Morecambe Bay Partnership

OUR FUTURE COAST

Historical Coastal Change at Sunderland Point

Our Future Coast is using historical data to understand the long-term patterns of coastal change at our sites. This document captures the results of the research into Sunderland Point.

Aerial image of Sunderland Point, Lancashire, 2018

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Contents

Document Summary

Sunderland Point is a coastal community near Lancaster which is extremely vulnerable to coastal flooding and climate change. Our Future Coast is exploring the potential for using Nature Based Solutions, such as saltmarsh, to reduce the impact of this in the future. This report reviews historical environmental data and changes to the estuary which may influence the placement and effectiveness of these strategies.

Its location on a peninsula between Morecambe Bay and the River Lune leaves the village exposed to storm surges from multiple directions. Records explored in this report show the area has been subject to catastrophic flooding since the mid 19th century, and likely for much longer.

While the location of the village would naturally lead to flooding the regularity and extent of it has been worsened by human changes to the river and surrounding landscape. Land reclamation from the 16th century onward has dramatically reduced the flood plain of the Lune meaning that where storm surges would once have dispersed through marshland, they now damage homes, farms, and businesses.

The addition of training walls to the river to improve its navigation, and the increased pace of land reclamation, in the 19th century further narrowed the channel, likely increasing the force of storm surges in the river and slowing drainage. Dredging and the removal of natural barriers in the Lune have also likely changed the force and direction of storm surges.

Property level flood defences alongside the walls, embankments, and rock armour that surround the peninsula have had a positive impact on flooding and erosion at Sunderland Point but some are in poor condition and they have not always withstood larger storms.

Growth of saltmarsh along the western shore of the peninsula and in Lades Marsh, a bay to the north east of the village, has provided some protection from flooding and erosion since the late 19th century. Despite more recent vegetation loss it could continue to do so with proper management and small scale repairs to the major channels.

An alternative approach for Lades Marsh is to strategically breach the embankment to rewet some of the former marsh and widen the floodplain. The new position of the coast would need to be carefully chosen due to the scale of the land reclamation in this area, to avoid isolating properties and shifting the problem elsewhere.

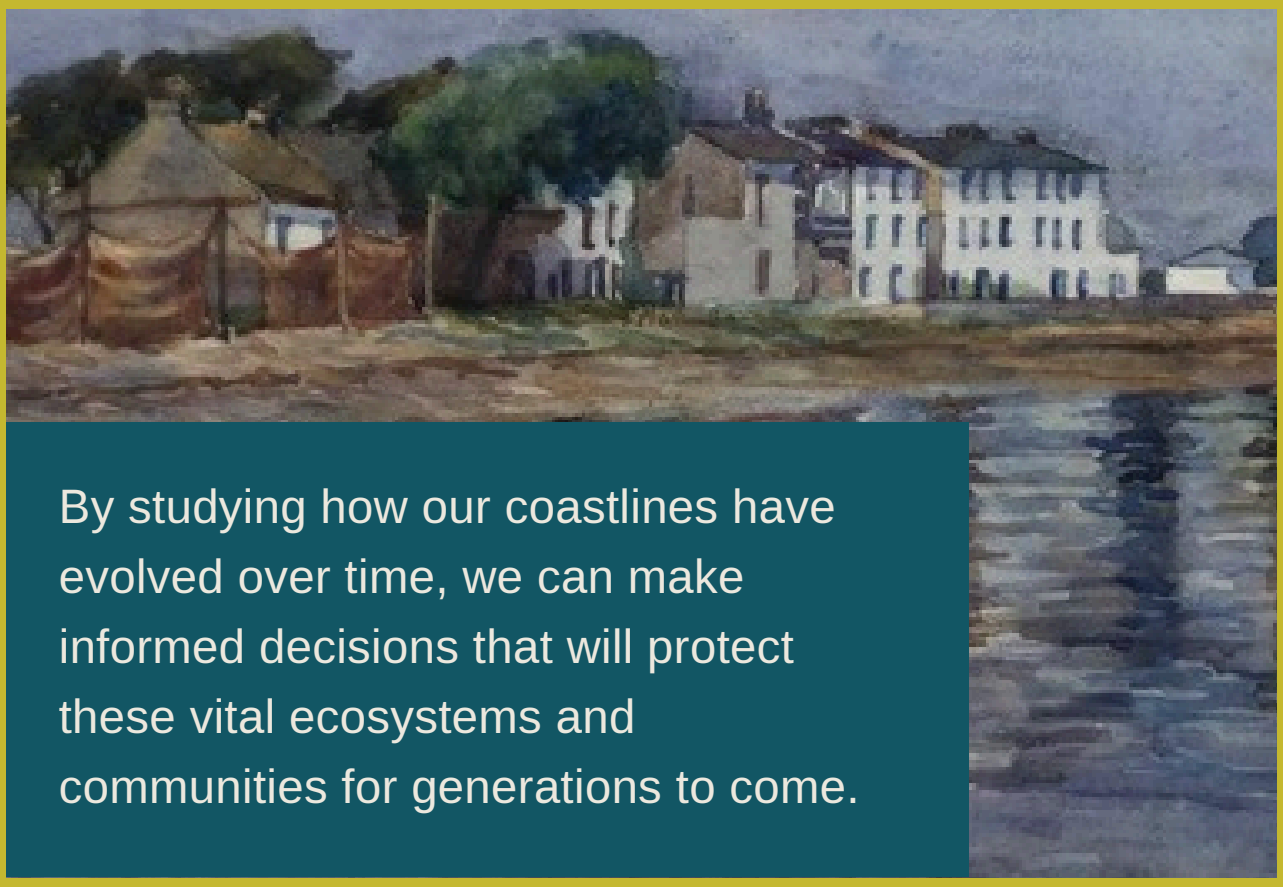
The strip of foreshore in front of the village itself has mixed potential for saltmarsh growth. Photographic collections have shown evidence that vegetation has grown there in the past, sometimes quite extensively, particularly in the slight bays in front of Old Hall and between the housing terraces. These, however, have been short lived and are vulnerable to erosion because of the narrowness of the foreshore. Saltmarsh can be grown here but will need intensive maintenance and barriers to provide a long term flood defence.

