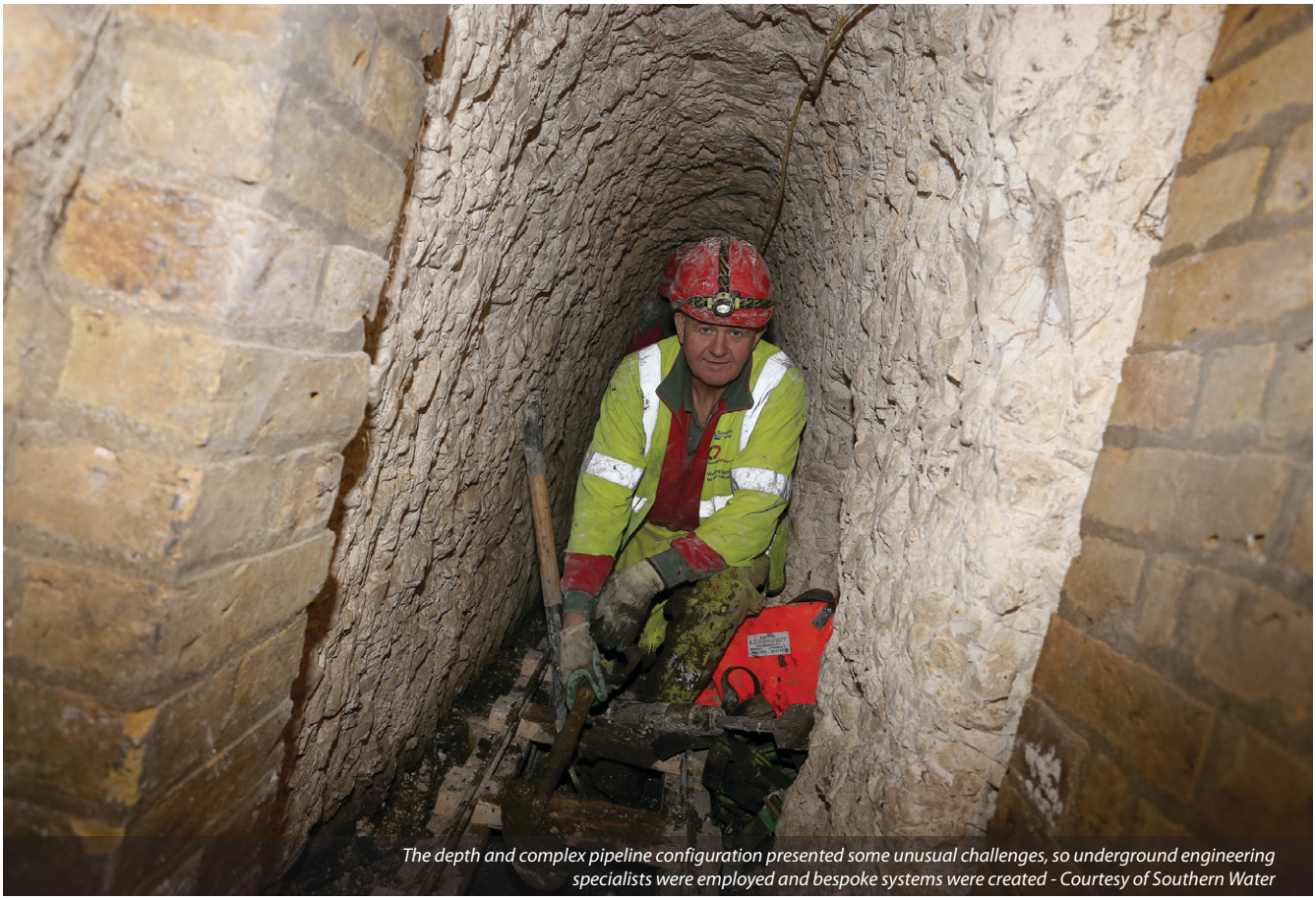
Thanet Sewer Rehabilitation Scheme

using specialist and innovative techniques to renovate sewers built in chalk tunnels by the Victorians

by Adnan S Naeeni BSc CEng MICE MCIWEM APM & Norman Howell

Southern Water is undertaking a major upgrade of the 100-year-old sewer network across Thanet, Kent. Having started work in 2012, it represents an investment of more than £80m over 10 years to maintain the integrity of the sewers, reduce the risk of flooding and protect the environment and chalk aquifer that spans much of the area. The sewer network was constructed more than a century ago by miners who excavated underground tunnels through chalk and built the sewer pipelines within them. These tunnels remain in place, up to 10m deep in some places and continue to act as a conduit for the sewer network. The depth and complex pipeline configuration presented some unusual challenges, not least how the sewers were accessed to start the work. To overcome these problems, underground engineering specialists were employed and bespoke systems were created. These new systems will be used to deliver the future phases of the project over the next five-plus years. This article is about the phase of work that took place in Ramsgate, which started in July 2014 and completes in the summer of 2015.



