

CHAPTER 82

CASE HISTORIES OF TWO ESTUARIES

by

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ABSTRACT

The coast of Great Britain has many interesting examples of the interaction between tidal estuaries of rivers and the littoral drift of the coast. These have been described with historical detail mainly by geographers (ref.1). Two cases coming to the author's firm for action have interest for coastal engineers. For the River Spey in the Moray Firth of Scotland, a famous and vigorous river, unusual works have been undertaken with success. For Dawlish Warren, a sand spit in the Exe Estuary of Devon in South West England, a scheme of works is being prepared which has novelty in regard to British practices.

THE RIVER SPEY

The River Spey, famous for its whisky distilleries and for its reputedly piratical capture of the headwaters of other rivers, is a vigorous, rejuvenated river. As a young river it cannot, of course, have a fixed bed in the valley floor and locally this is recognised together with the biological analogy by a saying: "The Spey is like a bad woman who winna' keep to her own bed".

At its junction with the Moray Firth, a large inlet from the North Sea, it meets a littoral drift of sand and shingle of intensive movement preponderantly in the one direction westwards. The combination produces an extensive shingle spit resting on sand below. This spit has the common cyclic history of such circumstances and this has been traced back to 1724. The westward growth of the spit diverts the river mouth westwards until the hydraulic resis-

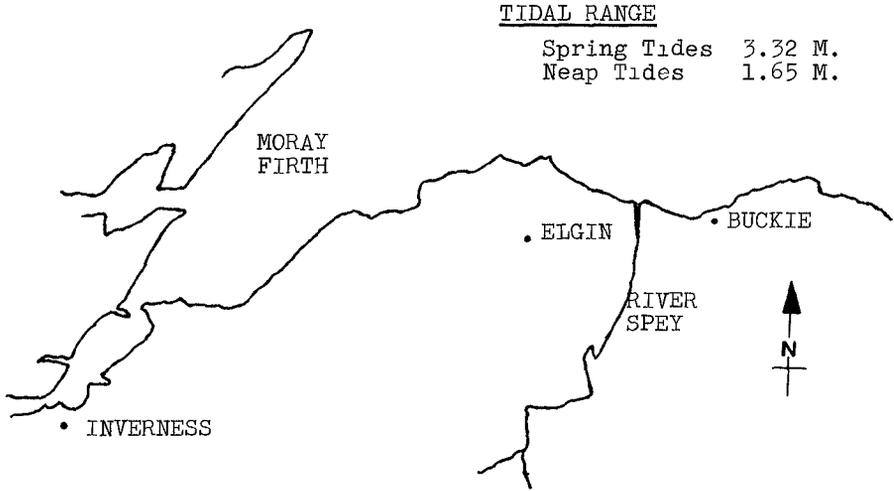


Fig.1: Location Plan

tance of the prolonged passage builds up sufficiently in river spate to cause a burst through the eastern end of the spit. In the last century the owner of the land and of the salmon fishery caused new channels to be cut at intervals to protect his interests.

The chronological order of events is:

- 1650 - Charles II landed from Holland and was carried ashore (hence the name Kingston)
- 1724 - Mouth 1555 metres west of Tugnet.
- 1829 - Year of famous Moray floods.
- 1860 - New cut brings mouth 232 metres west of Tugnet; old mouth 1555 metres west.
- 1870 - Mouth is 104 metres east of Tugnet.
- 1885 - New cut made.
- 1897 - New cut made 232 metres west of Tugnet.
- 1903 - Cut still in position of 1897.
- 1905 - Mouth 457 metres west of Tugnet.
- 1928 - Mouth 674 metres west of Tugnet.

1933- New cut 232 metres west of Tugnet.

1960- Mouth is 1311 metres west of Tugnet.

In 1961 the Moray County Council became involved as the Coast Protection Authority. The lands that had flooded were in numerous ownership and the valuable salmon fishery had passed to the Crown. A further complication was that extensive commercial abstractions of shingle had been made to the westward of the spit. Two cottages in the village of Kingston had been washed away and more buildings were threatened. Direct protection of the village was rejected by the consultants and a recommendation was made for a new cut. This was accepted and the consultants had a scheme carried out to induce the River Spey to do most of the work itself. The design procedure has been described in considerable mathematical detail related to Lacey's and other formulae for river regime (ref.2).

