Managed realignment – a sediment management perspective
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Introduction

Managed realignment is a concept that has been used for nearly two decades as part of the coastal management ‘toolbox’ but was used in a much less overt manner in the past. There are numerous examples of sea walls kinking inland where a location was unsustainable or a small breach had occurred and it was impractical to repair. There are even occasional examples of such practices on the Humber Estuary which is the focus of this meeting.

There are numerous reasons for realigning flood defences, many of which are based on sound flood risk management principles. Unfortunately, flood risk benefits have been largely obscured by emphasis on realignment for nature conservation reasons. Moreover, some flood risk managers have been highly resistant to realignment and have told local communities have been told that realignment would not be a consideration if it was not for English Nature (the predecessor to ‘Natural England’). This situation was particularly noticeable on parts of the Suffolk coast in the relatively recent past.

Emphasis on managed realignment for conservation reasons is made more apparent by the degree to which different statutory and non-governmental bodies promote realignment. For example, various agri-environment schemes that are primarily about conservation management have included options for managed realignment. English Nature started the process by championing realignment (as ‘managed retreat’) during its ‘Campaign for a Living Coast’. More recently, the concept of CHaMPs1 and their use in developing offsets to ‘coastal squeeze’ have helped to further embed the idea that realignment is a conservation tool. High profile projects promoted primarily for nature conservation help to reinforce the message because they have been largely promoted for nature conservation management. These include Freiston Shore, Abbotts Hall Farm, Tollesbury, Northey Island and the various Wallasey Island projects.

It is therefore unsurprising that local communities who face the uncertainty of sea level rise and increasing concern about the viability of flood defences see managed realignment as a threat to their local environment. A recent decision by elected members to refuse planning permission for managed realignment at Tetney sends a clear message to this effect. Such decisions clearly reflect the views of a significant proportion of coastal communities that realignment is not an option, as highlighted by campaigns such as ‘Suffolk Coast Against Realignment’ (SCAR).

The question that must be asked is therefore ‘does society in general understand coastal dynamics and the role of sediment in maintaining defences?’ To which, the overwhelming answer must be no! Yet we also have examples of realignments that have been carried out for sound economic and flood risk management reasons. The most compelling case is Alkborough on the Humber but there are others such as the initial development of new defences at Wallasea Island by a private landowner (Wallasea Farms Ltd). So, a case can be presented that realignment has its place in flood risk management and can be used to deliver more resilient coastlines. Unfortunately, the messages are still being overwhelmed by environmental priorities that do not resonate with the views of local communities. Today, the emphasis is on ‘ecosystem services’ which again are largely being advocated by the environmental movement.

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1 CHaMPs = Coastal Habitat Management Plans
Today, realignment is promoted for its benefits as a carbon sink and for fish nursery areas. Yet it could equally be promoted for sound engineering reasons and perhaps these would have much greater resonance with coastal communities if enough effort was made to explain the basic physics? This is especially significant as this Coalition Government’s policy promotes greater local control over decision-making, which potentially creates the environment for an increasing emphasis on traditional hard engineering funded from local levies.

**Does managed realignment work**

This question needs to be asked because there have been unfortunate cases where rates of sedimentation have been slow and consequently the initial argument that realignment would create saltmarsh has been undermined. The Tollesbury realignment is a particularly noteworthy example that is regularly quoted by opponents of realignment. Unfortunately, this case is also associated with papers in the academic literature that suggest that failure to become saltmarsh is due to the activities of ragworms rather than as a consequence of low rates of sedimentation because sediment loads within the Blackwater Estuary are relatively depauperate. Tollesbury’s cautionary message about sediment supply is therefore now greatly overlooked, and yet this is the critical issue in terms of coastal management.

On the Humber, the same question need hardly be asked. Paull Holme Strays has absorbed sediment at an astonishing rate – upwards of 30 cm in the first year. Chowderness is doing the same. Both cases tell us that where sediment loads are high realignments will rapidly turn to saltmarsh, especially where cordgrass *Spartina anglica* occurs.

