

Following the Great Stink of 1858 the government of the day decided action was needed to improve the sewage system of London. The options were to improve London's system or rebuild the Houses of Parliament in Oxford. The inheritance of that decision was to leave London in the 21st century dependant upon an aging Victorian sewer, which during heavy rain pumps raw sewage into the Thames; 39 million tonnes per year. Having carried out all the technical investigations into a suitable solution, Thames Water are on the brink of putting their plans to public consultation. The plan is to bore a 32 km tunnel, 7 metres in diameter and 75 meters below a centre line of the Thames in London; quite a feat of engineering. This will have a dramatic improvement on the quality of water in the Thames.

① History

The lost rivers

At the end of the 18th century, London had two drainage systems, one to the North, the other to the south of the Thames. These used the tributaries to the Thames and catered for surface water. Foul sewage was captured in septic tanks. There was a good trade in selling barrels of sewage from septic tanks at 3/6^d to farmers.

Development of the land led to the rivers being put into culverts and thus restricted the flow of water. Furthermore, with the new installation of WCs in houses, the volume of foul waste increased beyond the capacity of the septic tanks and people connected their overflow to the surface water drains. This led to serious pollution of the Thames.

Water had traditionally been taken from the Thames at Southwark, which now was causing outbreaks of Cholera. Many will remember the invention of a classic Quality root-cause analysis tool, the concentration diagram / measles diagram, by Dr John Snow when he identified the source of one such cholera outbreak in 1854 from the Broad Street pump in Soho, and thus showed that the disease was water borne and not air borne (emanating from the smell of the sewage).

Bazalgette's plan - 1858

People were sceptical about Snow's theory, so it was still considered necessary to prevent the smell of the sewage from getting out, by containing it in pipes; it was not considered detrimental for the raw sewage to go into the river.

Joseph Bazalgette was a civil engineer who put forward the plan in the 1860s to construct 1,600 km of underground sewers to intercept sewage outflows, and 1,600 km of street sewers, to intercept the raw sewage. The outflows were diverted downstream where they were dumped, untreated, into the Thames as the tide went out. Today there are sewage treatment works at Crossness to the South of the river and Beckton to the North.

Today's situation

Today, with increased sewage, small amounts of rain can cause the system to overload and this results in a mixture of rainwater and sewage being discharged into the Thames at one of the 57 CSOs (Combined Sewage Overflows). CSOs are discharges along the banks of the Thames in London, which operate like a relief valve following high levels of rain, allowing the combined surface and foul overload to discharge into the Thames. On average 39 million tonnes of raw sewage are discharged into the Thames each year through this system. This is projected to rise to 70 million tonnes

② Measures of acceptability

A good healthy river will have 8mg/litre of O₂. At 1.5mg/litre of O₂ all fish die. The target of the scheme is to minimize the number of breaches of the levels reducing below. A model to simulate the sewage system and the Thames has developed the following targets and likely outcome of the improvement. It used climate change predictions up to 2080.

	Number of occasion per 34 years when O ₂ levels in water in the Thames drops below these levels			
	Below 4 mg/litre O ₂ for 29 tides	Below 3 mg/litre O ₂ for 3 tides	Below 2 mg/litre O ₂ for 1 tides	Below 1½mg/litre O ₂
Today	120	110	65	
Target	34	11	6	3

