# How will Slapton Ley Evolve in the Next 100 Years ?

## Summary

A concern for the communities around Start Bay is that, much further in the future, evolution of the Slapton Line shingle beach will lead to a break through to the Ley; the freshwater will drain out, mud will be exposed and the bird and plant life will change adversely, creating a less attractive area for residents and visitors alike. But studies and a comparison with another site suggest that the new tidal environment created will quickly settle down and form a new and richer habitat similar to the estuaries in the area.

There have been two main studies that have looked at the changes that the coast and the Ley are undergoing generally referred to as [1]Scott Wilson and [2]Haskoning. Information from these indicates that::

- a breach of the shingle barrier is not predicted for at least 50 years, and probably beyond 100 years
- likely sea level rises will mean that rather than freshwater draining out leaving extensive mud areas, sea water is likely to flow in.
- for example based in predicted sea levels for 2080 there would be salt water in the Lower Ley for 40-60% of the time based on spring tides.
- a breach formed in this timescale may not be permanent.
- comparing the site with Porlock in North Somerset, it is likely the Ley would evolve to a similar intertidal habitat. This habitat is considered to be more scarce.
- The habitat that would be formed is in fact similar to Slapton Ley 3,000 years ago and it is a natural evolution for the site, albeit speeded up by sea-level rise.
- The new habitat would be of equal ‘value’ in habitat richness terms to the current state, though different birds, plants and fish would inhabit the area.

[1]The Slapton Zone Coastal Management study (Scott Wilson 2006)

[2]Slapton Ley Study – A Vision of the Future (Royal Haskoning 2007)

*View of Slapton Ley from Strete direction*

## Introduction

Slapton Ley is the largest natural freshwater body in the West Country. A natural lagoon, it is home to protected plants and animals and its proximity to the sea makes it special too. So important is the geomorphology and its mosaic of coastal, freshwater, terrestrial and transitional (in between) habitats that it was designated a Site of Special Scientific Interest in 1954 and as a National Nature Reserve in 1993.'

The Ley was formed as a result of a series of sea level changes. The coastline which is now the inland shore of the Ley was shaped 100,000 years ago when the climate was warmer and sea levels were slightly higher. The Ice Age followed with dramatic sea level drop of 40 metres (120ft) and the new coastline moving to 20 miles further out from the present line. As the ice melted, the sea level rose and it pushed a band of shingle onshore which eventually joined up the two headlands at Torcross and Strete Gate. Behind it an embayment was created, which then filled up with freshwater from the streams and rivers trapped behind the barrier.

This incredibly dynamic system is particularly vulnerable to easterly winter storms which have the potential to breach the shingle bar. At high tide the Ley is a mere 25m from the sea. In 1856 the Victorians built a road along the length of the shingle bar and over the years a lot of effort has been expended trying to protect the road and prevent the sea from washing it away.

100,000 years ago

18,000 years ago

10,000 years ago

3,000 years ago

## The Changing Coastline

A dramatic illustration of the changes possible came at the end of the 19th Century when 650,000 tonnes of shingle were removed off the coast from Hallsands to extend Devonport docks. This removal of material tipped the delicate natural balance of what is termed a closed sub-sediment cell of the Start Bay, and after a particularly wild winter storm in 1917, half of the village was washed into the sea. Even before this example of human intervention accelerating the natural processes, there is the story of Strete Undercliffe, a fishing village at the foot of the cliffs first recorded in 1693 which is believe to have disappeared into the sea at the end of the 1700s.

In recent years concern about the shingle bar has increased. Prolonged easterly storms have caused it to narrow and a small section of the road was undermined in 2001. This caused conflict and division within the community, between those convinced the road must remain open at all cost and those who take the view that hard engineered sea defences are not consistent with the natural beauty of the area.

Recent changes in the overall approach to ‘coastal engineering’ has moved much towards trying to accommodate change rather than fight it, managed retreat rather than rigid sea defences and this is the approach recommended by the Scott Wilson study commissioned following the damage to the road.

