

Leamington Sewerage Strategy

strategic project to provide greater capacity, alleviate the risk of sewer flooding and improve water quality in the River Leam

The town of Royal Leamington Spa is located in Warwickshire. The area is predominantly residential with a population of nearly 40,000 covering the catchment which sits both to the north and south of the River Leam. The town had experienced flooding from a variety of different sources, including the sewerage system, river flooding and overland flow. Flooding from the existing public sewerage system had resulted in the internal flooding of over 50 properties internally to the north of the River Leam.



The main causes of the flooding from the sewerage system were as follows:

- Sewers undersized for current flows that had increased due to growth in the area.
- Restrictions in the system (railway and watercourse crossings and several Combined Sewer Overflows (CSO) with limited outfalls).
- New housing, infill development, and paving over permeable surfaces (e.g. block paving of frontages) increasing intensity of run-off.

Due to the complexity of the flooding mechanism, the Leamington catchment has been divided into two strategic areas either side of the River Leam; north (Phase 1) and south (Phase 2). This paper details the North Strategy (Phase 1) solution.

Existing sewerage system

The existing sewerage system is predominantly a combined system within the town centre area. Total catchment area of 97ha of which 76ha (78%) is connected to the combined system. The system is very complex with duplicated carrier sewers, multiple bifurcations and a

triplicate siphon crossing at the River Leam. In addition surcharge within the system is controlled by 5 (No.) CSOs, which discharge to the River Leam via surface water (storm relief) sewers in the town.

Flows from the upstream catchment arrive at Princes Drive where flows up to 3DWF (consented at 525l/s) carry on from this site via the gravity Valley Sewer to Longbridge Sewage Treatment Works at Warwick; some 2.5km downstream. Flows above 3DWF are either pumped into the storm tanks at the Princes Drive site or discharge via a direct storm overflow (consented for flows above 2,328l/s). Additional sewerage catchments from Heathcote and Warwick connect into the Valley Sewer downstream of Princes Drive and then further storm tank capacity and treatment are provided at Longbridge STW.

The storage provided at the Princes Drive site (5,500m³) and Longbridge Sewage Treatment Works (2,400m³) provides the requisite allowance per head of population in the catchment. Princes Drive effectively acts as a remote inlet works to Longbridge STW. In times of storm, the system becomes surcharged from the Princes Drive site all the way back into the town, affecting many

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below ground basement properties as soon as the capacity within the existing pipework is taken.

Development of the strategic solution

A project team, consisting of Severn Trent Water (STW) In-house Asset Creation Sewerage Solution Team, with NMCNomenca (a division of the North Midland Construction plc), appointed as design and build contractors, was set up once the outline of the strategy had been established. Each phase was procured using a Target Price Contract in accordance with STW's Contract Strategy.

Due to the complex sources of flooding and the number of bodies responsible, STW took the lead to try to understand the drainage interactions in detail, setting-up a "Flood Forum" of key stakeholders and community leaders following the 2007 storm events. The group met quarterly, quickly establishing the flooding mechanism in each area, and the interaction between each contributory element through a sharing of information.

Hydraulic analysis

Hydraulic analysis of the catchment and development of the strategy was achieved by building a verified Infoworks model. Verification of the North Side Strategy Catchment was undertaken by data from 15 (No.) flow monitors which confirmed fundamental hydraulic problems, and verified the reported flooding at 53 (No.) residential properties from the combined sewer, via private connections or overland flow from gullies and manholes in the highway.

Each property was assessed to verify reported flooding through additional information gathering and a topological survey to aid further development of the hydraulic model.

Initially thought to involve several separate solutions, it became apparent during the feasibility stage that a strategic approach was required for the whole catchment due to the interaction and scheme dependency of options.

Sewer enlargement

The key feature of the Strategy in the north of the town is the enlargement of 2.24km of existing foul combined sewer between the existing siphon, crossing the River Leam at Victoria Park, and Clarendon Street at its junction with Binswood Avenue, via Dormer Place, The Parade & Regent Grove.

The enlargement involves on-line replacement of the Dormer Place sewer from 975mm diameter to 1,400mm diameter between the Siphon Riverside CSO and the Dormer Place junction with Parade; a distance of 590m. Enlargement is then extended through Euston Place, Regent Grove and Clarendon Street from 800mm diameter brick egg and 600mm diameter pipes respectively to sizes ranging

from 1,400mm diameter to 1,050mm diameter for a distance of 900m. The enlargement is to provide hydraulic capacity and remove surcharge from the system to protect basement properties.

