

Whitley Bay Sewer Flooding

extensive history of sewer flooding removed

by
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The Whitley Bay sewer flooding project formed part of Northumbrian Water's (NWL) AMP 4 Sewer Flooding Programme. The catchment has a long history of flooding cumulating in the summer of 2005 when a series of intense storms caused extensive flooding in the residential areas of the town. Following hydraulic investigations to identify the flood mechanism numerous properties were identified as "at risk of flooding" due to hydraulic incapacity. A total of 44 properties were added to the Director General List (DG5) Internal Flood Register with 19 properties added to the External Flood Register. The effected properties are in a number of geographically spread clusters within two drainage areas in the Whitley Bay catchment. The project was split into separate study areas and a phased approach was adopted as the delivery strategy split over years 4 and 5 of the AMP.



Detention Tank St Ronans Rd

Photograph Courtesy of Mott MacDonald

Feasibility & Design

NWL framework consultant Mott MacDonald was appointed to carry out the feasibility study and design to identify solutions that would result in the removal of the DG5 listed properties from the flood register. A flexible approach was adopted, innovative options were required given the design challenges which included working on line within heavily serviced, trafficked urban areas on sites of a restricted nature. For each catchment an unverified hydraulic model was built, the model established the true extent of the problem and assisted with the optioneering. Extensive survey work was undertaken to aid with the model build. Contributing areas were assigned to the model using aerial photographs supported by information collected from site visits along with population information derived from address point data. The options identified were subject to a thorough technical and financial review by the project team. The options progressed to design were as follows:

- **Briardene North & South** – 750m of the existing 300mm diameter sewer upsized. The new sewers varying in diameter between 450 – 1200mm.
- **Fairfield Green Monkseaton** - 360m of the existing 300mm diameter sewer upsized. The new sewers varying in diameter between 375 – 1800mm.
- **St Ronans Monkseaton** – Construction of a 750m³ pumped storm detention tank, 160m of new 450mm combined sewer and 40m of new 100mm new rising main.
- **Cullercoats & Whitley Road** – Basement "cut & pump" installations, work comprised the disconnection of basement gravity connections and installation of a small pump within a newly constructed sump.

Design work was undertaken in conjunction with extensive ground investigations to identify the geological conditions and any

contamination issues along with utility trial holes to identify the position of the trunk services. The variability of the ground was a consideration in the design of permanent and temporary works. Mott Macdonald managed the planning process submitting applications for the associated above ground structures and coordinated the necessary service diversions. The procurement strategy adopted was competitive tender NEC ECC Option A, with Activity Schedule. The design consultant prepared detailed design drawings, specification and works information which was issued to NWL's framework 1 contractors for pricing.

Design Criteria

- Existing sewerage network to remain fully operational throughout construction works;
- DG 5 listed properties shall not be at risk of flooding due to hydraulic overloading from the combined system more often than once in forty years;
- Recommended solution to ensure no detriment to the existing sewerage network.

Customer care was given a high priority throughout all phases of the project. Communication with the residents, Local Authority and internal stakeholders was key to the projects success. Public perception was managed prior to commencement of construction by undertaking an extensive consultation exercise. A customer drop in day was held where residents could speak face to face with the design team. The drop in day was an opportunity for residents to express their concerns in response the design team was able to reassure customers that every effort was being made to minimise disruption. The drop in day was supplemented by letter drops notifying the residents of the construction start date. Additionally a "door knocking" exercise was undertaken by the construction supervisory staff in advance of the open cut work restricting vehicular access to driveways.

The Solutions

The nature of the solutions varied considerably from major Civil Engineering construction to building services type work. Furthermore the construction sites varied significantly from highway & public open space to the basements of private residence and cellars of Public Houses, each offering specific construction related challenges.

Briardene North & South – The Briardene North system was upsized to remove a local incapacity with flows directed to the adjacent interceptor system. The Briardene South system was upsized to attenuate storm flows. The new sewers were constructed online by traditional open cut methods relying on the hydraulics of the downstream system to control top water level.



Manhole Construction

Photograph Courtesy of Mott MacDonald

Fairfield Green - To relieve surcharging the system capacity was enhanced. Sewers were upsized adopting a combination of construction techniques. Traditional open cut for the sewers up to a depth of 5m and tunneled, adopting pipe jacking techniques, where depths exceed 5m. Management of top water level was achieved without the installation of a mechanical flow control device. The design horizon model indicated that adequate control would be offered from the hydraulics of the downstream system.



Pipe Jacking Fairfield Drive

Photograph Courtesy of Mott MacDonald

St Ronans – A 15.0m diameter offline segmental shaft was sunk, the depth was restricted to 10m in order to avoid interference with underlying worked coal seams. Flow is diverted to the tank via surcharge relief structures built on the existing system which spill during storm periods to control top water level within the catchment. Spilled flows are transferred to the tank via twin 300mm diameter sewer constructed by open cut which deliver storm flow to the detention tank via a single internal backdrop pipe. The tank will store storm flows until remote sensors detect falling surcharge levels in the adjacent public system, flows will be returned by duty /standby pumps via a 100mm rising main.

Cut & Pump – Six properties with basements were protected from further flooding by adopting a "cut & pump" approach. Basements and cellars are particularly susceptible to sewer flooding due to the vertical proximity to the public system. Negligible surcharge within the sewerage system can cause extensive basement flooding. Cut and Pump solutions comprise the abandonment and replacement of the existing low level gravity connection. A small sump is constructed in the basement and all existing drainage is direct into the sump. A pump is installed within the sump and small diameter rising main returns flow back to the public system above the predicted top water level.

Summary

Northumbrian Water Limited is providing a high quality service to its customers throughout the region. Despite the complexities this £2.85m project has been delivered on time and within budget, demonstrating Northumbrian Water's continued commitment to deliver property flooding and environmental improvements.

Note: The editor and publishers thank Ian Davison, Project Manager with Northumbrian Water Ltd for preparing the above article. ■