The depth and complex pipeline configuration presented some unusual challenges, so underground engineering specialists were employed and bespoke systems were created - Courtesy of Southern Water

The challenge

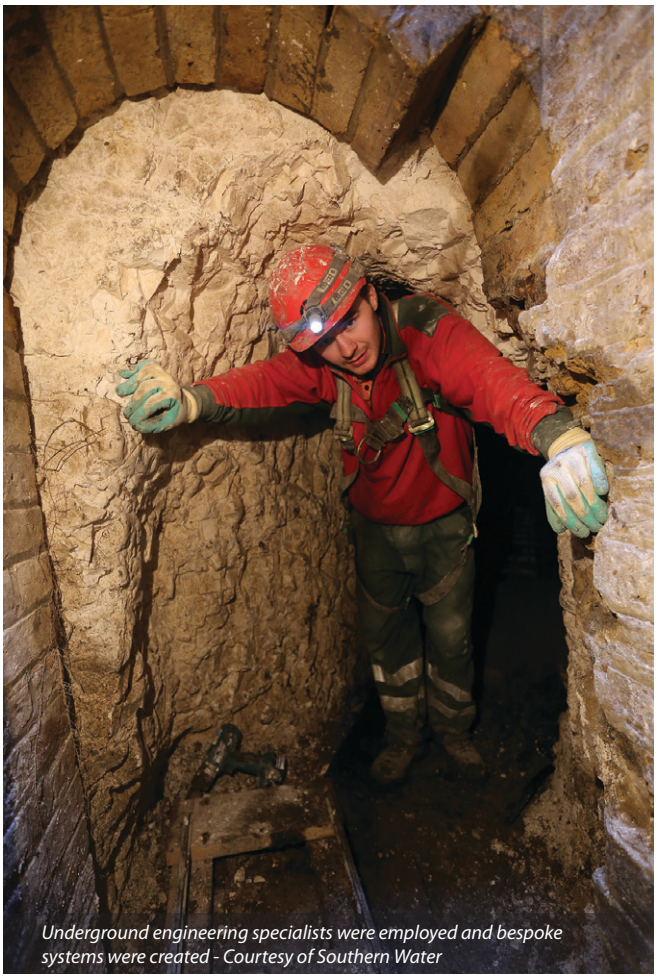
The sewer network in Thanet is complex, in a region where the Environment Agency is focusing on reducing nitrate concentration in a major aquifer; one of the drivers for the scheme.

The use of headings for sewerage infrastructure is unique to the UK and has the potential to impact the local environment if the sewer flows are uncontrolled during storms. Therefore, part of the brief was to seal and repair existing sewers and manholes and build new overflow sewers to contain the flows, protecting the aquifer long into the future.

The team also built new and enlarged existing manholes to make access easier and safer. The team comprising Southern Water, designers Atkins and delivery partner Clancy Docwra developed new solutions to overcome a wide range of technical, social and environmental challenges. This phase of work had a value of more than £20m and focused on Ramsgate.

As part of this phase, the team:

- Lined 5.5km of existing headings.
- Lined more than 12km of existing sewer.
- Built more than 2km of new pipeline.
- Improved 98 (No.) manhole shafts.
- Sealed chalk tunnel entrances in 92 (No.) manholes.
- Constructed 40 (No.) new manholes, including five up to 10m deep.



Underground engineering specialists were employed and bespoke systems were created - Courtesy of Southern Water

The depth and complex pipeline configuration presented some unusual challenges - Courtesy of Southern Water

This phase took place in a small urban area with a mix of main roads and a network of narrow residential streets. There were eight schools in the vicinity, with more than 18,000 traffic movements during peak times. In addition, other highway and utility works were ongoing in the area.

Solutions

Community: To meet the completion date, work had to be undertaken on multiple sites, sometimes up to 10 at any one time. Therefore, the site team had to forge a close working relationship with Kent County Council's highways team to manage vehicle movements and avoid gridlock.

Proactive planning was critical and a complex programme to coordinate traffic movements was agreed. Flexible working was adopted with various elements being undertaken at night, weekends and during school holidays.

A dedicated customer liaison manager maintained close contact with the community to give an understanding of the need for the work and discuss progress and concerns. More than 9,400 letters were hand-delivered to customers to keep them updated with progress.