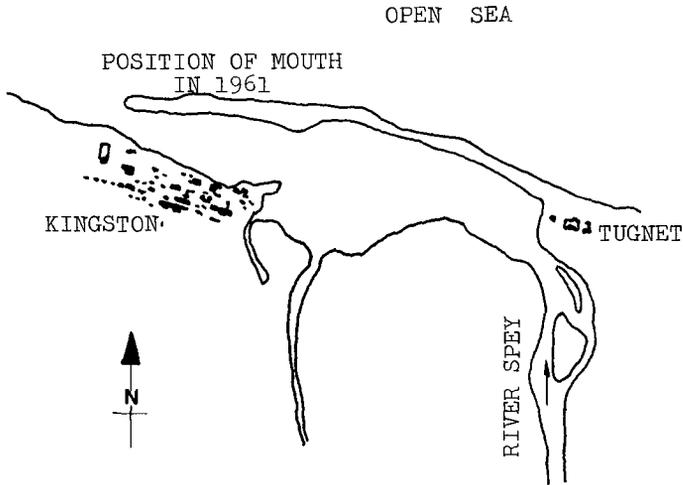


Fig.2: Estuary in 1961

The works included a gabion groyne, various excavations and fillings along the banks and a row of gabions through the spit at the selected site of the new mouth.

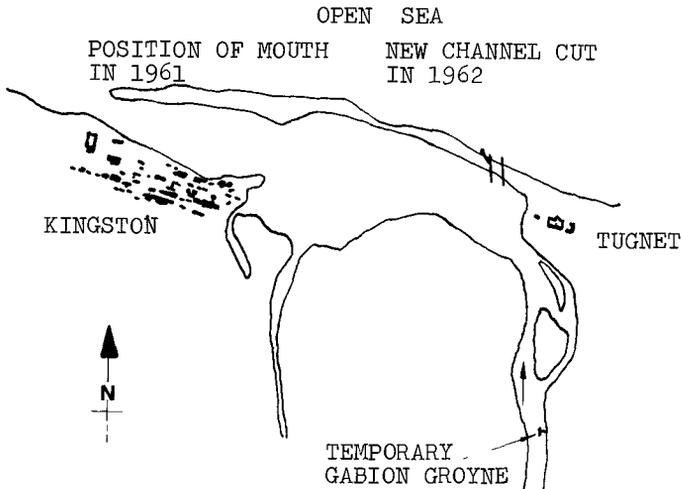


Fig.3: Works to induce new cut.

In July 1962 a flood of 424 cumets did in fact excavate 91,750 cubic metres of shingle and took the selected route out to sea. The old mouth did seal up again in 1965 and the new mouth has started off again on its migration westwards. By 1967, after 5 years, it has moved at an average rate of 92 metres per year and at this rate no further action will be needed for 15 years. Surveys of the spit are available for various years as are oblique aerial photographs illustrating the general problem.

A comment has been offered that the flood of 1962 would have taken the designed course regardless of the prepared works, and that the elaborate design procedure and exercises in fluvial coastal hydraulics were illusionary. To the consulting engineers who had responsibilities, the answer is that the flood would more likely have entered the gravel workings west of Kingston and have caused a great deal of damage generally.

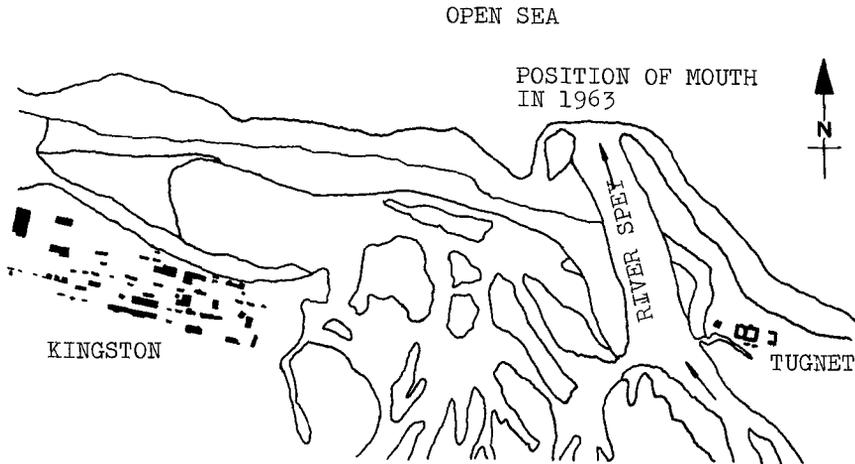


Fig. 4: Estuary 1963.

