

To Barrage or Not To Barrage?

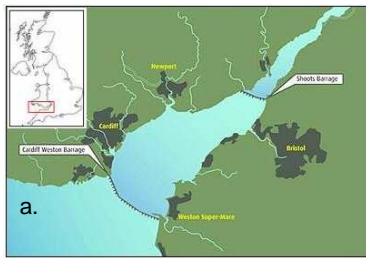
The response of tidal resonance to the presence of a barrage using a two-dimensional numerical model

Laura Finlay, Scott Couch, David Ingram

Work stream 1: Numerical and physical convergence

Introduction

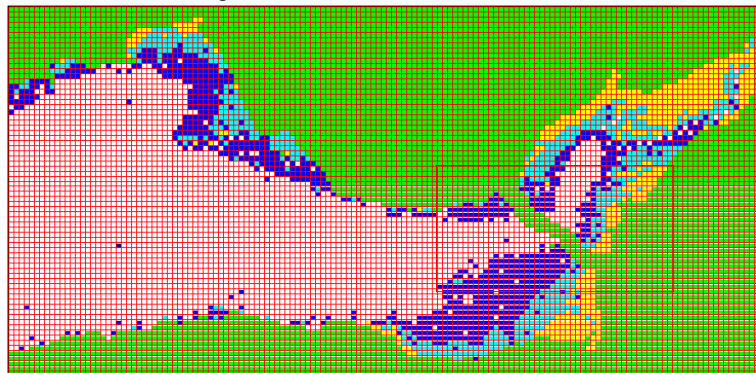
The Bristol Channel, UK has been proposed as a site for a tidal energy barrage due to it having the second highest tidal range in the world and its close proximity to the grid and users. Although the UK government has recently claimed that funding for the Severn Barrage will not immediately be forthcoming, they recognise the great potential for low carbon energy generation this project has for the future. Five barrage placement scenarios have been proposed for the Severn Estuary. The two main proposals are the Shoots and Cardiff-Weston barrages (see Fig a). Such a high tidal range in the Bristol Channel / Severn estuary is caused by shelving of the sea bed, funnelling and resonance.



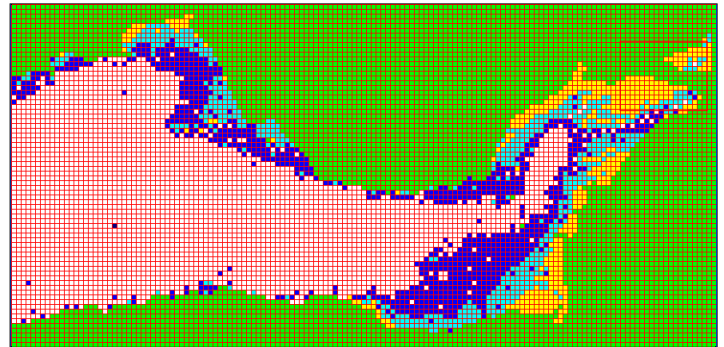
(a) Position of Shoots and Cardiff-Weston barrage options in Severn Estuary, (b) La Rance tidal energy barrage, France

Project Overview

Primary project aims are to: 1. Establish the effect on tidal resonance of proposed barrage positions, 2. Determine how this may affect barrage design and construction costs. The 2-d Tidal Flow Development (TFD) numerical model was used to develop a series of 10 grid systems and estuary simulations. The two figures below show the Severn Estuary simulations of the two most popular barrage proposals, the Cardiff-Weston and Shoots barrages.



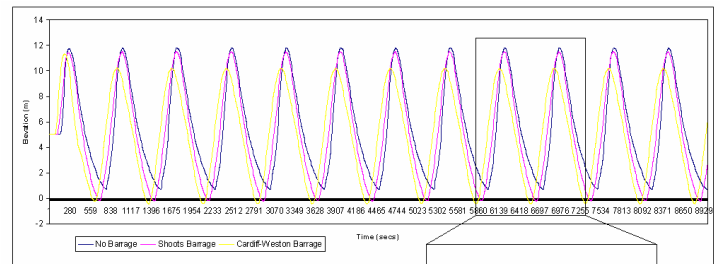
Model domain of Bristol Channel with simulated Cardiff-Weston barrage.



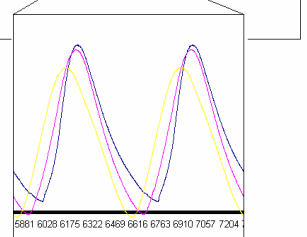
Model domain of Bristol Channel with simulated Shoots barrage

Preliminary Results

Tidal elevations are reduced by 0.5m with the Cardiff-Weston barrage and up to 0.3m with the Shoots barrage.



Tidal elevations in Severn estuary for scenarios without barrage, and with Shoots and Cardiff-Weston barrages.



It can tentatively be concluded that tidal resonance is reduced with construction of a barrage, with less impact caused by the smaller Shoots barrage than the larger Cardiff-Weston barrage.

The Implications...

1. Energy output predictions will be reduced from their current figures to less optimistic levels,
2. Any change in tidal system can affect sedimentology, bird and fish habitats and water quality,
3. Reduction in tidal elevations will potentially have negative impacts for energy generation, therefore likely to have less benefit when taking cost and power output ratio into account.