Thames Tideway Tunnel

one of Europe's largest infrastructure projects, the 25km 'super-sewer' will tackle sewage discharges into the River Thames

In September 2014, the government granted a Development Consent Order (DCO) giving the green light for construction of the 25km long Thames Tideway Tunnel. The 'super sewer', which will run from west to east London, will be one of the biggest infrastructure projects in Europe and the largest undertaken by the UK water industry - one needed to address a serious problem facing the capital's river. London's sewerage system was designed by Sir Joseph Bazalgette in the 1850s, for a population of four million people. While the Victorian sewers are still in excellent working condition, they are struggling to cope with the demands of the city's growth.

CSO discharge at Vauxhall - Courtesy of Thames Tideway Tunnel

Why is the Thames Tideway Tunnel needed?

Now, even just a small amount of rain can cause the Victorian sewers to overflow, pouring sewage into the tidal River Thames from combined sewage overflow (CSO) discharge points all along the river. In a typical year discharges occur over 50 times with a total volume of over 39 million tonnes - enough to cover Hyde Park 27m deep in sewage. In 2014, 62 million tonnes of untreated sewage spewed into the river from Chiswick in the west through to Greenwich in the east.

The proposed solution

The solution to this unacceptable, unsustainable situation is a tripartite one: Thames Water is well advanced in delivering two components of the overall London Tideway Improvement Programmes: the Lee Tunnel, tackling the single largest overflow point near the Olympic Stadium in Stratford and the expansion of the five sewage treatment works on the tidal River Thames. The sewage treatment works improvements are complete and the Lee Tunnel will start controlling discharges in early 2016.

The third component of the improvements is the Thames Tideway Tunnel, a 7.2m diameter interception and transfer tunnel running up to 65m below the river. Starting in west London, the proposed route for the main tunnel generally follows the River Thames to Limehouse, where it then continues north-east to Abbey Mills Pumping Station near Stratford. There it will be connected to the Lee Tunnel, which will complete the transfer of sewage to Beckton STW. Construction is due to start on the Thames Tideway Tunnel in 2016, with the aim of CSO control by 2023. The Thames Tideway Tunnel will control over 90% of sewage discharges into the tidal River Thames and reduce the number of discharges from more than 50 per year to four.

Progress to date

Planning a project this size was an enormous task. To give some more perspective on the scale of the project, it will require 24 construction sites across 14 London boroughs and the route will pass under 1,301 buildings, 75 bridges, 20km of river walls, 50 in-river structures, 45 tunnels, 24km of gas mains, 15km of water main and 18km of sewers.

Thames Water started consultation on the project in 2010 and, following 114 days of public exhibitions and over 300 meetings, the biggest planning application ever submitted in the UK was handed to the Government for consideration in February 2012. This led to a Development Consent Order (DCO) being granted in September 2014. Key to achieving the successful application was, and continues to be, the team's dedication to engaging with communities, stakeholders and regulatory authorities and protecting the interests of Thames Water customers.

More than 400 employees, including engineers and scientists of all types, planners, project managers and architects, now work on the project. Although main construction is due to begin in 2016, the past seven years have involved meticulous planning, operational studies and design preparation to de-risk the project as much as possible and facilitate competitive bidding for the final design and construction work.

This has included thorough investigations of the ground being tunnelled through and working out how to minimise the potential impact on London's infrastructure, studying hydraulic structures, and exploring how the Thames Tideway Tunnel will integrate operationally with the sewer network.

In July 2015, the project received the Silver Jubilee Cup and the title of overall winner at the Royal Town Planning Institute Awards for Planning Excellence. The awards provided peer recognition of the fantastic team effort, over many years, involved in obtaining the Development Consent Order.

Delivery

The Thames Tideway Tunnel is being financed and delivered by an independent 'Infrastructure Provider' (IP), Bazalgette Tunnel Ltd, funded by investors and provided with its own water utility licence from Ofwat.