DAWLISH WARREN

Dawlish Warren is a double sand spit across the mouth of the estuary of the River Exe. The outer spit has been suffering erosion for some time and has been studied since 1872 (ref.3). The Great Western Railway, which runs along the perimeter of the Estuary and along the sea shore, did in the past carry out protective works on the landward root of the spit, but little work has been carried out on the Warren itself.

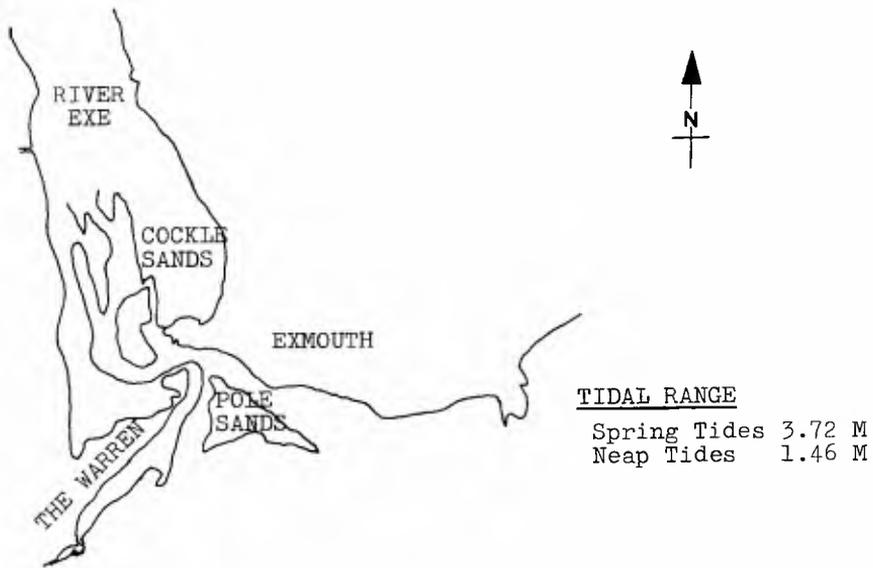


Fig. 5: The Estuary of the River Exe.

The photograph of a model shows the various surveys made since 1787. Some of the surveys were for the south eastern frontage only, hence the estuarial frontage of the model are for these surveys shown by a series of semi-circles.

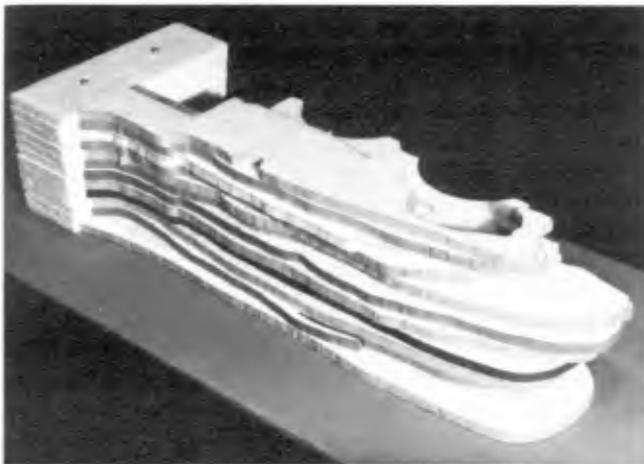


Fig: 6 Model showing the Warren from 1787-1962.

In July 1965 the Devon River Authority obtained a report on the Warren by the Hydraulics Research Station, and in 1966 the author's firm was asked to write a feasibility report on carrying out the works recommended in the report. The consultants reported that the Warren was in danger of disappearing thus losing a valuable amenity area much used by holiday makers. Estuarial conditions would change to the detriment of land protection, of fresh water flooding and navigation.

