

Glyncoed Terrace Flood Alleviation Scheme

integrated catchment planning and smart assets to deliver a sustainable and affordable flood risk management scheme in South Wales

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Flooding from urban drainage systems is a big problem in the UK. The wettest winter on record during 2013/14 has illustrated the devastating impact of climate change on our communities across the country; without a significant change in approach the number of homes at risk of flooding from urban drainage systems is set to increase from 2 million to over 3 million by 2050. Finding solutions to this national problem demands innovative and collaborative ideas to create a pathway to an affordable, resilient and sustainable approach to flood risk management. Glyncoed Terrace is located at a critical pinch-point on an aging Victorian sewer network which was never intended to serve the 11,500 residents it does today. After a century of slow degradation, urban creep and increasing rainfall intensity, the critical sewer infrastructure is now inadequate, stifling much needed growth and investment in the town.



Glyncoed Terrace flooding - Courtesy of Dŵr Cymru Welsh Water

Setting the scene

Glyncoed Terrace lies at the north of Llanelli in South Wales, a once prosperous area based on local mining, copper and tinplate industries which are now all but gone, leaving a legacy for what is now one of Wales' poorest areas. People in Glyncoed Terrace have suffered from sewer related flooding for many years with homes and local business' regularly inundated with contaminated wastewater. The negative impact goes beyond the repair costs and local clean-up operations; the area is a main access route to schools and businesses, all of which suffer significant disruption during periods of heavy rainfall.

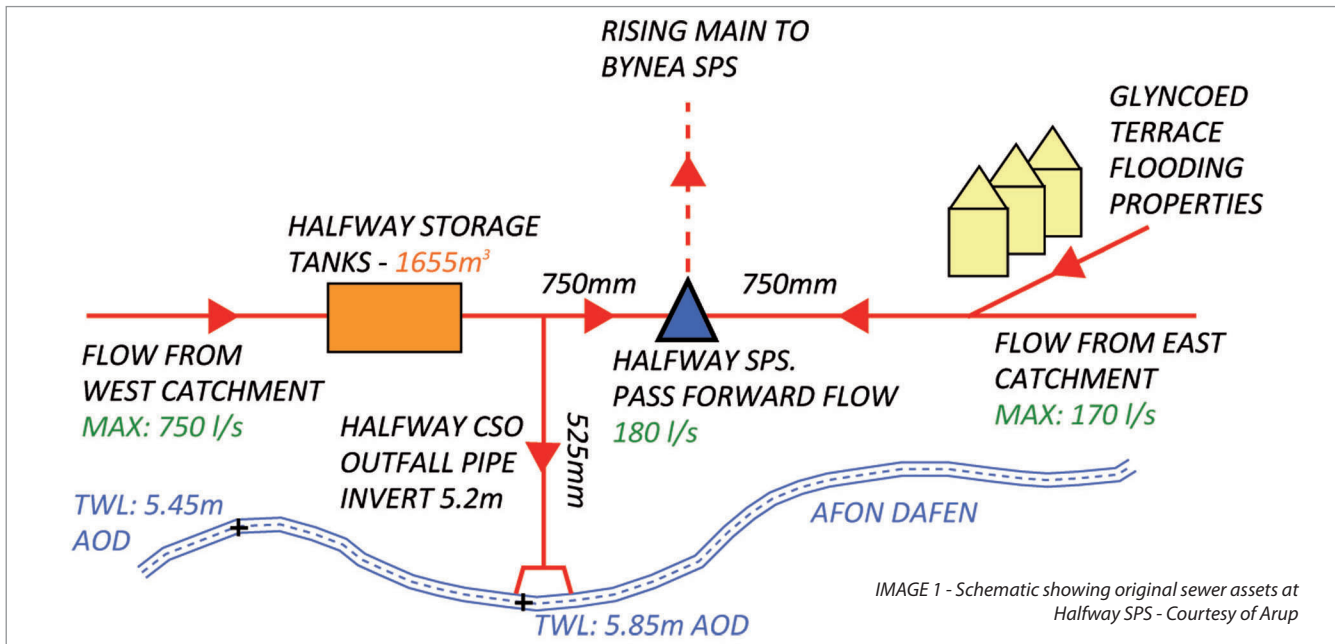
Defining the problem

The flooding in Glyncoed Terrace is typical of many UK catchments; aging undersized sewers with high levels of surface water inflow and groundwater infiltration.