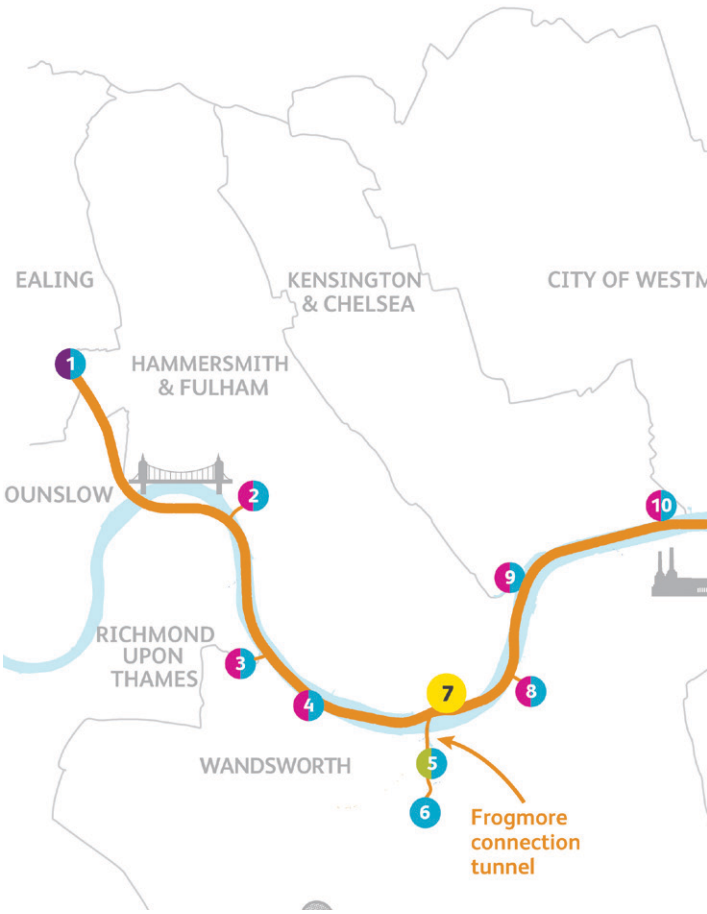
The project has been split geographically into three main construction works contracts which correspond to the anticipated tunnelling conditions - Central, East and West, and each section of the tunnel will be under construction at the same time to ensure that the Thames Tideway Tunnel can be completed effectively. The contractors named as the preferred main works tenderers are:

- ***West Contract***: BMB JV
  Joint venture of BAM Nuttall Ltd, Morgan Sindall Plc and Balfour Beatty Group Limited.
- ***Central Contract***: FLO JV
  Joint Venture of Ferrovial Agroman UK Ltd, Laing O'Rourke Construction.
- ***East Contract***: CVB JV
  Joint Venture of Costain Vinci Construction Grands Projects Bachy Soletanche.
- ***System Integration Contract***: Amey
  Infrastructure support service provider, Amey, has won the System Integration contract on the project to design and deliver the operational control systems that will turn the tunnel into a fully functional CSO control system.

Collaboration

At the outset, the project has established what it hopes will prove to be a pioneering delivery Alliance, involving the IP, all the contractors and Thames Water, to ensure and facilitate a spirit of

1. Acton Storm Tanks
2. Hammersmith Pumping Station
3. Barn Elms
4. Putney Embankment Foreshore
5. Dormay Street
6. King George's Park
7. Carnwath Road Riverside
8. Falconbrook Pumping Station
9. Cremorne Wharf Depot
10. Chelsea Embankment Foreshore
11. Kirtling Street
12. Heathwall Pumping Station
13. Albert Embankment Foreshore
14. Victoria Embankment Foreshore
15. Blackfriars Bridge Foreshore
16. Shad Thames Pumping Station
17. Chambers Wharf
18. Earl Pumping Station
19. Deptford Church Street
20. Greenwich Pumping Station
21. King Edward Memorial Park Foreshore
22. Bekesbourne Street
23. Abbey Mills Pumping Station
24. Beckton Sewage Treatment Works



collaboration and effective delivery of the project safely, on time and within budget. Although the main constructions work has been split into three packages it is imperative to share best practice across the project to assure the best value for money for customers and avoid unnecessary duplication of common work.

Collaboration is also paramount in terms of health and safety, where a zero compromise approach is non-negotiable. Everyone working on the project - from Thames Tideway Tunnel staff, to contractors and sub-contractors - will be required to be inducted into the project at the project's employee induction centre, EPIC. In its first 10 weeks, 600 project, Thames Water and contractor staff attended and participated in the forward-thinking induction experience, bringing to life the potential impact of health and safety related decisions and actions at work and representative of the continued 'transformational' aspirations of the Thames Tideway Tunnel.

