into the Thames, would not meet the required standards and would also be more disruptive, take longer and be more expensive than a Tunnel.

The Thames Tideway Tunnel Project Specification Notice[21] issued in June 2014 under the Water Industry (Specified infrastructure Projects) (English Undertakers) Regulations 2013 required Thames Water to put the project out to tender by running a competitive procurement for an Infrastructure Provider that would be separate from Thames Water and would be responsible for delivering the project, including its financing.

The associated Reasons Notice gave the reasons why Defra considered the Thames Tideway Tunnel Project to be of a size and complexity that threatened Thames Water's ability to provide services for its customers, and why an Infrastructure Provider was likely to result in better value for money than would be the case if the Tunnel were built by Thames Water.

[20] www.thameswater.co.uk/about-us/9344.htm
[21] www.gov.uk/government/publications/thames-tideway-tunnel-project-specification-and-preparatory-work-notices

Following the procurement of an Infrastructure Provider, Bazalgette Tunnel Ltd. was awarded a project licence[22] by Ofwat on 24 August 2015. Based on the requirements placed on Bazalgette Tunnel Ltd. by the Specification Notice and the project licence the whole life costs of the project have been estimated at £4.1bn (2014 prices, discounted present value terms)[23].

## Economic case summary

The Tunnel will secure at least £7.4 billion to £12.7 billion worth of economic benefits (where estimable)[24] for a 'whole life' cost of around £4.1 billion (2014 prices, discounted present value). Thames Water expects the Tunnel construction to employ around 4,250 people directly with some 5,100 more jobs in the supply chain and wider London economy, alongside other regeneration benefits such as lifting constraints on future housing and other developments and enhancing London as a major tourist destination. The Tunnel also meets our statutory requirements under the UWWTD and will reduce the risk of infraction fines against the UK.

# 6. The chosen solution

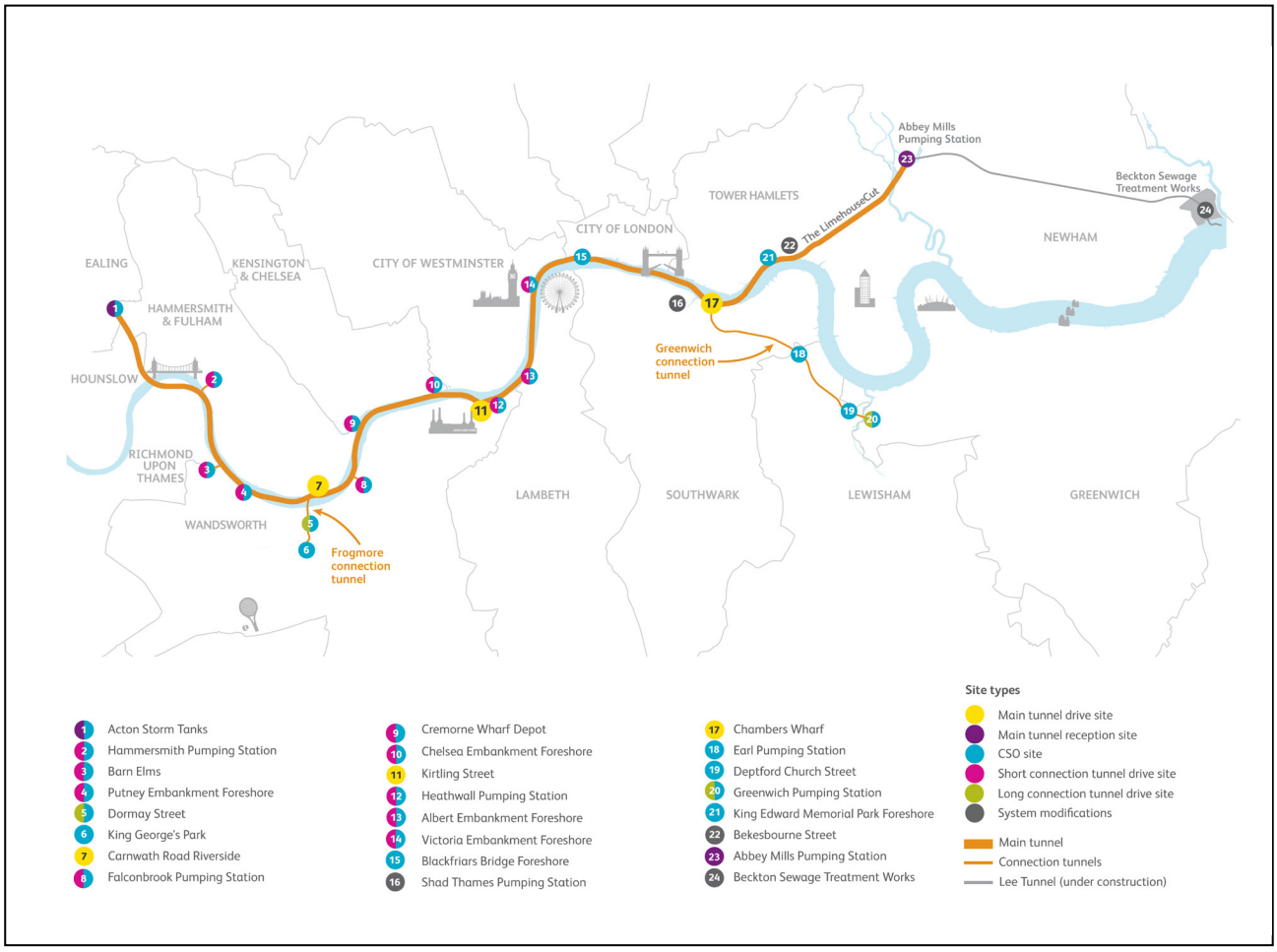
The Thames Tideway Tunnel will be 7.2 m in diameter, up to 67 m deep, and up to 25 km (16 miles) long. A tunnel of this size is necessary to provide sufficient storage capacity within it and the depth is necessary to avoid other tunnels and to allow the sewage to flow through the tunnel by gravity. Figure 1 illustrates the route of the Tunnel.