The contrasting messages of the Blackwater and Humber Estuaries impart very important messages that are highly relevant to coastal engineering and the development of long-term flood risk management strategies. Realignments are essential sinks for sediment that may otherwise be lost offshore if it cannot be absorbed in low-energy situations on the coast.

There are some cautionary messages too, but these come from un-managed realignments. The Blyth Estuary on the Suffolk coast sends one of the most important messages in this respect. Breaches of what was once a tidal canal have led to the development of might best be described as a bladder with a large tidal basin joined to a long tidal canal. The system is heavily ebb dominant with current velocities in the order of 6-7 knots on the ebb tide. This estuary now supports extensive mudflats but remarkably little saltmarsh despite having what appears to be sufficient accommodation space. It could be used to form an argument against realignment, and indeed there is a local group that contends that sedimentation has kept pace with sea level rise. They may be right but clearly the rate of sedimentation is insufficient to generate saltmarsh, which is the best means of providing sea wall stability. I suggest that there is an alternative model that is tremendously important to our understanding of how wave energy affects the geometry of realignments. It might also be used to develop an approach to habitat creation to offset the loss of important mudflats.

**Bladder-shaped estuaries**

The Blyth is not the only example of a bladder-shaped estuary in the UK. There are at least two others and the model might even be extended to the Mersey in some respects. The Alde-Ore is very similar in having relatively little saltmarsh and a large expanse of mudflat upstream from its canalised sections. More compellingly, Breydon Water exhibits very similar characteristics, but there is the added point that its orientation is such that the main body of the water is exposed to prevailing winds, whereas the western end is relatively sheltered and is exposed to north-westerly winds which are relatively infrequent. It is
notable that the main body of Breydon Water supports very little saltmarsh or reedbed but the western end is dominated by reedbeds except where the greatest fetch occurs – here the unmanaged realignment at Burgh Castle remains as high level mudflat.

Figure 1. The Blyth Estuary, Suffolk. The apparent islands are the remnants of former sea walls used to create a canal to allow navigation to Blythburgh.

Figure 2. Breydon Water, Norfolk. (left) with the location of the Burgh Castle breached site (above) highlighted.

The examples of the Alde-Ore, Blythe and Breydon Water all tell a similar story and can be used to develop a conceptual model of how sedimentation operates within highly ebb-dominant systems:

- Sedimentation will occur during periods of relative calm, and this may proceed until storm events remobilise lightly consolidated sediment.
- Remobilised sediment in highly energetic waters will not re-settle and therefore as the tide ebbs, fine sediment is drawn out of the estuary and delivered into the offshore environment where it forms part of background suspended sediment levels.
- Some of this sediment is drawn further afield and settles in deeper water where it is less likely to be remobilised except during the biggest storms.
- Sedimentation within the estuary re-commences once storms abate.
- If there are sufficiently long periods of deposition then saltmarsh plants may become established and this will reduce the sediment’s vulnerability to re-mobilisation. If so, saltmarsh will develop.
However, where sediment loads in the water column are insufficient to generate rapid deposition, further storm events will return the mudflats to an earlier state and elevation that is insufficient to support saltmarsh plants.

In the absence of sufficiently rapid sedimentation mudflats will evolve and will be maintained at a specific point in the tidal frame that is dependent upon the degree of wave energy that they receive.

The common feature of the Alde-Ore, Blyth and Breydon Water is the exceptionally long narrow neck that directs the ebb tide far offshore. Conversely, estuaries such as the Humber or Severn that have high sediment loads and rapid sedimentation are funnel-shaped and are strongly flood dominant.

Elsewhere, hardening of estuary mouths may lead to similar scenarios and may also mean that managed realignments do not naturally progress towards saltmarsh. One notable example is the Deben Estuary whose floodplain is extensive, but which has a constrained mouth. Realignments in such situations are therefore more likely to create long-term mudflats rather than follow the transition towards saltmarsh. This model may be extremely important from a nature conservation perspective because compensatory mudflat to offset losses is notoriously difficult to create because it has the natural propensity to develop into saltmarsh.