There are conflicting ideas of where and exactly when there will be a ‘catastrophic breach’ to the shingle barrier but a figure of beyond 50-150 years hence has been suggested. Certainly after the road is likely to have become impassable.

If a permanent breach did occur, there is a similar site at Porlock in north Somerset whose subsequent evolution gives us some ideas as to what would happen which we will look at in more detail later.

# The Evolution of Slapton

The Ley developed in two stages – prior to 3000 years ago sections of the ridge (spits) developed further out to sea than the present ridge. Sea levels continued to rise and these spits we pushed towards the land. At that time the Ley was tidal and the habitat was salt marsh as evidenced from cores of the silts in the Ley.

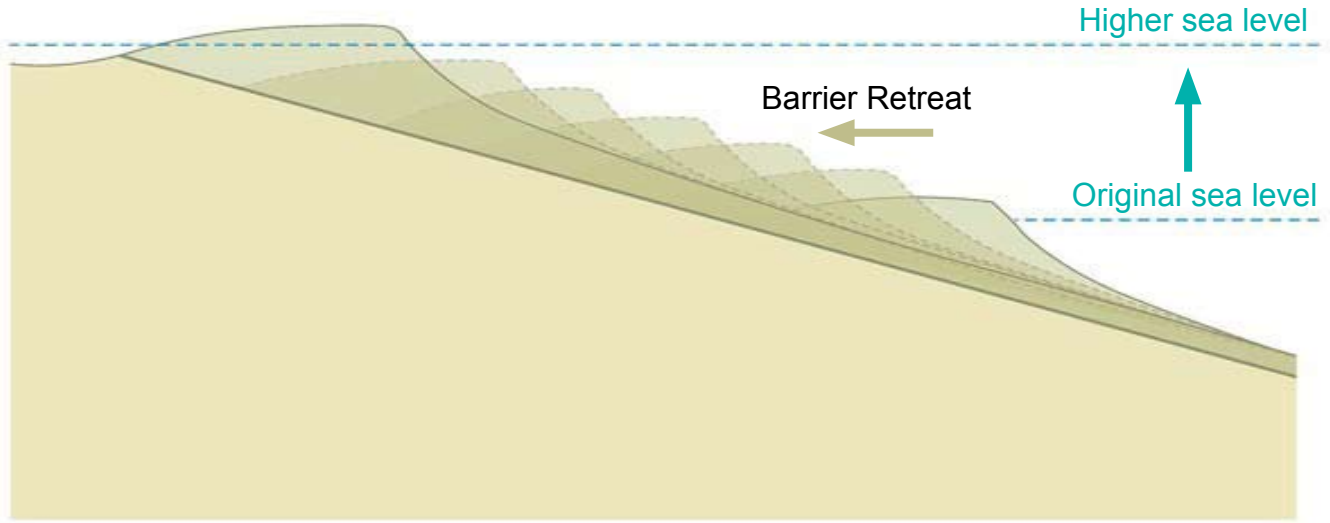
After 3000 years ago sea levels then dropped and the inlets between the spits closed up with sediment to form a continuous shingle ridge as seen today. The result of the continuous ridge was the formation of a lagoon, the freshwater 'leys'. Over the years these have been subject to a build up of silt.

Changes to the beach profile are caused by a number of factors. Storms and tides with over-topping and overwashing of shingle and water onto and over the crest, cause a change in its height and width. Longshore drift transports sediment up and down the beach.

There is no new material that is supplied to the ridge and so it responds to current sea level rise in changes to its height and curvature which therefore have an effect on its width. The ridge is also subject to subsidence and therefore makes it more vulnerable to sea level rise. The landward retreat of the ridge means it is increasing in length as it becomes more curved, the result being a longer and thinner ridge which is more vulnerable to breaching.