This route generally follows the route of the River Thames so that the tunnel can be connected to the 34 most polluting CSOs (as identified by the EA) located along the riverbank in London and capture about 15½ million tonnes of untreated waste water out of the 18 million tonnes that typically enter the river each year. It follows the River Thames as far as Limehouse, where it will continue north-east to Abbey Mills pumping station near Stratford. Here it will be connected to the Lee Tunnel, which will transfer the sewage to Beckton Sewage Treatment Works.

The remaining 2½ million tonnes of waste water that may still discharge into the Thames once the tunnel is operational will amount to 3-4 discharges a year, and consist of mostly surface water run-off during very heavy rainfall events after the most toxic sewer contents have first been passed into the tunnel. Figure 2 illustrates how the Tunnel will work.

[22] www.ofwat.gov.uk/industrystructure/licences/lic_lic_baz.pdf
[23] The updated 2015 Defra Cost-benefit Analysis provides further detail
[24] See Section 5, the economic case for change.

**Fig. 1: Schematic route of the Tunnel (Source: Thames Water)**




## Consulting on the Thames Tideway Tunnel as part of the development consent application

Thames Water carried out two extensive public consultations to refine the route for the Thames Tideway Tunnel. The first round of public consultation took place between September 2010 and January 2011, and the second between November 2011 and February 2012. It also conducted a third targeted consultation on four specific sites between June 2012 and July 2012. Thames Water subsequently revised its plans and submitted its planning application for a Development Consent Order (DCO) to the Planning Inspectorate on 28 February 2013[25].