Accommodation space – the sediment sink

One of the most significant features of the Humber Estuary is the relative absence of saltmarsh. Sea walls abut mudflats and in many places the mudflats are eroding (figure 3). Yet, wherever slight changes in sea wall orientation lead to an expansion of accommodation space, there is saltmarsh. Moreover, where saltmarshes occur, the mudflats in front are generally healthy and accreting. This suggests that the Humber Estuary has been so severely canalised that it does not have sufficient accommodation space to create sediment sinks. This in turn may have a bearing on the sediment load of the estuary and is, I believe, an issue that is worthy of discussion.

We know, for example, that deepening of the Ems Estuary has dramatically changed its sediment load. What was formerly a relatively clear-water estuary now carries a high sediment load and suffers from serious oxygen depletion as a result. Concern about water quality and what is referred to as ‘tidal pumping’ in Germany has led to a debate about possible remediation measures that were discussed at a conference in Emden in December 2010. This example bears some resemblance to sediment mobilisation in the Severn Estuary where high sediment load closely correlates with spring tides. Extreme sediment loads are also a feature of the Humber Estuary and similar characteristics can be seen in within the Bay of Fundy (e.g. the Pettitcodiac River and Minas Basin).

An argument might therefore be constructed that part of the reason why the Humber Estuary has exceptional sediment loads is that it has been over-canalised and the resulting lack of accommodation space prevents mobilised sediment from being removed from the system by deposition. If there was more accommodation space, then arguably sediment loads within the estuary would decline and there might be resulting water quality benefits. To make any significant difference, however, realignments would have to be very big.

Of course, any suggestion that high sediment loads within the Humber are due to the loss of accommodation space may be dismissed as conjecture, but there are several important messages to be generated out of this conceptual model and differing models presented by the Blackwater, Blyth and Breydon Water.
- The role of saltmarsh as both a sink and source of sediments has been overlooked or underplayed when the issue of coastal resilience has been assessed in flood risk management plans.
- Saltmarsh erosion is not a negative process but should be looked upon as a mechanism for releasing stored sediment that is vital to building more resilient features upstream and higher in the tidal prism.
- The relationship between sandy beaches and sediment disruption is relatively well known and understood. But, the processes of sediment husbandry in estuaries has been largely overlooked or ignored and this message has not been embedded in the psyche of coastal communities.
- Managed realignment needs to be viewed as a form of banking to safeguard an irreplaceable engineering resource i.e. sediment, rather than as a tool to deliver wildlife benefits.
- Different breach arrangements and realignment geometry might be used in more creative ways to safeguard sediment sources and to use them more efficiently to deliver better coastal defences.
- It might be possible to influence water quality in some estuaries by greatly increasing the available sediment sinks and removing long-term accumulations of mobile sediment.

**Re-shaping policy messages**

Bearing in mind that the dominant public perception is that managed realignment is a conservation management tool, there is a clear role for engineers and planners in shaping future strategies for coastal management. As long as the nature conservation world has to be the primary champion of realignment, the prospects for generating greater resilience to sea level rise and increased storminess will remain poor. It is the engineers who must become the primary advocates of realignment.

If such a shift in emphasis were to be secured there would be associated nature conservation benefits, but they would be incidental to delivery of long-term resilience in coastal defences. This is a much more sustainable and practical relationship that places people and their protection at the heart of the argument.

However, for sediment husbandry to take a more prominent place in the debate there is a need to gain a much greater understanding of the economics of sediment loss. For example, rather than looking at the flood risk gain from saltmarsh, the costing exercise needs to start to look at the flood risk cost of foreshore lowering and beach steepening.

Thus the traditional illustration of the value of saltmarsh as an energy attenuator needs to be revised to take account of loss of mudflats (see figure 3 below).
Figure 3. Revised approach to the importance of saltmarshes and mudflats to sea wall construction and costs.