Traditional marsh restoration and fishing techniques could be useful for forming these barriers. ‘Brushwood retards’ have previously been used in Lades Marsh to trap sediment in gaps left by turf digging in the marsh and were effective at early vegetation regeneration.

Barriers made from poles and woven withies fixed into a low stone wall have been used in the Lune for salmon fishing in the past, and could inspire more robust structures for trapping sediment and protecting initial marsh growth in front of the terraces.

Mussel beds and shingle banks have been damaged or removed from the river in the past through dredging, erosion, and pollution. These were likely important barriers to flooding and could be reinstated now that pollution and river traffic have been reduced.

Introduction



By studying how our coastlines have evolved over time, we can make informed decisions that will protect these vital ecosystems and communities for generations to come.

Image: Painting of Second Terrace, Sunderland Point by Beatrice. H. Swainson b.1879 d.1971. Courtesy of Lizzie Gilchrist.

Coastal change has rapidly become a serious risk to communities around the world. While flooding and erosion events have undoubtedly become more regular and extreme in recent years humans have been writing about these problems for centuries.

Historical documents, maps, and photographs can help us build a picture of how our coast has changed through time. Using these sources, we hope to understand how human and environmental changes have shaped our current coastline and how it might continue to change in the future.

Collaboration and community ownership is at the heart of our project. A professional historian identified potentially useful documents in local archives and then worked with volunteers to digitise and analyse them. Our sincere thanks go to Katharine Green for photographing the documents in this booklet, and to Katharine, Lizzie Gilchrist, and Bill Morris for sharing their collections of photographs, paintings, and maps.

Sunderland Point

Sunderland Point is a narrow peninsula, near Lancaster, between Morecambe Bay and the Lune Estuary. With 38 properties, some dating back to the 17th century, Sunderland Point is a place rich in history, heritage and culture, and hosts worked farmland, an active fishing community and extraordinary birdlife.

It is a place where the community shares a lived connection with the natural environment, including the sea, river, salt marsh, shingle, and mudflats, and where they are routinely cut off twice a day by the flooding of the access causeway at high tide.

The entire Point is at high risk of flooding, with many domestic properties fitted with flood protection measures. However, climate change and sea level rise predictions pose increased risks of flooding and erosion and threaten the longevity of the community.

