The Avon Estuary Siltation Research Project: outline of results and recommendations for the Avon Estuary Forum

INTRODUCTION

It is a fact that all estuaries fill up over geological time but within the memory and experience of many local people from around the Avon estuary there is strong evidence suggesting the tidal part of the river has been silting up much more rapidly in recent decades. However, the accuracy of some of the distant memories cannot be verified and incontrovertible causal links cannot be established between past events and the current state of the estuary. A summary of these contributions from local knowledge may be found here - http://auneconservation.org.uk/?attachment_id=1476.

The only possible sources of in-filling sediment are the soils and detritus carried by water in run-off from within the river valley or material washed or blown in from the sea by tide, wind and wave action. The relative importance of these sources of sediment and the complex interactions between land, river and sea will differ depending upon the many variable factors existing in specific parts of the tidal area under consideration i.e. the upper, middle or lower (seaward) areas of the estuary.

It was the purpose of the Aune Conservation Association's (ACA) Siltation Research Project to establish some scientific facts and try to identify ways to slow down or prevent any loss of navigation on this precious waterway.

METHODS

The project consisted of several work packages that were undertaken by various academic and commercial organisations in the period 2005-2007.

The work included:-

1) A 3-dimensional mapping survey of the estuary and a comparison with historical records (WS Atkins & Univ. of Plymouth)

2) A geo-chemical analysis of core samples taken from the estuary bed and from the fields and streams which feed into it (Univ. of Plymouth)

3) A scientific description and analysis of the physical conditions, boundaries, flow and sediment transport characteristics of the river waters, particularly at the mouth of the Estuary (Plymouth Marine Laboratory)

4) An examination of land use along the slopes of the Avon (Univ. of Plymouth).

RESULTS

The complete research reports from the University of Plymouth and Plymouth Marine Applications can be found, respectively, in the following files:- http://auneconservation.org.uk/wp-content/uploads/2011/02/Final-summary-report-UoP-Nov-2007.pdf & http://auneconservation.org.uk/wp-content/uploads/2011/02/FinalReport-PML-Sept2007.pdf

1. Influx of sediment from the land

1.1 There is an accumulation of muddy sediment in the central to upper shallow parts of the estuary where salt marshes are able to become established above MHWN tides, further accelerating the rate of silt accretion.

1.2. Analysis of salt marsh core samples has shown that sedimentation rates in the upper estuary have increased since around 1970

1.3. A large proportion (up to 66 %) of suspended sediment transported into the upper Avon estuary (by the main freshwater channel) is derived from surface soil erosion in the lower catchment zone as a result of the intensification of agricultural practices in the last few decades of the 20th century. Chronological, magnetic data and anecdotal evidence suggest conversion of pasture land to arable land is the primary cause. In more pastorally dominated areas of the catchment, natural channel bank erosion is more important than surface soil erosion.

2. Reduced flushing by the river

2.1 The influence of the Avon reservoir (and associated dam), commissioned in 1956, in a computer model of water levels and currents was small generally, with the reservoir acting to reduce estuary water levels and ebb-directed currents in the upper estuary. The differences in sediment transport due to the reservoir were generally very small, with some exceptions that occurred late in the year. The effect of the reservoir was to reduce ebb-directed transport and thus enhance any tendency for siltation, although the effect was slight.

3. Increased sediment delivery from the sea

3.1 The Devonshire Avon is a mixed wave- and tide-dominated estuary. The ratio between the tidal amplitude and the mean channel depth is relatively small, and in such estuaries more sediment is brought into the estuary during the flood tide than is taken out by the ebb tide. As a result, there will be a net influx of marine sediments.

3.2 In the lower estuary there appeared to be an inflow of sand into the estuary on the flood tide with a compensatory, outward pulse of turbid waters from the upper estuary on the late ebb. A cross-estuary model of the Aunemouth Sands section showed the mean sediment transport tended to be out of the estuary in the deepest part of the section and up-estuary on the flanking intertidal shoulders.

3.3 Suspended particulate matter concentrations in the estuary generally were small during any one tidal cycle. However, seasonal changes in sediment levels of more than 0.3 m occurred, as did movements of the sandbank boundaries and main channel.

RECOMMENDATIONS

1. Influx of sediment from the land

1.1 Targeted soil conservation measures are required within the river valley to reduce agricultural run-off. Specifically, it is important to reduce erosion rates and, more importantly, to reduce the proportion of eroded material that reaches waterways by the introduction of buffers or barriers (banks, hedges, wetlands, riparian vegetation, grasslands etc.) to its movement.

2. Reduced flushing by the river

2.1 Plant and tree debris within the river system should be sensitively managed. Whilst excessive debris may trap, accumulate and, eventually, encourage the consolidation of sediment, transient 'debris dams' are an important and complex part of the natural river system with respect to habitat.

2.2 Further abstraction of water from the river should be kept to a minimum.

2.3 Run-off of nitrates and phosphates from agricultural land and input via sewage treatment works should be minimised to discourage excessive plant growth in the estuary and feeder streams. Such growth inevitably leads to sediment retention and reduced flushing.

3. Increased sediment delivery from the sea

3.1 No action.

Dredging and dumping of sand from the lower estuary are unattractive from practical, aesthetic, financial and ecological viewpoints and would be unlikely to be effective without frequent repetition.

Re-building the groynes on Cockleridge would have uncertain consequences beyond slowing any longshore drift of sand on that beach and, possibly, preventing an eventual breach of the ridge by the sea.

Local reports of changes in water depth within the lower estuary are likely to be due to sand movements and the resulting deep water channel migrations together with a gradual accumulation of sand that does not wash out of the estuary on the ebb tide.

Stuart Watts, ACA Chairman – 6 November 2007