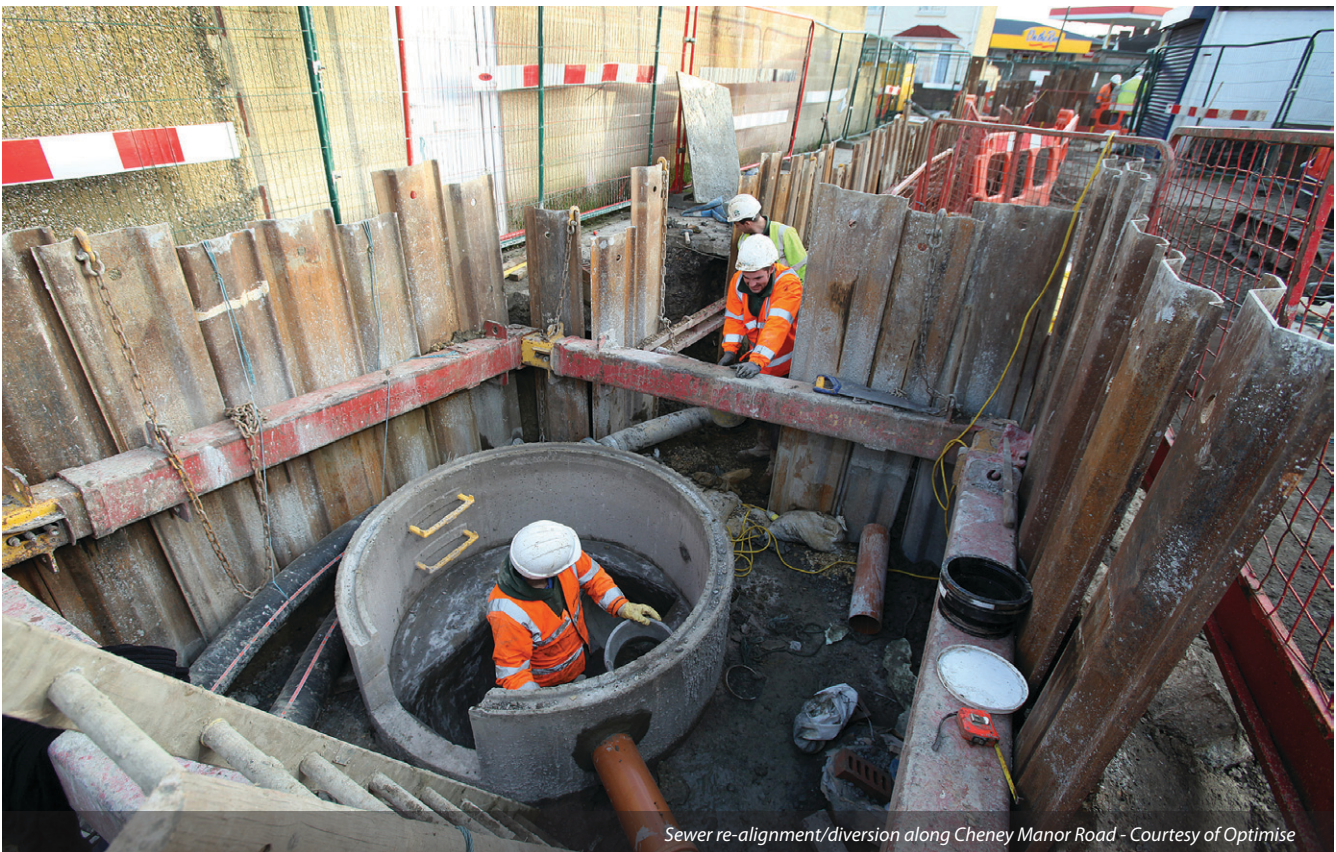


Swindon STW Network & Growth Upgrade Project

innovative thinking and collaborative working to achieve cost beneficial solutions

by Gareth Evans BSc MCIWEM CWEM

The Swindon STW catchment area has a population of approximately 200,000. It has been estimated that this will increase to 224,000 by 2026. The scope of this project was to resolve foul water flooding at homes and businesses within the Cheney Manor/Rodbourne Road area listed on a register of properties that are at risk of flooding internally (known as DG5 properties). The project's scope also covered improvements in infrastructure outside the curtilage of the STW to account for the projected increase in flow, due to planned housing developments.