Environment: Innovation was key, through the development of bespoke trenchless techniques that had a small site footprint, reducing disruption and limiting the environmental impact.

Great care was taken to use techniques that avoided the use of any substances that may have had a detrimental impact on the aquifer. In conjunction with the Environment Agency, talks were given to the teams about good working practice for working close to an aquifer.

Health and safety: Safe working methods for the workforce of more than 100, some working in tunnels up to 10 metres underground, was paramount. This required project-specific health, safety and risk management systems that included a resident safety manager and tunnel rescue team.

The project safety record was exemplary with 130,000 man hours worked without a lost-time incident. To provide support to the local community, joint tunnel rescue exercises were conducted with the local fire and rescue service.

Construction phase

Specialist technical operatives trained to work in deep tunnels prepared the headings for the pipe laying by clearing debris and chalk collapses, repairing and removing damaged pipes, laying a concrete base for the installation of a cured-in-place pipe (CIPP) liner and installing timber support where required.

Initially the headings needed to be fully surveyed to assess the extent of the preparation works and several challenges were encountered.

These included collapsed sections in the crown of the headings, creating voids that needed timber supports. Additionally, uncharted headings, sewers and lateral connections were located where the sewer records did not always match the network that had developed over the years. To overcome these issues, the project team continually reviewed the design requirements and hydraulic model.

An innovation was the development of a stand-alone CIPP lining system for the chalk headings. Consultation with the Environment Agency provided clear guidelines on the materials that could be used in contact with the chalk aquifer and it was important to avoid the use of chemical or cementitious grouts which could flow within the cracks.

This presented the project team with a challenge as traditionally, the lining would have been achieved by the installation of a standard pipe surrounded by grout infill.

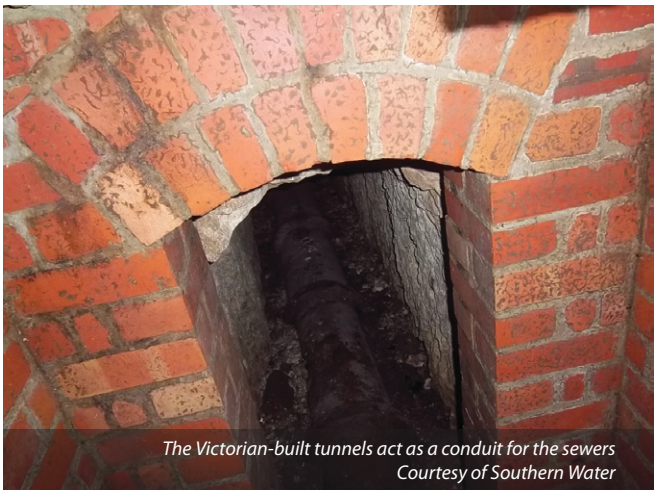
To address this, CIPP liner was designed and tested that negated the need for any grout infill. This liner is a composite, seamless closed liner comprising layers of unwoven polyester and glass fibre webs made with an ultra-violet, light-sensitive polyester resin.

The liners have an internal and external polyethylene foil layer and an external HDPE protective grid foil sheath which provided a completely sealed liner. To provide added protection to the liner a PVC-coated polyester foil was wrapped around the liner prior to installation.

The liners were reinforced to have sufficient strength to be self-supporting and the grid foil designed to prevent over-inflation and provide protection against the rough chalk walls of the headings. The liners were subject to a rigorous testing regime to ensure that they could withstand static loading from any overburden pressure and impact loading should they experience any shock impacts from chalk blocks falling from the heading soffits.

This was the first time that a CIPP liner was used as a stand-alone liner and they could be designed to have either circular or oval cross-section in a diameter range from 150mm to 1,500mm. This offered operational flexibility for lining headings with variable dimensions.

The development of this innovative lining solution coupled with a UV light curing system for the chalk headings meant minimal environmental impact by eliminating the need for a grout surround. The remote installation method and short timescales minimised the requirement for entry into the headings which reduced health and safety risks and meant a shorter programme schedule.



The Victorian-built tunnels act as a conduit for the sewers
Courtesy of Southern Water

Completion

Through collaborative working, the project overcame many complex challenges. Technical innovation developed resulted in a 10% saving to the total out-turn cost together with an approximate 30% reduction in programme time. In addition, it provided systems and technology that could be used to deliver the future phases of the project over the scheme's remaining five-plus years.

This success was achieved through a commitment to engage with all stakeholders and by the development of new solutions to overcome technical and environmental challenges. The end result will be a more robust sewer network for Ramsgate, which will have many benefits for both customers and the environment.

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