In addition to the sewer enlargement 2 (No.) CSOs upstream of the Siphon at Riverside and in The Parade are being relocated and rebuilt. 2 (No.) other CSOs at Dormer Place and Regent Grove are to be closed and abandoned.

The rationalisation of these flows required an additional 550m of new 1,200mm diameter storm relief tunnel sewer to be provided to pass forward flows from upstream of the Siphon at the Riverside CSO to the existing site at Princes Drive, where they can now be pump lifted and discharged to the River Leam in the low amenity area below the existing River Leam weir, via a new Pumping Station, rebuilt outfall and twin 800mm diameter rising mains.

This avoids any significant increase in spill volume in the high amenity area within the English Heritage listed parks and gardens adjacent to the River Leam. This facility reduces the number of spills significantly in the high amenity area as the shorter duration small spill events are retained within the system compared to the existing performance.

CSO approvals

River Impact Assessment - WRC were commissioned to by STW to undertake a river impact analysis using SIMPOL3. This study provided a comparison between the existing modelled river quality and the planned river quality achieved through the strategy. The river system was broken into 6 (No.) stretches with the overflow inputs being represented in stretches.

The results demonstrated:

- Predicted compliance with both FIS and 99%ile standards within the high amenity town centre area.
- No predicted deterioration in WFD class at either the 90%ile or 95%ile level.
- Overall predicted improvement in the water quality downstream of the Princes Drive Weir.

The Environment Agency approval to the revised CSO consent applications was received in the summer of 2010 in advance of construction.

Construction and programme

This strategic project will improve the capacity of the sewerage network through the significant enlargement of over 2km of large diameter sewers and rationalisation and rebuilding of the towns CSOs. On completion of this strategy, Leamington will have a sewerage system to cope with all but the most extreme forms of weather.



Siphon Riverside CSO under construction Courtesy of NMCNomenca



Flooding of habitable basement Courtesy of Severn Trent Water

This £7.8m project is currently half way through its 20 month construction period and has so far completed construction of the new storm relief tunnel sewer (including major rail and River crossings), the storm relief pumping station including associated outfalls and Siphon Riverside CSO. It is now in the second phase of construction undertaking the on-line sewer enlargement and Parade CSO build within the town which is due for completion in March 2012.

Strategic approach

This strategic approach has resulted in major efficiencies in the development of the solution, design, construction and future operation of the sewerage system, clearly delivering best investment choice for the company and customers. The Leamington Sewerage Strategy effectively demonstrates how Severn Trent Water's investment is meeting the objectives set out under the company's Key Strategic Intention of improving the capacity of the sewerage network to alleviate internal sewer flooding.

The project delivery team has strived to adopt innovative materials and techniques in the construction works to provide benefits in reducing construction time, improving quality of the finished works, and overcoming logistical problems associated with construction of large diameter sewers in restricted environments.

Precast concrete

Bespoke precast concrete solutions have been developed to construct all large structures required by the scheme. These include two river outfalls which were built concurrently to meet the programme restrictions associated with river works, and to minimise impact on a popular riverside walk which needed closure during their construction.

The two CSO structures are designed as sectional precast units; Siphon Riverside CSO has been successfully installed in a fraction of the time required by traditional construction techniques. The valve chamber on the twin 900mm diameter rising main was also designed and installed as a precast concrete assembly, again producing significant programme savings, but also providing a factory quality finish on an open structure.

All these structures were completed to schedule during one of the severest winter seasons for many years, mitigating any impact on final project completion.

Twin rising mains

To construct the twin rising mains, the design team established the suitability of Weholite pipes with flexible connectors to deal with the low flow pressures generated by the system. This produced a cost-effective alternative over more conventional pressure pipeline products, and enabled a continuous construction process without



TBM being lowered into shaft

Courtesy of NMCNomenca

the need for time consuming pipe-end preparation and welding operations.

The large diameter sewers are currently being installed on two separate fronts within the town centre area. For these sections, the delivery team has been active in the development and certification of a lightweight plastic pipe with composite spiral steel reinforcement and a simple push-fit flexible joint in preference to traditional concrete product. These are proving to be a real benefit in the more compact working area by allowing a substantial reduction in the capacity of construction plant required to handle and lay these sewer materials.

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TBM Launch from drive shaft

Courtesy of NMCNomenca



Tunnel Breakthrough

Courtesy of NMCNomenca