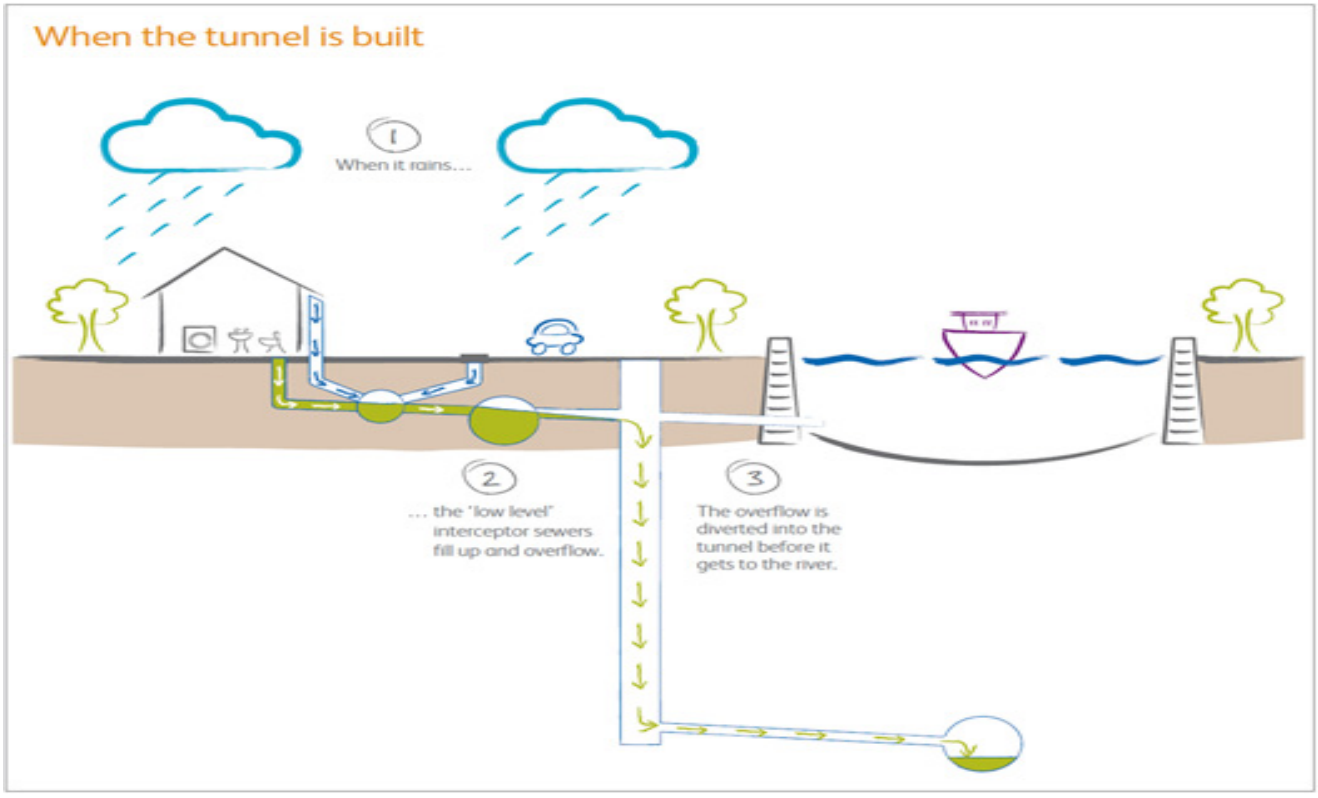
The Planning Inspectorate examined Thames Water's planning application for a DCO for the Tunnel between September 2013 and March 2014, including public hearings from November 2013 to February 2014 to enable local authorities and other interested parties to provide views on the application. The Planning Inspectorate took all views into account

[25] The DCO is granted under the Planning Act 2008 and combines various consents or permissions in a single order. It includes planning permission with a range of other separate consents, such as listed building consent and rights to compulsorily purchase land.

and made a recommendation to CLG and Defra Ministers on 12 June 2014. Ministers made the final decision to grant the Development Consent Order for the Tunnel on 12 September 2014.

Bazalgette Tunnel Ltd. expects construction of the main tunnel to begin on the ground in 2016, although Thames Water has already started preparatory works on a number of sites. The target date for completion of the Tunnel is currently 2023.

**Fig. 2: diagram showing how the Thames Tideway Tunnel will capture sewer overflows (Source: Thames Water)**




## Paying for the Tunnel

Thames Water customers will pay for the tunnel and work needed to improve CSOs through their sewerage bills. This cost will be spread across Thames Water's 13.8 million sewerage customers, including those outside London. This is standard water industry practice for apportioning infrastructure costs across all a company's customers in accordance with their charging schemes, and applies equally to London residents paying for improvements to sewage infrastructure to Thames Water areas outside London.