The contractors are already thinking hard about how they can innovate to improve delivery of the Thames Tideway Tunnel and minimise the impact on communities close to construction sites.

One example of this is a commitment to use the river to transport material excavated during the tunnelling phase, no matter how logistically challenging that may be. The target is to remove 90% of this 'spoil' by river. Every barge taking that waste away on the water means 50 fewer lorries on London's already congested roads.

Future system resilience

The Thames Tideway Tunnel project has a design life of 120 years. While there are many uncertainties, we know that on that timescale there will be change in land development patterns, climate and population that will influence the performance of the Thames Tideway Tunnel, the Lee Tunnel and STW upgrades, in achieving CSO control and the water quality improvements in the tidal Thames.

The studies carried out showed that with estimated land development change, the predicted rainfall variation and continued population growth the Thames Tideway Tunnel is resilient to these changes and would continue to deliver the CSO control performance.

Design development

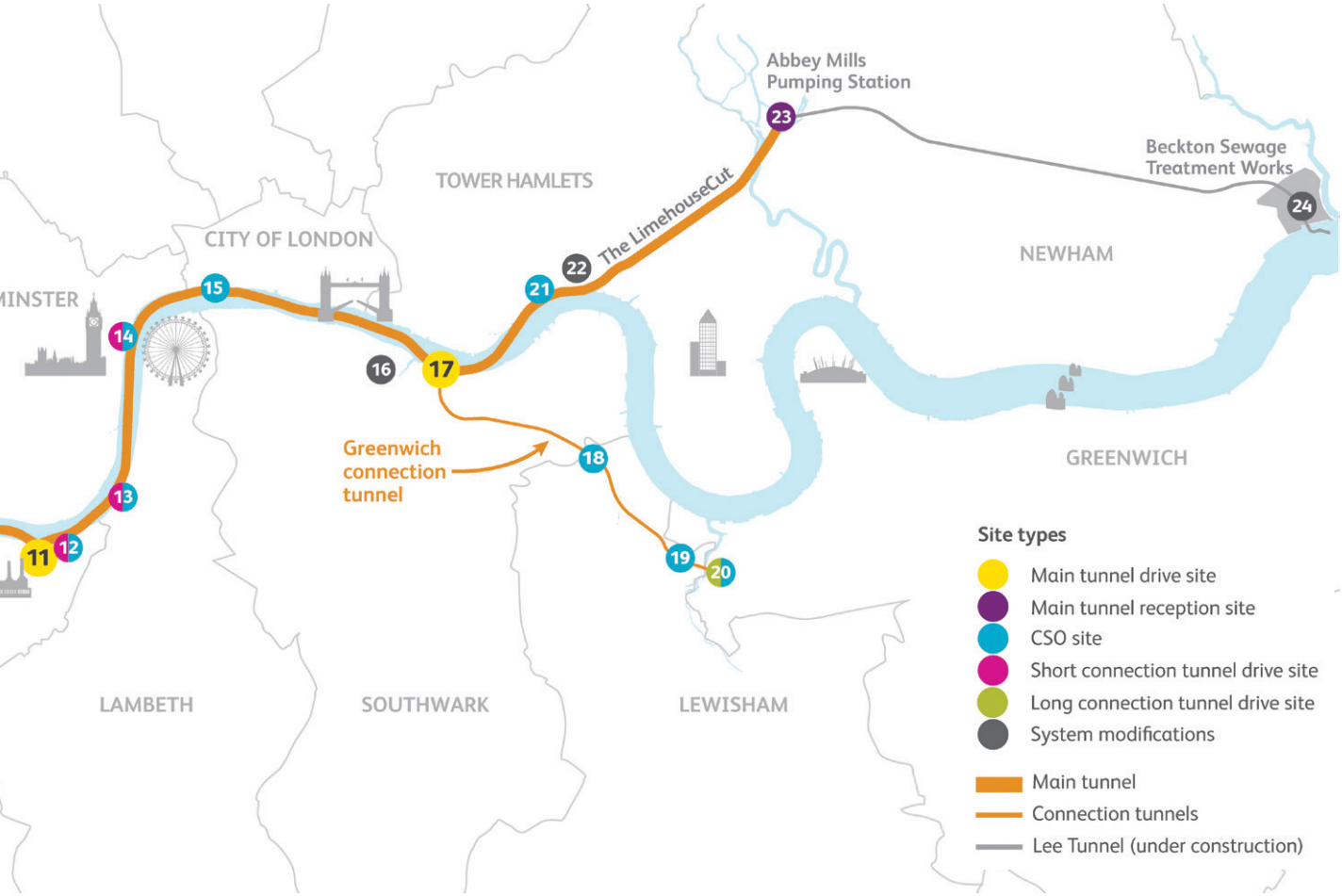
The detailed design and construction of the Thames Tideway Tunnel has been procured under three main works design and build contracts and a system integrator contract.

