Comments on the Alde-Ore Estuary Modelling Report by HR Wallingford, November 2017

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1. The report by HR Wallingford (HRW 2017), commissioned by Tidal Lagoon Power Ltd (TLP) and the East Suffolk Internal Drainage Board (ESDB), present results of hydrodynamic modelling using the two-dimensional (2D) Info Works Integrated Catchment Model (ICM). The existing Environment Agency 2D TUFLOW model was converted into Info Works primarily because the latter offers faster computational speeds and a large number of modelling scenarios could therefore be simulated relatively quickly.

2. The HRW modelling used essentially the same basic bathymetric model of the estuary used by JBA (2015) for TUFLOW flood risk modelling, with some adjustments to reflect recent changes to the river walls defences as a result of storms and defence improvements. Adoption of a triangular rather than regular mesh in the Info Works modelling also allowed improved resolution of the flood defences in the model. The bathymetric model used by JBA (2015) was based on a bathymetric compilation of the estuary by Pye & Blott (2015) which used the best data then available (2008, 2012 and 2014 LiDAR survey data, 2013 swath bathymetry data of parts of the estuary, 2014 Trinity House Survey data of the estuary mouth region, and older Seazone bathymetric data for offshore areas). Since 2015 new surveys have been undertaken but these data were not used to update the bathymetric model for the HRW modelling.

3. No new field data were collected by HRW for the purposes of calibrating and validating their model, and the HR modelling has used the same model boundary tidal level inputs (point ESL4223) as the JBA modelling. Comparisons were made with the results of the previous JBA modelling of water levels within the estuary; the level of agreement was considered by HRW to be generally good although differences were noted and are commented on in the report. No comparisons with the Eden Vale Young modelling (also using TUFLOW) are reported. The sensitivity of the HRW model outputs to variation in model boundary input conditions and variations in estuary morphology (e.g. at the mouth) was apparently not investigated.

4. The HRW modelling addressed three main tasks, including a number of sub-tasks:
   - Task 1 Modelling the components of the AOEP Flood Management Plan to assess the impact of the measures on flood risk
   - Task 2. Modelling of habitat creation options proposed by TLP to assess the likely impact on amount of intertidal habitat and flood risk

- Task 3 – Modelling the combined flood management measures and the habitat creation measures

5. The habitat creation measures considered consisted of managed realignment (MR) schemes at (a) Boyton Marshes, (b) Gedgrave Marshes and (c) Iken Marshes, both individually and in combination. 'Extended' Iken MR and Iken spillway sub-options were also considered. Impacts of climate change (using Environment Agency 2017 recommended allowances for sea level change) were also included in the modelling scenarios.

6. The findings of the HRW study are succinctly summarised in the Executive Summary to the report and are not repeated here. However, I make a number of general observations in the following paragraphs.

7. The forecast changes in water levels arising from the scenarios considered are relatively small (general < +/- 5 cm). Changes of this magnitude should be viewed within the likely 'error' or uncertainty associated with the modelling; may be significantly larger than 5 cm when natural variability in input boundary conditions, meteorological effects within the estuary and spatial / temporal variations in estuary surface roughness are taken into account).

8. The general sign of the changes predicted by the modelling (in terms of water levels, and current speeds), are generally consistent with what would be expected from conceptual understanding - e.g.:

- an increase in peak current speeds downstream and decrease in speeds upstream of each MR breach would be expected, leading to a reduction and increase in average mudflat / saltmarsh widths, respectively
- the overall effect of the AOEP plan to raise the height of the river walls is (when completed) to reduce the number of properties from flooding, most notably at Snape and Orford, even though water levels within the estuary are increased slightly due to reduced overtopping; in the short-term the initial raising of the walls at Aldeburgh and Snape are predicted to lead to a small increase in flood risk at Orford and elsewhere in the estuary
- the effect of MR schemes at Boyton and Iken would be to slightly lower the water levels for most of the return periods, although the results suggest that MR at Gedgrave could lead to an increase in the flood risk for properties in the Orford area, making MR at this location unsuitable unless other defence improvements are undertaken
- the effects of other scheme options (e.g. extended Iken MR and spillway) are relatively small and offer few advantages (or additional disadvantages) in terms of number of properties affected)

9. The modelling indicates that mudflat is likely to be the predominant habitat created at all three MR sites in the short term. However, the expert geomorphological assessment concludes that, based on available suspended sediment concentration data, sedimentation rates are likely to be high at Boyton and Gedgrave leading to transition from mudflat to saltmarsh on a time frame of > 15 years. Slower accretion is predicted at Iken, even though most of the site lies higher in the tidal frame at present, on account of lower average suspended sediment concentrations. Consequently, Iken might retain significant areas of mudflat for the order of 40 years. It should be stressed, however, that these conclusions are based on very limited field data (taken from Pye *et al*., 2015) and an assumption that wave re-suspension of sediment will be minimal at all sites (which may not be the case).

10. The geomorphological assessment presented in the modelling report forecasts that there will be some loss of mudflat and/ or saltmarsh from the edges of the main estuarine channel immediately in front and downstream of any of the breaches, but that this will probably be largely or wholly compensated for by gains upstream of the MR sites, and within the MR sites themselves. However, the locations of areas of potential erosion and the possible impacts on defence toe stability are not considered in detail. The implications of the breaches for changes in the pattern of meandering of the main estuary channel are not specifically discussed.

11. The assessment concludes that vertical down-cutting of the new creek systems through the MR breaches is likely to be only of the order of a few cm or tens of cm at Iken, though perhaps greater at Boyton and Gedgrave. The rationale for this conclusion appears to be predicted post-MR current speeds of 0.5 m/s through breach 1 (Fig. 4.20 of the report). However, during a surge tide the large volume of water within the MR area could generate much higher ebb tidal speeds through the breach, resulting in rapid down-cutting, as has been observed at numerous other MR locations. If such should occur, there could be impacts on the alignment of the main estuarine channel.

12. Away from the immediate vicinity of the MR breaches, the hydrodynamic modelling results indicate changes in peak current speeds of up to 0.5 m/s downstream of the breaches, declining to an increase of c. 0.1 m/s 1 – 1.5 km away. Fig. 4.17 of the report indicates an increase in depth averaged peak speeds of 0.01 to 0.1 m/s between Iken and Slaughden. While these potential increases would not appear large, the increase in surface current speeds could be higher, with possible consequences for sailing and moorings in the Slaughden bend area. Field data are required from this area to provide better information about the three-dimensional variation in flood and ebb currents speeds. The combined effect of the Hazlewood Marshes reactivation (Pye & Blott, 2014) and a further MR at Iken Marshes could potentially be very significant compared with the pre-2013 situation (both in terms of flow velocities and likely changes in local mudflat / saltmarsh extent). This issue requires further detailed investigation.

References

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