Sewer re-alignment/diversion along Cheney Manor Road - Courtesy of Optimise

Undertakings

This project was undertaken by Optimise (a joint venture between MWH, Clancy Docwra, Murphy and Barhale) on behalf of Thames Water and was coordinated with two other schemes. Those schemes were the upgrade to the Swindon STW inlet works/storm flow treatment, and a surface water and highway drainage flooding scheme along Rodbourne Road.

As the two other schemes were being undertaken by different parties this provided its own set of challenges. Upgrading the STW inlet works was undertaken by Black & Veatch on behalf of Thames Water, whilst improvements to the surface water and highway drainage were delivered by Swindon Borough Council.

Investment requirements

- Resolve internal property flooding along Cheney Manor and Rodbourne Road (Optimise).
- Provision of network infrastructure to account for projected increased flows due to network growth (Optimise).
- Upgrading/refurbishment of the existing Inlet works to allow for increased flows (Black & Veatch).
- Improvements to highway drainage through Rodbourne

Road (Swindon Borough Council) - It must be noted however, that the highway drainage improvements covered a much wider area throughout the catchment, although these had no impact, or were not impacted upon, by this scheme.

- Level of service issues.
- Current hydraulic overload of both foul and combined sewers leading to internal property flooding.
- Lack of capacity within the current foul/combined sewerage network both at Cheney Manor and along the Rodbourne culvert
- Lack of capacity at the existing STW inlet works.
- Inadequate highway drainage through Rodbourne Road.

Scheme synergies

The existing sewerage network and inlet works at the STW were significantly under capacity, and did not allow for the resolution of property flooding or projected growth within the catchment without significant funding. Under normal project pathways, each element of this scheme would have been assessed as an individual scheme, utilising different investment lines i.e. funding would have been provided via growth or flooding programmes.

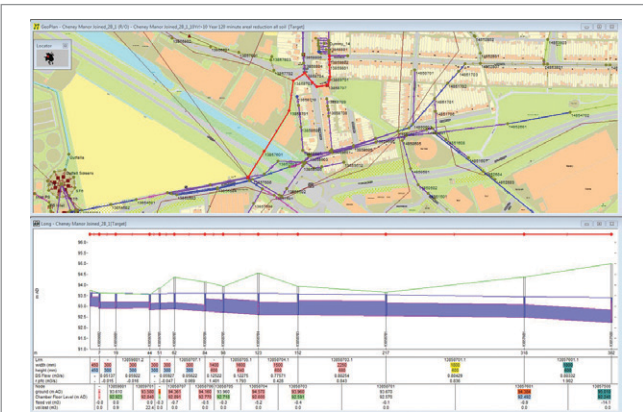


Figure 1: Long-section through Cheney Manor Road down to the Rodbourne culvert - Courtesy of Optimise

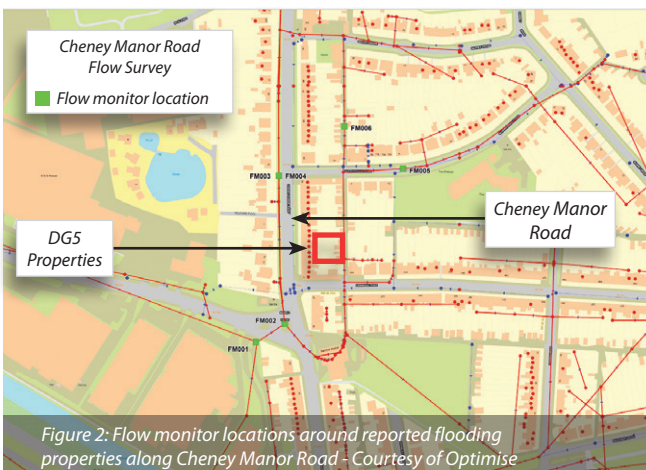


Figure 2: Flow monitor locations around reported flooding properties along Cheney Manor Road - Courtesy of Optimise



New pumping station downstream of Cheney Manor - Courtesy of Optimise



New CSO located along Rodbourne culvert - Courtesy of Optimise

The previous proposals to resolve the issues independently required funding in the region of £42m (excluding the highway drainage improvements). The outline solution involved routing all increased/storm flows through the inlet works. Given the existing inlet works was already under capacity, this would have resulted in significant upgrades to the existing infrastructure.