The approach to design has been to provide the contractors with a 'Reference Design', detailed specifications and where necessary performance requirements against which the contractors will need to design and demonstrate compliance. There are minimum requirements in a number of key areas:

- Health and safety (during construction and legacy operations and maintenance).
- Hydraulic structures.
- Air management.
- Durability.
- Health and safety.
- Operability and maintainability.
- Standardisation of equipment.

A number of modelling applications have been used in developing the Reference Design. These include the catchment model defining the inflows to the tunnel, specialised modelling techniques (for example water quality, air movement and transients), computational fluid dynamics (CFD) and scale physical models.

These have helped to show how the system will operate during the wide range of possible flows expected during the life of the project and define hydraulic surface requirements, as well as the



performance of energy dissipation and deaeration chambers at the drop structures. One example of a specialist application used to address an issue often associated with storage tunnels is pneumatic and transient analysis, which has provided an understanding of the dynamic conditions during rapid filling, and how these affect both water level rise and air displacement.

BIM

The project's BIM strategy is to provide an Asset Information Model (AIM) that will be compiled during design and construction delivery and ultimately used to manage the operation and maintenance of the system's facilities. The contractors are required to comply with UK BIM Level 2, consistent with the HM Government directive for all publicly funded projects to deploy BIM methodology by 2016.

Although the Thames Tideway Tunnel is a privately funded scheme, this is an excellent opportunity for the project to deploy a BIM strategy that supports preparation for and achieves success in later operations and maintenance phases, and is another example of the transformational direction of the Thames Tideway Tunnel project.

Jobs and skills

Given that the project is estimated to employ about 9,000 people, directly and indirectly, the project's broader social and economic potential is not to be under-estimated. Through close liaison with the education sector and wider construction industry, the project will contribute to unlocking a vast wealth of as yet untapped, home-grown talent that becomes well qualified to perform similar work elsewhere. A first step has been to prescribe that one in every 50 jobs on site is held by apprentice, which should see between 280 and 400 apprenticeships being completed on the project.

There is a wide spectrum of professions that need to be enlisted - not just engineers, construction and project managers (to name a few), but also marine specialists, environmental experts and financial managers. Where gaps exit between the availability of skilled individuals and the demand required for the project, Thames Tideway Tunnel supports the development of relevant skills and sectors, for example by supporting the Tunnelling and Underground Construction Academy , established by Crossrail.

In an industry that has long been dominated by men, the project is making positive steps in encouraging more involvement of women by having a target of gender parity on the project by the end of construction in 2023. The project's 'returnship' programme, whilst open to all, is particularly aimed at helping women, who are more likely to have a career break, to return to the industry.

The programme involves a 12-week period to help the transition back to the workforce and the first seven-strong cohort have all secured longer term positions with the project.

The Thames Tideway Tunnel will not only deliver its key purpose of a cleaner, healthier river, but will also seize the opportunity to maximise the broader benefits that the project can offer, including environmental, health and safety and employment aspects. These will help the country flourish socially and economically for decades, if not centuries, to come.

Conclusion

The Thames Tideway Tunnel is entering an exciting phase, following the IP's licence award, and contracts to initiate construction. There are some huge opportunities ahead for everyone working on the project, and the focus is now on final design and delivery of the Thames Tideway Tunnel to tackle sewage pollution and complete the improvements necessary to create a cleaner and healthier River Thames.