③ The plan for the Thames Tideway Tunnel

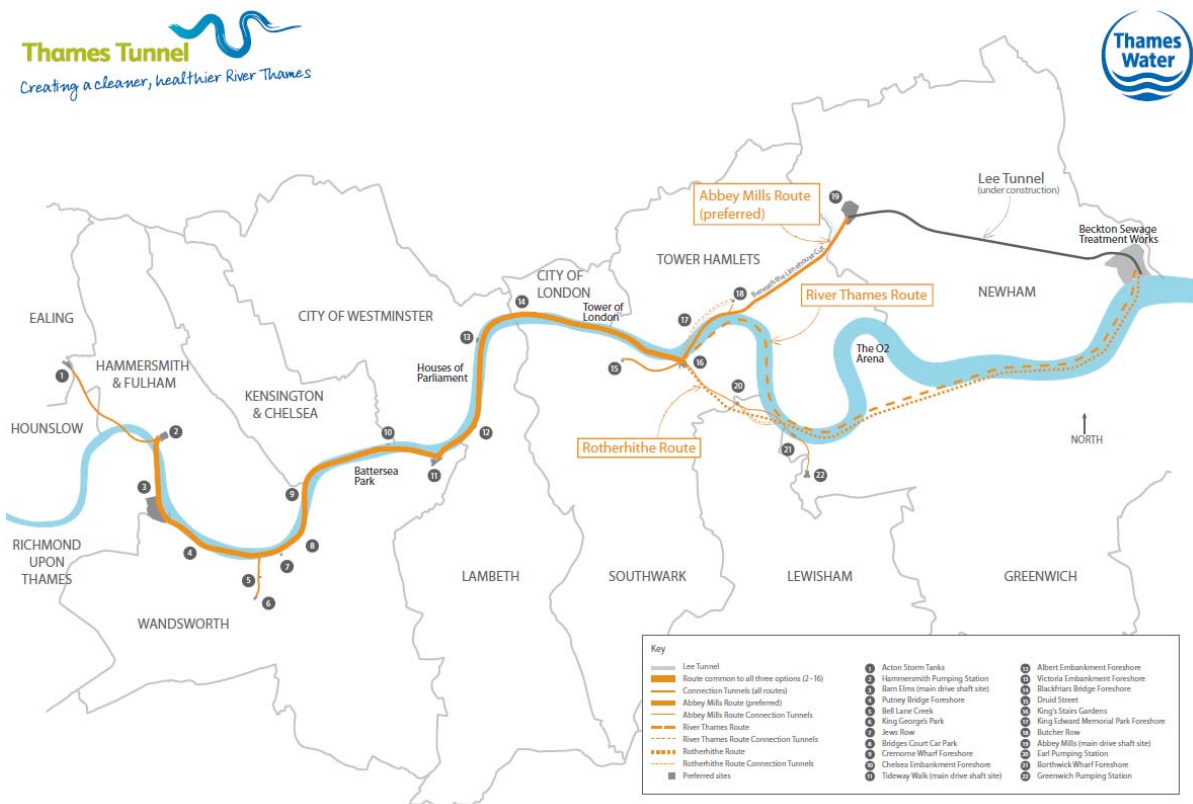
The outline system

It is not possible to economically separate the foul and surface water systems in London; the disruption to daily life would be unacceptable in building the estimated 12,000 kms of new drainage across the capital. Hence the plan is to create a system to prevent sewage from discharging into the Thames from the 36 most polluting CSOs. A system is needed to ensure sewage is treated before being discharged into the Thames and thus reduce pollution.

The Lee tunnel has just been completed to reduce discharges from the Abbey Mills pumping station into the river Lee, by taking overflows to the Beckton treatment plant. This is a 6½ km, 7metre diameter tunnel.

The Tideway tunnel is needed in order to further reduce discharges, by taking overflows from CSOs in central London, act as storage during and transport of the sewage to the treatment plants in the East of London. As the CSOs are on the Thames, the tunnel must follow the Thames. This tunnel will also be 7metres in diameter, but it will be 32 kms long and about 75 metres below ground. It will have a design life of 150 years, which includes amongst other things for the geological tendency to gradually tilt downwards in the South East England and also the expectation of rising sea levels from global warning. By courtesy of Thames Water, the preferred route, with CSOs, is shown below

<http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/10115.htm> .



Tunnel construction (TBM)

Improvements in tunnel boring over recent years have reduced the risks of damaging existing tunnels beneath London, especially London Transport tunnels. Movement of less than 2 mms is predicted.

Work to understand the structure of the ground will enable special care to be taken when traversing difficult fault lines.

Cost of boring about £100million per mile.

The projected timetable (start dates)

2007	Geological work and bore holes to understand ground and select route
2007	Government backing given
2009	Bidders for project invited
2010	Support from new coalition government confirmed
2010	Public consultation
2012	Apply for planning permission
2013	Construction starts
2020	Tunnel and system in use

The projected cost

£3.6 billion

Notes by Richard KIRBY, Chairman of Thames Valley Branch of the Chartered Quality Institute
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