The permanence of a breach is dependent on several factors including the rate of roll back of the barrier, the transport of sediment by longshore drift, the width of the initial breach, the cohesion of sediments within the ley itself and finally the rate of sea level rise. Experts disagree as to whether a breach of the barrier in the near future would be permanent or it will self-heal.

In the Haskoning report after studying the area, the authors decided to look at a breach around the Stokeley Bay area of the Lower Ley. There were four scenarios used to determine the extent of saltwater penetration into the Ley as a result of a breach, with the current sea level being used as a control so that a comparison could be made of the losses with sea level rise.



## If a barrier breach happened now

## .....If it happened in the future

*showing ingress of salt walter on the very highest tide*

If a breach happened now, the lake bed levels mean that the Ley would only partly fill. The illustration (*far left*) shows the extent of ingress of saltwater on a spring tide at high water.

You can see an animation of the tidal range at this point click here.

A breach is more likely to happen, say in 50-100 years time when sea levels are likely to be higher (by 0.5 to 1.0m). Assuming that a breach doesn't self-heal, a substantial amount of water will be flowing in and out, as well as water remaining in the deeper parts of the Ley.

To view animation of the tidal change in the future click here

The resulting water levels would be likely to vary between these two states in the lower Ley, with the fringe areas changing to salt marsh.

Although there is not a large difference in the size between the two ‘Leys’, the Higher Ley has a much lower volume. The reason for this is the greater elevation of the bed level owing to a greater rate of deposition within the Higher Ley which has a significantly larger catchment than the Lower Ley. With such a difference in levels a dam could be put in place to prevent the Higher Ley habitats being affected by a breach occurring in the Lower Ley.

When a breach occurs the main loss of habitat will be of fresh water, with some loss to carr (wet woodland) and reed-bed. This essentially would be replaced with a saline lagoon and salt marsh habitat.

The Haskoning study looked at the potential for habitat creation to redress the balance of the loss of habitat due to a breach. The two areas where there is opportunity for effective habitat creation are along the Gara and Start valleys (two of the three tributaries that feed into Slapton Ley). The nature of the topography of the study area and its catchment mean that the total area of fresh water and reed-bed habitat is limited to around one third of the habitat lost and the work required would be at a cost of around £542,000.

In creating fresh water and reed-bed this will also have a corresponding loss of terrestrial habitats such as woodland which then will have to be re-created on additional land such as grassland and arable land. The creation of the reed-bed goes hand in hand with the re-creation of the freshwater, as the conditions required to create a reed-bed are that of freshwater and to some extent the freshwater would be colonised naturally by reed-bed and swamp.

A discussion of this scenario in 2008 as part of the Slapton Ley Land Management committee concluded that this was an expensive course of action, with knock-on effects and that freshwater habitat in fact was not as scarce in fact as inter-tidal habitat.

The loss of freshwater (in particular the Lower Ley) will cause a dramatic shift in the habitats and species which have made Slapton special but allowing it to go through this change will result in the creation of new valuable habitats.

A future breach is as certain as the fact that the Leys were created by barrier roll-over under rising sea levels in the first place. So a breach is just a further aspect of the evolution of the Slapton Ley system. Although there will be a loss of freshwater the trade-off is the establishment of different and potentially even more diverse habitats such as salt marsh, coastal grazing and a saline lagoon. The site would be likely to have an increased richness and diversity.

Through modelling processes using LiDAR and bathymetric data using the predictions of climate change, it is predicted that the Higher Ley could be preserved as a freshwater habitat, except for the worse case sea level rise scenarios. This would maintain 15% of the freshwater habitat and over 40% of the reed-bed habitat.

## What Happened at Porlock?

Porlock in north Somerset is a very similar site to Slapton in many ways in that it had a shingle ridge which protected a freshwater marsh from the sea, however it is on to the next stage in its succession in that the breach has already occurred and the management policy is ‘natural retreat’ .