The editor and publishers would like to thank Thames Tideway Tunnel for providing the above article for publication.

Barge on the River Thames
Courtesy of Thames Tideway Tunnel

Beckton STW
Courtesy of Thames Tideway Tunnel

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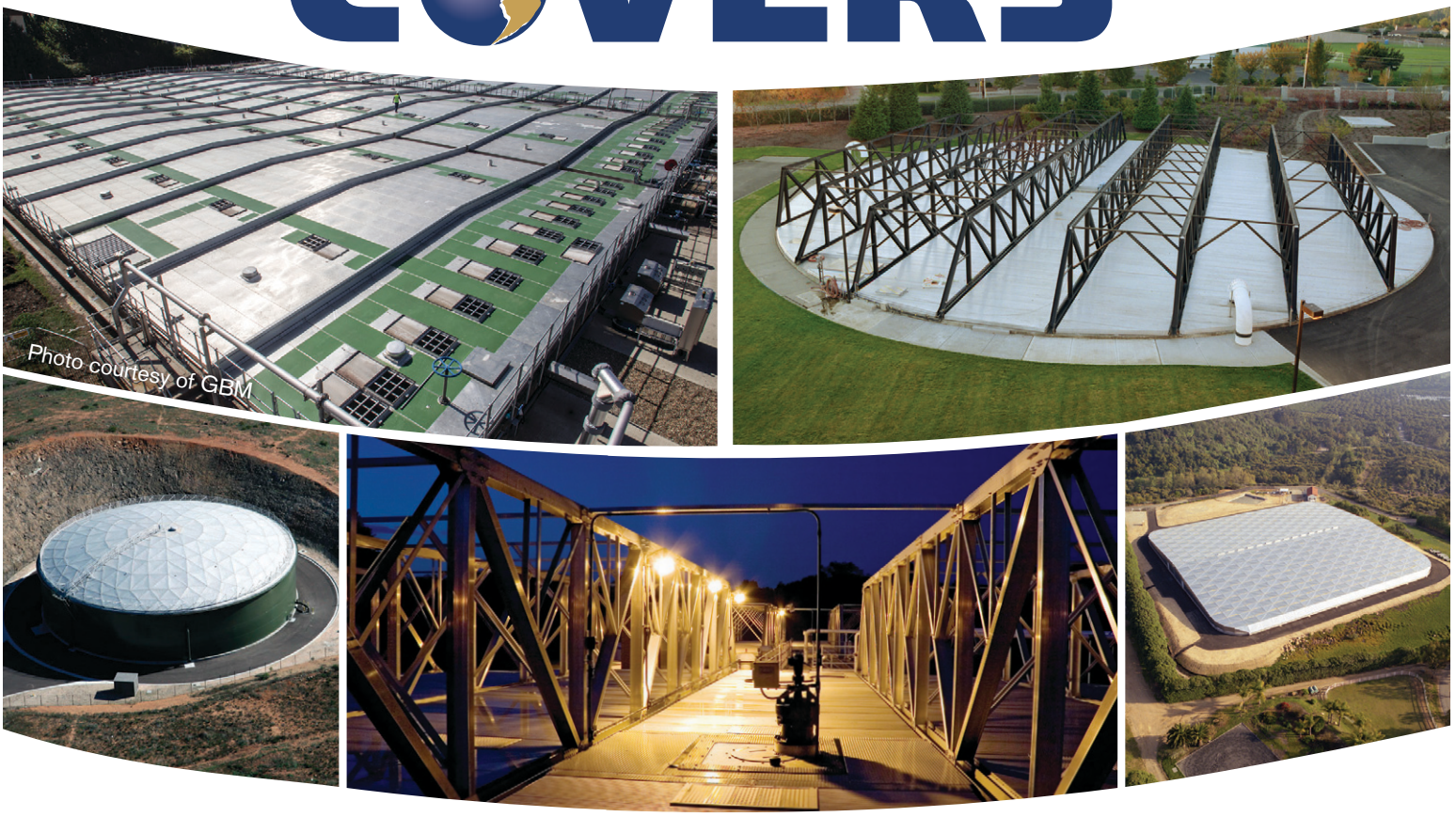

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