Over 40% of the dry weather flow arriving at Glyncoed Terrace is groundwater infiltration; additional flow enters the sewer pipes through leaking joints and fractures via 52km of upstream public sewer pipes.

The upstream sewer network is partially combined serving foul flows as well as surface water runoff from roofs and some highways. During significant rainfall the flow arriving at Halfway Sewage Pumping Station (SPS) exceeds 900l/s, far greater than the maximum pass forward flow of 180l/s. Excess flows discharge to the local Afon Dafen watercourse through a static mesh screen (Halfway CSO) and a 525mm diameter pipe.

On average, Halfway CSO discharges to the river 33 times (52,000m³) annually causing significant pollution problems and regularly blinds the mesh screen resulting in excessive maintenance costs.



This blinding increases local hydraulic headloss which raises top water levels in the upstream sewer. The impact of this headloss and lack of capacity in the outfall pipe alone is enough to cause flooding in Glyncoed Terrace. But these are not the only problems. The receiving watercourse regularly “drowns” the existing outfall pipe during periods of prolonged rainfall, significantly increasing flood risk upstream.

Solution Development

A traditional solution for this kind of flooding would be to remove the key risk at the point of impact rather than addressing the problem at source. In this case, the localised option provided a new storm pumping station to pump all flows in excess of 180l/s to the Afon Dafen, thus mitigating the impact of high river levels on the sewer network.

The capital cost of this option was £2.2m with a TOTEX of £3.35m, far greater than the available budget and in excess of Welsh Water’s cost/benefit calculation for flood alleviation investment. In addition, given their longer term ambitions to reduce energy usage and carbon impact by 50%, this kind of solution, as illustrated below, could not be considered sustainable or appropriate.

Welsh Water required a new way of thinking, an informed and innovative approach to address the flooding in an affordable and sustainable way.

In 2010 Welsh Water commissioned Arup and Morgan Sindall to investigate the root cause of the flooding in Glyncoed Terrace and develop an alleviation strategy. Twelve months of survey and investigation followed by Welsh Water operator and Natural Resources Wales (NRW) workshops and hydraulic network modelling afforded the capital delivery team comprehensive catchment knowledge.

The subsequent integrated catchment solution was built upon three principles; a focus on maximising the use of existing local assets, removing surface water from the network and thirdly on linking local assets with key assets in adjacent catchments.

Best use of existing assets

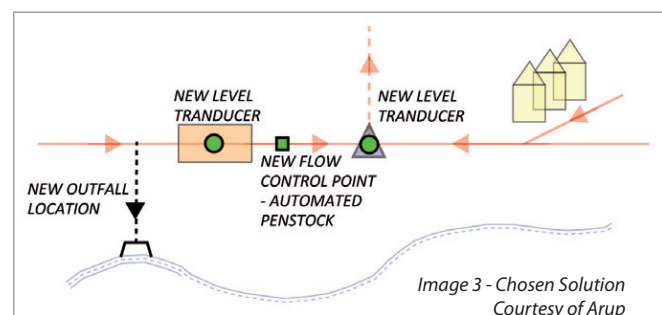
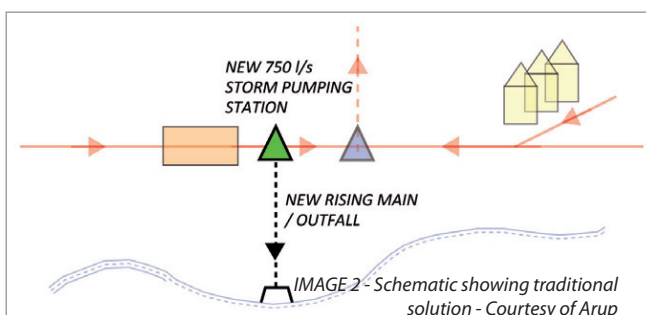
The existing Halfway SPS asset had three major shortcomings:

- It did not fully utilise the existing storage tanks prior to spill events (never filling beyond 70% of the 1,655m³ available).
- The outfall pipe and screen were under capacity.
- The outfall was regularly river locked during significant rainfall events.

Lowering and upsizing the outfall pipe may have provided some relief; however, the properties would still remain at risk of flooding due to river locking whilst the storage tanks would remain under-utilised. Working with NRW, it became apparent that there was opportunity in the Afon Dafen to improve the outfall position and level.

According to a previously developed river model, approximately 50m downstream of the existing outfall the top river water level reduced by some 700mm; providing enough headroom to give the Halfway CSO outfall pipe a free discharge during extreme events. Detailed localised analysis of this apparent change in water level determined this figure to be closer to 400mm, still adequate to provide the headroom required for flood alleviation.

