An investigation into the impact of a 50yr old discrepancy on the safety of Tittesworth Reservoir

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SYNOPSIS In 1963 the Tittesworth Reservoir, now operated by Severn Trent Water (STW) was commissioned to respond to the increasing demand for water supply. The reservoir comprises an earth embankment with a concrete core wall. It incorporates an older dam in its upstream shoulder and has a bellmouth spillway and tunnel in the left abutment.

In 2012 a pre-inspection identified differences between the as-built spillway and 1963 physical model geometry and raised concerns that the as-built geometry might not have sufficient capacity compared with the physical model.

After consideration of the benefits and limitations of both physical and numerical modelling, the spillway rating and performance were evaluated numerically using Flow3D, a computational fluid dynamics (CFD) package. Using the 1963 physical model as a reference, the modelling showed that the spillway gorged earlier than predicted as a result of the changes and therefore the capability to safely pass Probable Maximum Flood (PMF) outflows was reduced. It was also found that, once gorged, flows were controlled by the hydraulics within the shaft and tunnel. The stilling basin was also modelled for PMF flows.

PMF flows increased the expected flood rise and options were put forward to increase freeboard at the dam.

The use of CFD showed it was possible to model complex flow conditions with control moving between inlet, shaft and tunnel and demonstrated the complex range of flow conditions possible for bellmouth spillways.

The project has illustrated the benefits of STW’s pro-active strategic approach to reservoir safety which has provided time to consider the options ahead of statutory drivers.