By working together with the other scheme partners, collaborative solutions were put forward that would significantly reduce the scale and amount of capital expenditure required. It must be noted that, if the proposed collaborative solutions had been put in place in isolation, the independent solutions would not have resolved the current issues, and/or would have caused significant detriment to the existing network.

The following sections will focus primarily around the resolution of flooding at Cheney Manor Road and Rodbourne Road, and how this then linked to the other elements of the project.

Scope of works

A due diligence exercise was undertaken to determine the current state of the model, in order to formulate a plan going forward. Using 2007/8 historical flow survey data, the existing InfoWorks hydraulic model (InfoWorks being the modelling software) showed a reasonable correlation to observed peak flows arriving at the top of the Rodbourne culvert, which was critical in assessing flows arriving at the inlet works.

Following the inclusion of additional manhole survey data, a similar assessment was undertaken to assess the flows within the Cheney Manor area. Again, the correlation of the model performance was considered acceptable for assessing pass forward flows to the Rodbourne culvert. However, in order to resolve the internal DG5 flooding properties and to optimise any proposed solution, further enhancement would be required.

Cheney Manor and Rodbourne Road flooding

The sewer network through Cheney Manor down to the Rodbourne Culvert is relatively flat (see Figure 2). Although model investigations showed that there was localised shortfall in hydraulic capacity, the current surcharge levels experienced within the Rodbourne culvert were exacerbating the reported flooding. Subsequently, any storage solutions would drain down the flooding observed along the Rodbourne culvert prior to resolving the flooding along Cheney Manor/Rodbourn Road, making this line of solution development unfeasible.

It was determined early on that isolating the flooding properties, whether through a FLIPs (Flooding Local Improvement Process) device, or through a network isolation, would be the best way forward. Although a FLIPs device would resolve internal flooding caused by hydraulic capacity issues, an overland flooding risk still existed due to highway flooding in the adjacent road. Network isolation therefore proved to be the only viable solution, since this removed flooding from the foul sewerage onto the highway, and therefore the potential to overland flow and impact upon the highway drainage.

Solution modelling

Having identified network isolation as the preferred solution, the decision was made to improve the confidence within the model through the Cheney Manor area, in order to confirm the level of flooding and help determine the exact size of storage requirements. This was also particularly important when it came to removing the DG5 properties from Thames Water's Sewer Flooding History Database (SFHD), since a verified hydraulic model is one of the sign-off criteria to support customer evidence.

Additional flow monitoring was undertaken to confirm flows through Cheney Manor Road, to the rear of the DG5 properties,

the convergence of these flows, and pass forward flows to the Rodbourne Culvert.

Following verification, extensive solution development was undertaken. The model was used to replicate isolation (diversion) of the network via a new pumping station, with network upsizing and a re-alignment/diversion to transfer flows. After close liaison between the network modellers and the detailed design teams, the final location of the new pumping station was determined at the junction of Cheney Manor Industrial Estate and Rodbourne Road.

Dry Weather Flow (DWF) and 1 in 30 year design storm rainfall events were run through the model to determine that the required self-cleansing velocities were achieved, the required storage volume, SPS pump rates, and to confirm the level of protection provided to the DG5 properties. Pump return rates were confirmed at 131l/s, providing a 1 in 30 year level of protection.

Proposed network infrastructure

Contractor Black & Veatch was undertaking a separate project to upgrade the Inlet Works to the STW. It was imperative that Optimise provided exact figures on the flows arriving at the inlet works, in order for them to undertake their design simultaneously.

Given the population increase within the catchment and the peak flows arriving from the new Cheney Manor pumping station, the only way to maintain the current DWF of approximately 780l/s, and 1 in 30 year design flows of approximately 7500l/s, was to provide a new CSO chamber at the top end of the Rodbourne culvert. The CSO controlled flows going forward, whilst allowing any storm flows to be diverted to the existing storm tank.