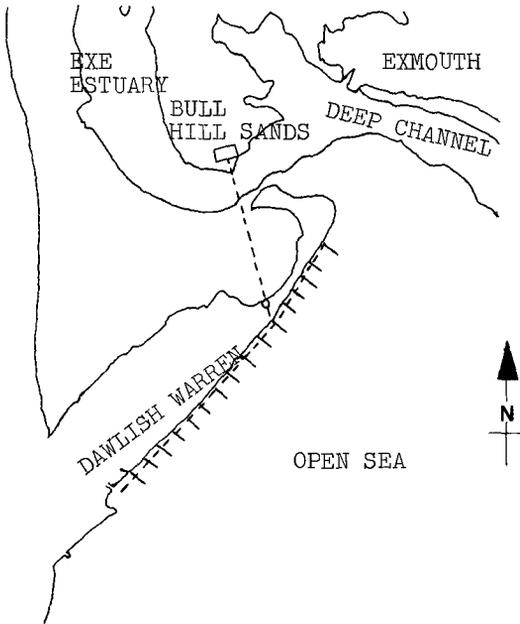


Fig. 7: Dawlish Warren 1962.

The Hydraulic Research Station proposed a large groyne at the distal end of the spit together with other groynes, extensive beach replenishment by pumping from offshore and longitudinal works. The consultants produced a modified Hydraulics Research Station Scheme with more conventional groynes and leaving out the controversial large groyne.

Administrative difficulties having been overcome, the author's firm is now instructed to prepare the scheme in more detail. The scheme now being prepared is for groyning the frontage and protecting the weakest length of beach crest by longitudinal works. A second stage is for beach nourishment. The whole of the Exe seaward estuary is a

massive sand complex as can well be seen on a sunny day at time of low water. The Hydraulics Research Station's idea was to pump sand from the Pole Sands, but the consultants preferred to pump from the Bull Hill Sands which are much more protected from sea action, and this was the basis of their first report. This involved a permanent pipe line underneath the navigation channel and a booster station for distribution on the Warren frontage. Subsequent thought is that it may be possible to obtain supplies from the estuary closer to the Warren without crossing the navigation channel.

The consulting engineers were asked to give an assessment of beach nourishment and reported: "It is, indeed, a difficult task to give a reasonable assessment of the average annual addition needed to keep the beach in good condition. From a geomorphological viewpoint the whole structure is ephemeral, but in the context of everyday coastal engineering to keep the Warren in existence it is necessary to make the best estimate possible of periodical volumes of beach nourishment so that financial provision can be made. Even if the average volume of nourishment is assessed reasonably accurately the annual variations due to weather conditions must be very great.

"Some guidance can be found in the past history of the Warren and Kidson in his paper to the Geological Society in 1964 (Vol.75, part 2) gave the following tables of sand loss above H.W.O.S.T. on the Warren:-

Period	Volume (cubic metres)	Annual rate (cubic metres)
1949-59	100,157	10,015
1959-62	63,458	21,140
1949-62	163,615	12,577

"This gives a loss of 12,577 cubic metres per annum above H.W.O.S.T. It is reasonable to assume on an ordinary sand beach profile that the loss above H.W.O.S.T. is equal to the loss between H.W.O.S.T. and L.W.O.S.T. so that the annual volume lost above L.W.O.S.T. was approximately 25,230 cubic metres per annum.

"To restore the status quo then an average of 25,230 cubic metres should be pumped onto the landward end of the Warren Beach. This is further complicated, as under the modified Hydraulics Research Station Scheme the frontage is to be groyned and the rate of littoral drift will be reduced. The reduction is again a matter of great difficulty with little data. A figure is necessary and perhaps 25,230 cubic metres could be reduced to 19,114 cubic metres.

"Unfortunately, it is well-known that on any frontage pockets of erosion develop without any obvious cause or, over the years, without any obvious pattern. These should be filled with sand when pumping the basic replenishment. If the volume is taken as 3,823 cubic metres the total becomes 22,937 cubic metres and this is the figure taken."

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1. Steers, J.A. The Coastline of England and Wales, Second edition, C.U.P. 1964. Pps. 627-629.
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3. Kidson, C. Dawlish Warren; A Study of the Evolution of Sand Spits across the Mouth of the River Exe in Devon. Transactions and Papers, Inst. of British Geographers, Paper 16, 1950. Pps. 67-80.