Paper 6 - Design of John Pier Pumping Station & Interceptor Sewer

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Introduction

The town of Workington is situated on the Cumbrian and currently has no provision for sewage treatment. The town has a population of 30,000 and substantial industrial developments, including the main railway track production plant for UK. Sewage currently discharges untreated directly to the Irish Sea along four short outfalls. The scheme to alleviate this pollution problem forms part of the overall Cumbria Coast Outfall Strategy, which provides for the closure of a total of eleven untreated outfalls and the construction of a new Wastewater Treatment Works between Workington and Maryport. The works itself was completed and commissioned in 1996, and the final phase of the strategy is the John Pier Pumping Station scheme, which deals with the four Workington outfalls.

Regulatory Requirements

The quality standard that has to be achieved by the scheme can be summarised as follows :-

- Closure of all direct sewer outfalls
- Transfer of “Formula A” to Workington WwTW (556 l/sec)
- Provision of one screened overflow with associated storage, which will achieve no spill on Time Series Rainfall event 25
- Maximum flow rate of overflow not to exceed 6,000 litres/sec

In reality, the volume of storage required was as much determined by the maximum rate of discharge as the spill criteria.

The Original Solution

WASSP models were built and verified for each of the four subcatchments in 1991 The outputs from these models were then used to size an interceptor sewer and pumping station which would transfer flows to Workington WwTW 2 km to the north of the town.

The original solution was not modelled initially. Instead peak flows were taken from each of the models and added together to determine the capacity of the interceptor required. A macro model of the four main catchments was later built by Acer Consultants using the beta test version of SPIDA in 1993. This led to an outline solution which entailed 2,000m of 3.0m diameter storage tunnel connected to an on line pumping station which would transfer flows to Workington

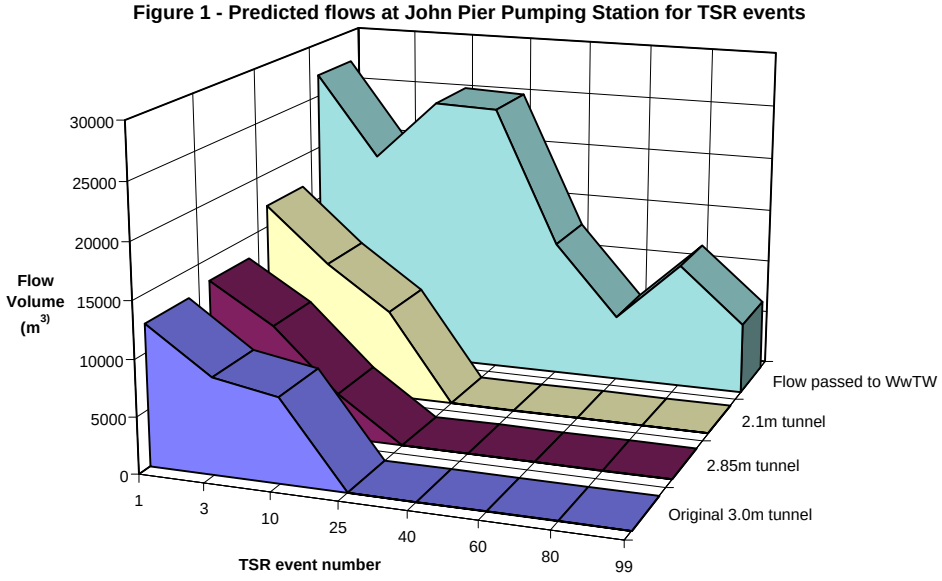
Revised Solutions

In 1996 it was decided to re-examine the design in the light of advances in modelling technology to determine whether any savings could be identified. A new proposed system model was constructed on Hydroworks from the four original WASSP models, and outputs were then checked against the originals to ensure that they were still valid. The interceptor and pumping station were then re-examined with several options being considered. These included pumped interceptors and a pumped storm overflow direct to sea were examined. However the final solution was very similar to the original, save only that the required tunnel diameter was 2.1m as opposed to the original 3.0m. The levels of the tunnel were also changed in the light of a borehole survey along the proposed route of the tunnel.. The main reason that this reduction was possible relates to the mobilisation of storage in the tunnel. In the original design the sewers connecting to the outfall were given a free discharge for the 1 in 30 year storm, as this was the only way to guarantee no detrimental effect on the upstream sub-catchments. However, as the full sewer system is now modelled, the revised proposals allow surcharge during the 1 in 30 year storm. It was also possible to reduce the diameter of the southern portion of the interceptor from 1.8m diameter to 1.5m diameter.

Availability of Tunnel Machines

A further consideration in the sizing of the storage tunnel came to light with the availability of two 2.85m dia tunnel boring machines from the Fylde Coast project. These machines had been bought by NWW and could therefore be provided to the contractor, realising a potential saving in the cost of the tunnel works. The design of the interceptor was revisited and though the increase in tunnel size did not reduce the number of spills for TSR, the magnitude was considerably reduced. Figure 1 below shows the relative performance of the three solutions in terms of total volume of flow, together with the total volume being passed to treatment for the standard 8 TSR events.

Figure 1 - Predicted flows at John Pier Pumping Station for TSR events



Elements of the Scheme

The main elements of the scheme are detailed as follows :-

- Transfer pumping station with 10,000m^3 storage in the wetwell, 25m dia, 25m deep, with 556 l/sec foul pumps and 6,000 l/sec storm pumps
- 2700 km of 700mm dia rising main from John Pier to Workington WwTW
- New screening chamber and outfall into the River Derwent
- Interceptor storage tunnel, 2.85m dia, 2020m
- Interceptor sewer from Shore Road, 1.5m dia 1038m long
- 3 pumping stations and associated rising mains within the sewer network
- Flood alleviation works to solve 47 FFP's at Vulcans Lane
- Closure of six UCSO's

The scheme has been split into three contracts. Contract one is for the main pumping station shaft, storage tunnel and 1.5m dia interceptor, and is currently on site. The second contract is forecast to start on site in September 1998 and encompasses civil, mechanical and electrical works to complete the pumping station, the rising main to Workington WwTW and the abandonment of the four untreated sea outfalls. The third and final contract will then cover all outstanding works, dealing with the alleviation of the flooded properties and closure of UCSO's. The works are expected to be completed in December of 1999, ahead of the EA compliance deadline which is March 2000.

Conclusion

The main lesson that can be learned from the design of this scheme is that there may often be scope for savings by making use of developing technology, in this case with respect to hydraulic modelling. However it is important to note that while savings were possible in the element sizes themselves, and therefore the overall scheme cost, the overall concept of the solution remained largely unchanged. Care should therefore be used when re-examining older designs to ensure that there is scope for real improvement, and hence avoiding a potentially expensive and time consuming exercise to prove that there was nothing wrong with the original design in the first place.