The addition of the CSO to the existing network also provided benefits to the work required at the inlet works. Originally, the outline solution was to provide a new inlet works to accommodate

the increased flows. However, by allowing the storm flows to bypass the inlet works, the upgrades required at the inlet works were significantly reduced, with the existing infrastructure undergoing a refurbishment rather than a complete replacement. This proved to be a significant cost saving to the project.

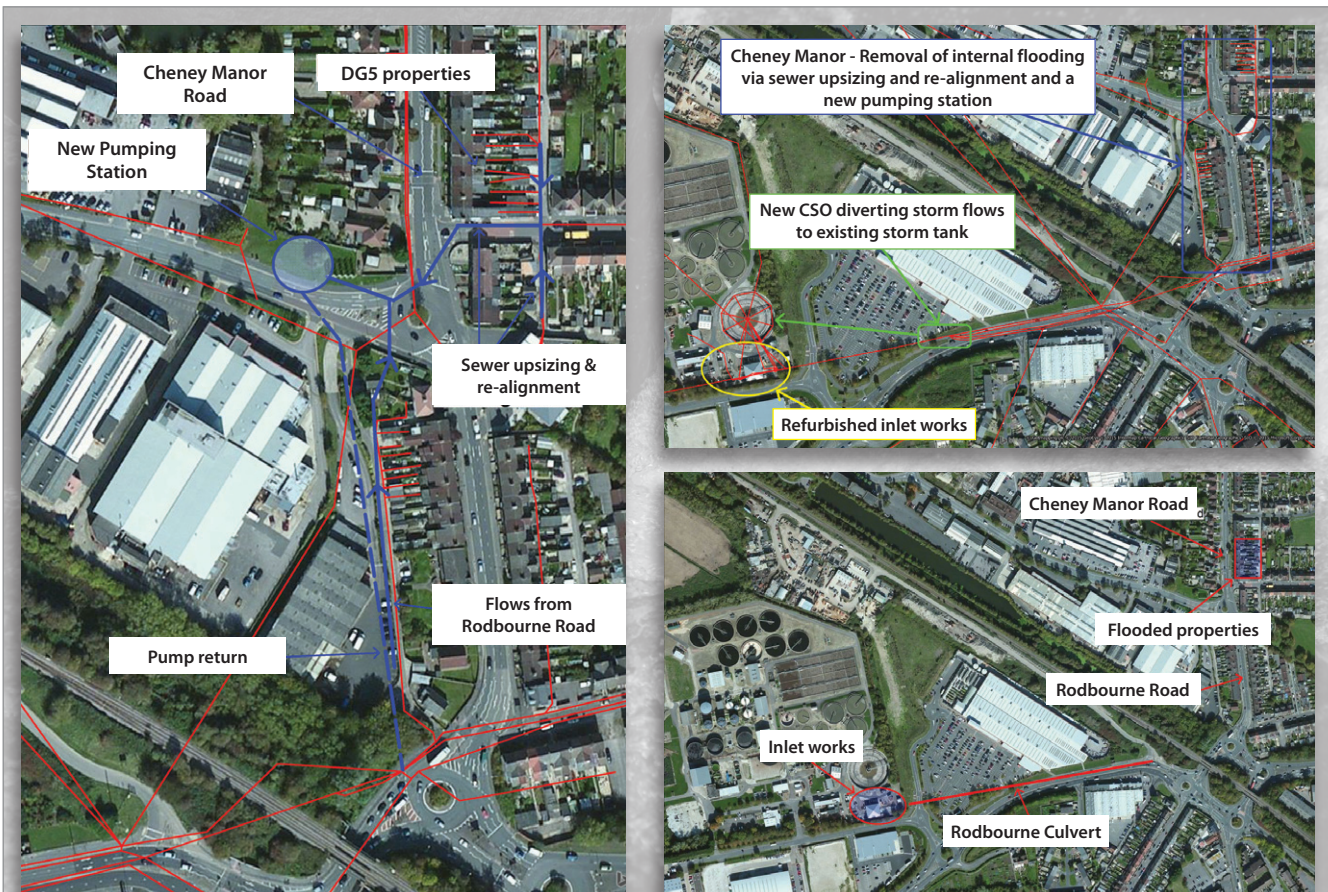
The CSO was designed using the hydraulic model, a static model, and also a physical scale model due to the complexities surrounding the CSO hydraulics. *This was featured in Mike Stokes' case study on www.WaterProjectsOnline.com 2014/2015: Swindon Networks Upgrade Project - design of combined storm overflow using a physical scale model by.*