Flow analysis and hydraulic modelling determined that the majority of the flow causing the capacity issues was from the west catchment, via the storage tanks, with the east catchment (the network Glyncoed Terrace flooding properties connect into) contributing a third of the total flow arriving at Halfway SPS.



These two catchment characteristics directed us towards a solution. By controlling the flows from the west catchment and moving the CSO discharge point 50m upstream (with an associated increase in weir height from 5.35m to 6.25m AOD), the sewer system was able to freely discharge to the Afon Dafen during extreme rainfall whilst also fully utilising the capacity of the existing storage tanks.

The flow control design consists of an automated penstock arrangement with a telemetry link to the Welsh Water asset communications network. The smart controls have programmed logic to manage flood risk whilst ensuring the storage tanks are filled efficiently and then emptied to minimise spill events. The penstock settings are designed to ensure the pumps are fully utilised at the start of, during and after storm events.

Passing maximum flow forward from the penstock to the SPS (flows from west catchment are controlled to ensure total flow arriving at the SPS is approximately 180l/s) at the start, during, and end of a rainfall event to ensure the tanks and pumps are fully utilised throughout any given rainfall event; this increases the likelihood of the tanks being ready (empty) for the next storm. The net result is an increase in flow volume retained within the sewer network and an equivalent reduction in spill volume.

During extreme events the penstock reduces pass forward flow to 10 l/s; this allows the SPS to service flows from the east catchment and lower the top water level in the Glyncoed Terrace sewer to alleviate flood risk.

The result is a long term resilient solution, providing flood protection beyond 30 year return period and an annual spill reduction of 7,500m³; a 14.4% reduction compared with pre-intervention volumes and with an associated reduction in predicted annual spill frequency to 28. Recent and future surface water removal schemes in the upstream catchment will reduce this even further. The new CSO discharge point includes a new Huber Rotomat powered screen to mitigate aesthetic pollution whilst minimising ragging risk and headloss through the screen apertures during operation.

This solution was delivered for a capital cost of £495k with an estimated TOTEX of £720k. This represents a 78% saving over the life of the asset founded on an informed decision making process and an integrated catchment management approach.

Costs, programme and key project participants

Project Phase	Information
Survey Programme	Sept 2010 – Jan 2011
Solution Development	Feb 2011 – Nov2011
Construction Programme	March 2013 – Sept 2013
Capital Cost	£495k (78% saving on original solution)
CSO Spill Reduction	14.4%
Role	Company
Client	Dŵr Cymru Welsh Water
Designer	Arup
Capital Delivery Partner	Morgan Sindall plc

Linking assets in adjacent catchments; the future

Halfway SPS is now prepared for the next phase of catchment investment and the Glyncoed Terrace solution is future-proof. This is being achieved through catchment wide interventions including retro-fit green infrastructure, surface water disconnections (from the combined sewer), sewer rehabilitation to minimise infiltration and river interactions, flow diversions and linkages between catchments, and the introduction of Smart assets.

By 2020, Halfway SPS/CSO will be communicating with all critical assets in the catchment to ensure the network is fully utilised prior

to a spill event occurring. For example, if Bynea SPS, downstream of Halfway SPS, is about to spill, the new flow control at Halfway has the capability to reduce pass forward flow and begin filling the Halfway storage tanks to avoid a spill event at Bynea SPS.

Conclusions and summary

The story at Glyncoed Terrace is a common one in the UK; a community affected by flooding, a local environment polluted by excessively spilling CSOs and a local economy stifled by inadequate critical sewerage infrastructure.

A localised problem to solve the flooding at Glyncoed Terrace was neither affordable nor sustainable. Welsh Water took a bold step in adopting an integrated catchment management approach to flood risk management. Glyncoed Terrace flood alleviation scheme was delivered for less than a third of the cost of an equivalent local "sticking plaster" solution.

The smart flow control and CSO modification at Glyncoed Terrace protects the properties from flooding today whilst allowing Welsh Water to integrate the critical assets into a long term flood risk and pollution reduction strategy across Llanelli.

The approach of catchment based solutions with linked smart assets has the potential to save the UK water industry significant capital and operational costs. Better informed investment which draws upon the rich and diverse expertise within the industry will allow water companies to maximise the benefit of limited investment and improve the service provided for whom it really matters, the customer.

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