Following completion of the successful competitive procurement in August 2015 of the Infrastructure Provider, Bazalgette Tunnel Ltd, and the construction contracts, the likely project costs can now be judged with more certainty. It is now estimated that the average annual customer bill impact will be £20-£25, in 2014 prices. This estimate replaces the

worst case forecast of £70-80 at 2011 prices originally estimated in the early days of the project development. Of the £20-25 an average of £7 is already included in customer bills as it represents project costs already incurred by Thames Water.

As before, the bill impact is given as a range rather than a single figure in order to capture uncertainties implicit in the forecast (for example, the construction contracts are based on a target price, rather than a fixed price, and other cost factors such as real interest rates cannot be known with certainty at this stage). Once the construction period is over Ofwat will regulate the prices customers pay, as they do for the rest of the industry.

Thames Water has said that its current average household bill for water and wastewater of around £370 per year is now expected to remain at that level, before inflation, until at least 2020, including the costs of the Thames Tideway Tunnel. This reflects cost reductions for other (i.e. non-Tunnel) sewerage services. Overall, Thames Water sewerage customers' bills are expected to increase from being currently the second-lowest in England (at £171 per year in 2015/16) to closer to the national average over the next decade or so.

In 2011, Ofwat estimated that an £80 increase in sewerage bills in the Thames Water sewerage area would see about 15% of households spending more than 5%[26] of their disposable income on water and sewerage bills, i.e. around 820,000 households. This was above the then England and Wales average and would have been the second-highest by a sewerage company, behind South West Water at 16%[27]. Ofwat is currently updating its affordability analysis, and as the estimated bill impact of the Thames Tideway Tunnel is now £20 to £25 per year by the mid-2020s, it is expected that overall it will have less of an impact on customer affordability given that the impact is two-thirds lower than previously forecasted.

The pros and cons of various financing and delivery mechanisms, including the existing standard regime for the water sector, were carefully considered before the Infrastructure Provider route and its adapted regulatory regime were selected. As set out in the Notice giving Reasons for Specification of the Tunnel[28], the mechanism that was assessed as likely to provide best value for money for Thames Water customers was a separate Infrastructure Provider company licensed by Ofwat. Ofwat also consulted twice on the Infrastructure Provider project licence that sets out the adaptations to the standard regulatory regime applying to other water and sewerage companies; in October 2014 on the regulatory framework that would govern the Infrastructure Provider[29], and in July 2015 on the proposal to award a licence to the preferred bidder in the procurement[30].

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[26] Used as an indicator of water affordability. For more information, see www.ofwat.gov.uk/future/customers/metering/affordability/prs_inf_afford.pdf

[27] This analysis is based on a number of assumptions: in particular, that bills for other companies do not change between now and 2020 and that Thames Water does not have any other investment. It also does not take account of population growth (which could result in a smaller average increase).

[28] www.gov.uk/government/publications/thames-tideway-tunnel-project-specification-and-preparatory-work-notices

[29] www.ofwat.gov.uk/regulating/pap_con20141007tttipregframework.pdf

[30] www.ofwat.gov.uk/future/accountability/thames/pap_con20150717ttt.pdf

# 7. Conclusion

This document has demonstrated that there is a clear environmental and economic case for addressing the problem of overflows of untreated sewage into the tidal Thames in central London. The discharges from CSOs into the River Thames is causing ecological damage including large fish kills at times, sewage litter and odour-related problems, as well as potential adverse health impacts. This will continue even after the Lee Tunnel and Sewage Treatment Works upgrades are operational, and without a solution, the situation is expected to deteriorate.

The Thames Tideway Tunnel remains the cheapest solution which addresses these problems and meets the objectives set by the Thames Tideway Strategic Study for water quality improvements in the Thames.

The Tunnel has a positive benefits-to-cost ratio and will bring additional economic benefits as well as enabling the UK to meet its legal obligations and reduce the risk of infraction fines.

Defra will continue to work closely with all parties in the project to ensure that the project is delivered in a way that secures value for money for customers and protects taxpayers. This includes its formal role under the Liaison Agreement between Thames Water, Bazalgette Tunnel Ltd and Defra through which Defra will receive information on project progress and be able to monitor the contingent risks being borne by the taxpayer and take action as appropriate.