Part of the project requirements of the new CSO was to reduce the top water level (TWL) at two manholes located immediately at the top of the Rodbourne culvert. Reduction of the TWL at these manholes by 200mm controlled the TWL throughout the Rodbourne culvert, allowing pass forward flows to the inlet works to be better controlled. This allowed the Cheney Manor Solution, along with network growth, to be undertaken without causing detriment to the existing network. Without the construction of the CSO, increased flooding would have been observed immediately upstream of the Rodbourne culvert, in addition to increased flows arriving at the Inlet Works.

Benefits

This scheme was originally planned as a STW project and a separate flooding scheme. The amalgamation of the schemes allowed for the delivery of the flooding scheme (removal of 8 (No.) DG5 properties from Thames Water's SFHD), and also allowed for an upgrade/refurbishment of the inlet works, rather than a new Inlet works as was planned.

The original scheme of a new STW inlet works and separate flooding scheme was cost estimated at over £42m. As well as a new



(Left) Proposed Solution at Cheney Manor (top right) Overview of schemes (bottom right) Geographical representation of scheme locations - Courtesy of Optimise

STW inlet works, a large diameter tunnel would have been required in order for increased flows within the upstream network (a result of the flooding scheme retaining flow within the network and additional flows from growth development) to actually reach the inlet works. Current surcharge levels within the Rodbourne culvert would not have allowed for this, with significant detriment to the existing network being predicted.

Optimise, along with Black & Veatch, was tasked with significantly reducing these costs. With the existing inlet works in reasonable condition, it was determined that, if the pass forward flows were retained or lowered, then a new inlet works would not be required, and that a refurbishment of the current infrastructure would meet the target guidelines. Subsequently, the new CSO was devised to maintain the existing level of service provided by the inlet works, and a significant cost saving to the project was achieved by eliminating the need for a new inlet works.

It must be noted at this stage that significant time was spent looking at a variety of different options to try and achieve the £22m budget. Given the significant cost reduction achieved this was time well spent, as normally the amount of optioneering undertaken is not usually accounted for in project budgets.

The new CSO also provided an additional benefit to the Cheney Manor flooding scheme. If the flooding scheme had progressed without the CSO in place, then significant detriment would have been observed downstream. The new CSO controlled the TWL within the Rodbourne culvert, thus allowing the pumped flows from Cheney Manor to be accommodated without causing detriment downstream.

An additional cost saving to the project was also achieved by eliminating potential costs from increased storage at the new pumping station, or downstream at the discharge point.

The combination of schemes and innovative thinking brought the previous cost estimation down to approximately £22m, a saving of approximately £20m. The Optimise part of the project was completed in July 2014, for a cost of approximately £7m.

Swindon Borough Council was able to delay the start of the highway drainage improvements to allow completion of the foul network solutions. With the foul flooding resolved, the risk of foul flows entering the highway drainage via overland flow was significantly reduced. There was also added benefit to the local residents in that the schemes along Cheney Manor/Rodbourne Road were undertaken simultaneously.


Although this delayed the start of the Swindon Borough Council highway drainage works, the overall timescale and impact to the residents for completion of all schemes was reduced.

At every stage of the project there was a high level of collaboration between Optimise, Black & Veatch, Swindon Borough Council, Thames Water Operations, and local residents. This allowed for good working relationships between all parties, leading to successful completion on all aspects.

For the Swindon Network and Growth Upgrade, Optimise Water LLP won a Silver Considerate Constructors Scheme 2015 National Site Award. The site showed the highest levels of consideration towards the public, its workforce and the environment through adhering to the Scheme's five-point Code of Considerate Practice:

Care about Appearance, Respect the Community, Protect the Environment, Secure everyone's Safety, and Value their Workforce.

The editor and publishers would like to thank Gareth Evans, Senior Modeller with Optimise MWH, for providing the above article for publication.



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