When the Porlock shingle ridge was breached in October 1996, initially the site changed dramatically. Where there had been 12 to 14 distinct habitats including coastal grassland, brackish lagoons, freshwater and reed bed it then crashed to 4 habitats. The green vegetation that had been there before was cut away by the sea and what remained was covered in bare mud. However after 2 years the mud was beginning to colonise and through the summer there was a green covering of vegetation which died back through the winter. After 5 years the area was colonising very quickly and now in 2009 the number of habitats has exceeded those prior to the breach.

Another positive side effect of the breach was the discovery of archaeological evidence and artefacts. The first things to appear were 18th century irrigation channels and exposure of tree stumps from the Holocene period and as the sea continued to cut away the clay deposits, then the ribs, pelvis and vertebrae of an ‘Aurochs’ were discovered. These were wild cattle that would have roamed this area five and a half thousand years ago. Slapton would probably have similar archaeological artefacts.

See video explaining what happened at Porlock - click here

Porlock Bay 1984 (Pre-breach)

Porlock Bay 1994

Breach of Porlock 1996

Holocene Tree Stump 1997

Porlock Bay 1998

Porlock Bay 2002

Saltmash Porlock 2003

Inter-tidal vegetation 2003

Vegetation 2003

Vegetation 2009

## The Balance Sheet

When a breach occurs the main loss of habitat would be of eutrophic water (nutrient enriched freshwater), with some loss to carr (wet woodland) and reed-bed. This essentially would be replaced with a saline lagoon and salt marsh habitat.

Although the freshwater and reed-bed are important habitats, in national terms salt marsh habitat is a more diverse and rare habitat.

Salt marsh starts off as mudflats which initially may not look as aesthetically pleasing to the eye, however over time plants arrive, their roots help to stick the mud particles together and trap even more sediment so the mudflats become more stable. Salt marshes are important areas for small creatures such as worms, shrimps and shellfish, fish, wading birds and wildfowl. They provide nursery areas for fish, food for waders and wildfowl and nesting sites for waders and seabirds.

So a loss of some of the freshwater would mean a reduction in the population of the freshwater fish species –pike, perch, rudd and roach. However there would still be some habitat further up the reaches of the Gara where they could thrive. Instead the salt marsh habitat may provide feeding and nursery grounds for such species as bass, flounder and gobies amongst others.

There will be some loss of bird species due to a breach, the great crested grebes would no longer breed and there would be a reduction in population of reed bunting, water rail, reed and sedge warbers due to the loss of reed-bed.

The reed-bed at present is only just big enough to support a pair of bitterns so it is highly likely that the wintering bittern will be affected. However, there would be an increase in the numbers of waders such as redshank, greenshank, curlew, oystercatcher and bar tailed godwit amongst others. The wildfowl visiting the area would increase with greater numbers of widgeon, teal and tufted duck and perhaps the presence of new species such as shelduck. The flagship mammal species present at Slapton – the otter is unlikely to be effected as salt marsh is a habitat that the otter can still hunt.

Dunlin

Greenshank

Redshank

Shelduck

Bar tailed godwit

Oystercatcher

The future of Slapton has been studied in detail, this was galvanised due to the breach of the road in 2001. There are conflicting ideas of where and exactly when there will be a ‘catastrophic breach’ but experts believe that it will happen sometime beyond 100 years and is more likely to breach the Lower Ley rather than the higher.

The main contradiction with the studies is to the permanence of a breach ie will it seal up, remain open stay the same or continue to erode.

At present if a breach were to occur it is likely that the freshwater entering into the lower ley would drain out on the changing tide (ie the freshwater would escape through the breach as the tide goes out). However the Higher Ley would retain much of its freshwater although at a lower water level.

When a breach occurs the main loss of habitat would be of eutrophic water (nutrient enriched freshwater), with some loss to carr (wet woodland) and reed-bed. This essentially would be replaced with a saline lagoon and salt marsh habitat.

Clearly in the longer term for Slapton Ley, there will be change, but not ‘loss’ in terms of its uniqueness as a natural site.

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The Slapton Zone Coastal Management study
*(Scott Wilson 2006)*