

Science Summary W5B-021/SS

**Porlock Bay Geomorphological Investigation and Monitoring:
gravel barrier breaching and tidal lagoon development**

Background to R&D project

Gravel barrier beaches protect significant areas of the open coast lowlands of England and Wales against flooding. Many of these features are of marginal stability and are maintained by various forms of active management. Should future management regimes alter towards reduced, or non-intervention approaches, it is likely that barriers could become increasingly dynamic resulting in breaching and tidal inundation of lowlands to create new lagoons or estuaries. Such changes could have economic and environmental benefits and are potential options along some open shorelines. However, there are major uncertainties relating to the nature and magnitude of the changes that could occur and their environmental implications. This is because permanent breaches of open coast barriers have been extremely rare over the past century and none have previously been monitored and analysed during the critical stages of their development. This report generates an improved understanding of these processes based upon a case study of a recent breach in Porlock Bay, NW Somerset.

A severe storm on 28th to 29th of October 1996 resulted in breaching of a section of the barrier protecting Porlock Bay and the formation of a new intertidal lagoon. This report explains the physical processes and landform changes that led to, and followed, the 1996 barrier breaching. It includes the results of detailed field observations, measurements and aerial photography undertaken between January 1999 and July 2001. Furthermore, it compares the results achieved with historical data sets extending back to 1888, setting the changes recorded into a longer-term context. The report scope covers the morphological changes occurring on the barrier beach, at the evolving breach channel and also the water levels and accretion rates occurring within the lagoon. Results are applied in terms of their implications for coastal defence, habitat conservation and further research.

Results of R&D project

The following key changes at Porlock are identified by the study:

- 1) A barrier subject to overwashing, landward migration, breaching and lagoon development existed naturally within Porlock Bay throughout the past 4,000 years.
- 2) Historical management attempted to maintain a continuous and static barrier by raising and steepening its crest.
- 3) Following relaxation of management in the early 1990s part of the artificial barrier has been reworked back to a natural lower, but wider form some 20-50m further landward. It is more variable in profile than its managed predecessor, but has retained its wave dissipation capacity by migrating landward to lengthen its dissipative profile.
- 4) A breach occurred in the barrier in October 1996. Co-incident factors of gravel depletion, the artificially steepened profile and a storm surge, high spring tide and wave event overwashed and flattened the barrier. Crucially, it transgressed landward over a drainage ditch that subsequently became exploited by tidal exchange leading rapidly to erosion of a permanent channel in the clay substratum that cannot be sealed naturally by drift.
- 5) The back barrier lowlands have formed an intertidal lagoon and a strongly accreting and expanding saltmarsh. Rapid headward erosion of the breach channel intercepted the main artificial drainage channel in December 2000, altering the tidal regime of the lagoon.
- 6) The breach introduced a new drift boundary and a local drift reversal. Gravels drift into the channel from the west and the east, creating spits and are flushed seaward to accumulate in a small ebb tidal delta.

- 7) Five partially dependent barrier “cells” including two spits flanking the breach channel have formed and the inlet at the breach is slowly migrating eastward.
- 8) A slow loss of barrier volume since 1988 is attributed to losses to the growing ebb tidal delta and also erosion of fine sediments from the core as the artificial barrier retreated. Landward recession and formation of spits flanking the breach have lengthened the barrier by up to 6%, spreading the diminished materials more thinly, which could drive continued landward barrier recession in the future.
- 9) Fine sediments eroded from the substratum as the barrier retreats are entrained and drawn into the lagoon by the flood tide. They sustain extremely high accretion rates that could result in long-term siltation and closure of the lagoon.

The changes documented have significantly increased the complexity and dynamism of the geomorphic shoreline system, but overall they appear favourable for earth science conservation and habitats as important new landforms and accreting saltmarsh have been created. Flood risks are contained by rising topography inland. A series of recommendations are provided covering the future monitoring and management at the site. Generic aspects of the monitoring (including GPS survey and GIS analyses) and the understanding gained should be transferable to other exposed British shorelines experiencing, or at risk of breaching.

R&D Outputs and their Use

The principal output is the R&D Technical Report that documents fully the changes recorded at the site and assesses the implications for coastal defence and habitat management. A CD-ROM of the data collected has also been produced. Some of the research has been extended and applied further within the PhD Thesis of Cope (2004) that is detailed below. These products provide guidance to Environment Agency staff, research contractors and external agencies involved in the management, research and monitoring of Porlock Bay. It also contains details of methodological and analytical approaches that are relevant to those concerned with monitoring, research, or appraisal of gravel barriers, tidal breaching and intertidal lagoons of other exposed coasts.

This R&D Science Summary relates to R&D Project W5B-021 and the following R&D outputs:

- **R&D Science Report - *Porlock Bay Geomorphological Investigation and Monitoring: gravel barrier breaching and tidal lagoon development*** - Published August 2001.

Publication Internal Status: Released to Regions

External Status: Released to Public Domain

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Readers may be interested in the following publication developed in part from this topic:

Cope, S.N. 2004. *Breaching of UK coarse clastic barrier beach systems: methods developed for predicting breach occurrence, stability and flooded hinterland evolution*. PhD Thesis, University of Portsmouth, 281p. it is available on inter-library loan from the British Library, Boston Spa and can be viewed in the Frewen Library, University of Portsmouth.

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Summary Product Code SCHO0305BISZ-E-P