# Further sources of information

To find out more about this project, visit www.tideway.london

# Annex 1: Options for solutions to the Thames sewage pollution problem

| Option | Drivers met (pros) | Drivers not met (cons) | Estimated costs | Comments |
|---|---|---|---|---|
| Doing nothing, i.e. not building a tunnel but continuing with the construction of the Lee Tunnel and the upgrading of five sewage treatment works (STWs). | None. | • Does not meet the statutory requirement to protect the environment and water quality to enable us to continue to meet our obligations under the UWWTD, increasing the risk of successful fines action being brought against the UK for failing to comply with the CJEU's judgment.<br>• Does not meet the need to adapt to climate change or population growth and increasing urbanisation. | Construction of the Lee Tunnel and the upgrading of Beckton sewage treatment works have cost £0.8 billion (2014 prices). | This is not a feasible option. The Lee Tunnel and Beckton sewage treatment works upgrade will help to reduce the overall volume of discharges but not by enough to meet environmental objectives. There is also an increased risk of successful fines action being brought against the UK for not complying with the UWWTD. |
| Converting the current combined sewerage system into a new, separate drainage system (in addition to the Lee Tunnel and STW upgrades). | Would alleviate sewer flooding and would eventually comply with the UWWTD and environmental objectives. | • Extremely disruptive to businesses, residents and transportation.<br>• Does not meet the requirement to find a timely solution as it would be extremely | More costly than tunnel option at an estimated cost of at least £13 billion (2007 prices; higher today), excluding economic costs of disruption to traffic, etc. | This option would involve creating a completely new network of sewers and every existing property would need connecting to the new system. Cost and disruption would be very high and |

| Option | Drivers met (pros) | Drivers not met (cons) | Estimated costs | Comments |
|---|---|---|---|---|
| | | time-consuming to implement.<br>• Increases the risk of successful fines action against the UK. | | might lead to large numbers of misconnections, which would create a legacy of problems, pollution and further work. |
| Sustainable drainage systems (SuDS), in addition to the Lee Tunnel and STW upgrades. | In certain areas, there are realistic local opportunities to reduce 37% of impermeable areas, potentially contributing to a reduction in CSO discharges. | • Does not meet the statutory requirement to protect the environment and water quality to enable us to continue to meet our obligations under the UWWTD, increasing the risk of successful fines action being brought against the UK. (Even in the most receptive of trial catchments it has been estimated that there would still be more than ten spills from the local CSO in a typical year.)<br>• Does not meet the requirement to find a timely solution as it would be extremely time-consuming to implement i.e. up to 40 | More costly than the tunnel option at an estimated cost of at least £13 billion (2007 prices; higher today). | This option would require properties to be retrofitted and space to be made available for storage, discharge routes and disposal routes. In most areas, this space does not exist. There are also limitations (in terms of cost and practicality) to implementation in existing properties. |

| Option | Drivers met (pros) | Drivers not met (cons) | Estimated costs | Comments |
|---|---|---|---|---|
| | | years.<br>• Does not meet the requirement to find a cost-effective solution. | | |
| A tunnel-based solution (in addition to the Lee Tunnel and STW upgrades). | Meets the statutory requirement to protect the environment and water quality to enable us to continue to meet our obligations under the UWWTD.<br>Meets the need to adapt to climate change or population growth and increasing urbanisation.<br>Meets the requirement to find a timely solution.<br>Meets the requirement to find a cost-effective solution. | • None; would meet all requirements.<br>• However, costs, complexity and planning issues may create difficulties in achieving target date for completion, increasing the risk of infraction fines. | A 'whole life' cost of £4.1 billion (2014 prices, discounted present value terms)[31]. | Although this option comes with significant costs and disruption at certain sites, overall and in comparison with other options (excluding the do nothing option), it has the lowest costs and is the quickest option, with minimum disruption to the existing system and London. |

[31] Assumes a cost outturn at the 50% level ("P50"). This is the median point of the expected cost distribution having accounted for project risks. Whilst the 2011 estimate was conservatively presented at the P80 level to account for greater uncertainty at that point, more definitive modelling of project risks now allows the use of the P50 level.