The Village is also faced with a No Active Intervention Shoreline Management Plan policy, although the community have demonstrated a strong collective will to fund and implement their own coastal defences in the past.

The two-year Our Future Coast project at Sunderland Point will be community-led, with Morecambe Bay Partnership and key partners supporting the community to plan, develop and implement alternative Nature Based Solutions to manage coastal change in new ways.

Research Questions

The Our Future Coast team worked with a Task Group of residents and landowners with an interest in Sunderland Point to develop a list of questions we had about the history of coastal change. We drew on existing historic research and coastal processes reports for the Lune estuary to find gaps in our knowledge of how the landscape developed and how this has affected water movement around Sunderland Point.

Saltmarsh

Saltmarsh is a vital part of our plans for nature-based solutions to flooding. We know saltmarshes around the north west have shrunk considerably overall in the last hundred years, but we also know some marshes have grown at times too. If we want to encourage saltmarshes to grow at our sites, we need to know more about the causes of these changes in size. We want to track changes in the saltmarsh over time, see where it has been useful as a barrier in the past and identify areas that we can encourage saltmarsh to grow in the future.

Erosion

The community at Sunderland Point has installed a number of coastal defences in recent years in response to flooding, and to erosion of the Point End. There are also remnants of older defensive structures visible on the foreshore. We want to understand the erosion events that triggered the building of these defences and whether we can learn from successful interventions in the past.

The River

Sea level rise plays an important role in coastal flooding but it is not the only thing to consider. Much of the flooding at Sunderland point has been the result of tidal storm surges travelling up the River Lune. We will investigate how changes in the estuary including the reclamation of former floodplains, erosion of the peninsula, the training of the Lune channel, and dredging associated with Glasson Dock have affected the flow of water and flooding in the area.

Flooding

As the village of Sunderland sits on a narrow peninsula, between Morecambe Bay and the River Lune, it faces flooding from both the east and west shores. Previous floods have caused substantial damage in the community which is predicted to worsen in response to climate change. We will explore newspaper articles, letters, and photographs for details of the conditions that have led to floods in the past, how deep the flooding was, and how they affected the community.

Saltmarsh

An aerial image of Lades Marsh © North West Regional Coastal Monitoring

The Role of Saltmarsh

Saltmarshes are coastal wetlands, regularly flooded by the tide and covered by salt-tolerant plants. Saltmarshes form in sheltered locations away from high wave energy, and where there is a sufficient supply of sediment. They are important habitats, particularly for the wide variety of birds that make Morecambe Bay their home, and act as carbon stores. Saltmarshes also play a role in coastal defence. The layers of sediment held together by plants are natural buffers to waves and erosion. Unlike traditional concrete coastal defences, these buffers can grow to adapt to sea level rise, providing a long-term, sustainable solution to coastal flooding.

Analysing the Marsh

This study will examine historic maps to measure the amount of saltmarsh at different points in the past and so track rates of growth and erosion. We will also compare photographs from the early 1900s to the present to gain a better understanding of the changing density of saltmarsh over time.

To complement the Baseline Coastal Processes Report produced for the project by Charlotte Evans, the historical research will focus on the extent of the marsh for approximately 300 years up to 2000 CE, with some temporal overlap in the photographic analysis.

Saltmarsh at Sunderland Point

In 2025 the Sunderland Point peninsula was surrounded by just over 1.5 km^2 of saltmarsh. For clarity, we have divided the marsh into three zones.

1. West Shore – an area of 0.88 km^2 of saltmarsh spreading along the entire western foreshore of the Sunderland peninsula from Potts' Corner in the north to Point End in the south. The marsh stretches some distance to the west along the sand shelf known as Sunderland Bank.
2. Lades Marsh – A salt marsh with an area of 0.65 km^2 located to the north-east of the village between Sunderland point and Overton.
3. East Shore – the foreshore on the eastern side of the peninsula, alongside the River Lune. This has two main patches of saltmarsh one about half way down the peninsula in a small cove between the two housing terraces and another larger area on the south-east side of the peninsula between Old Hall and Point End. The combined area of these two patches is approximately 7700 m^2.

These zones are shown on the map on the following page (Fig.).

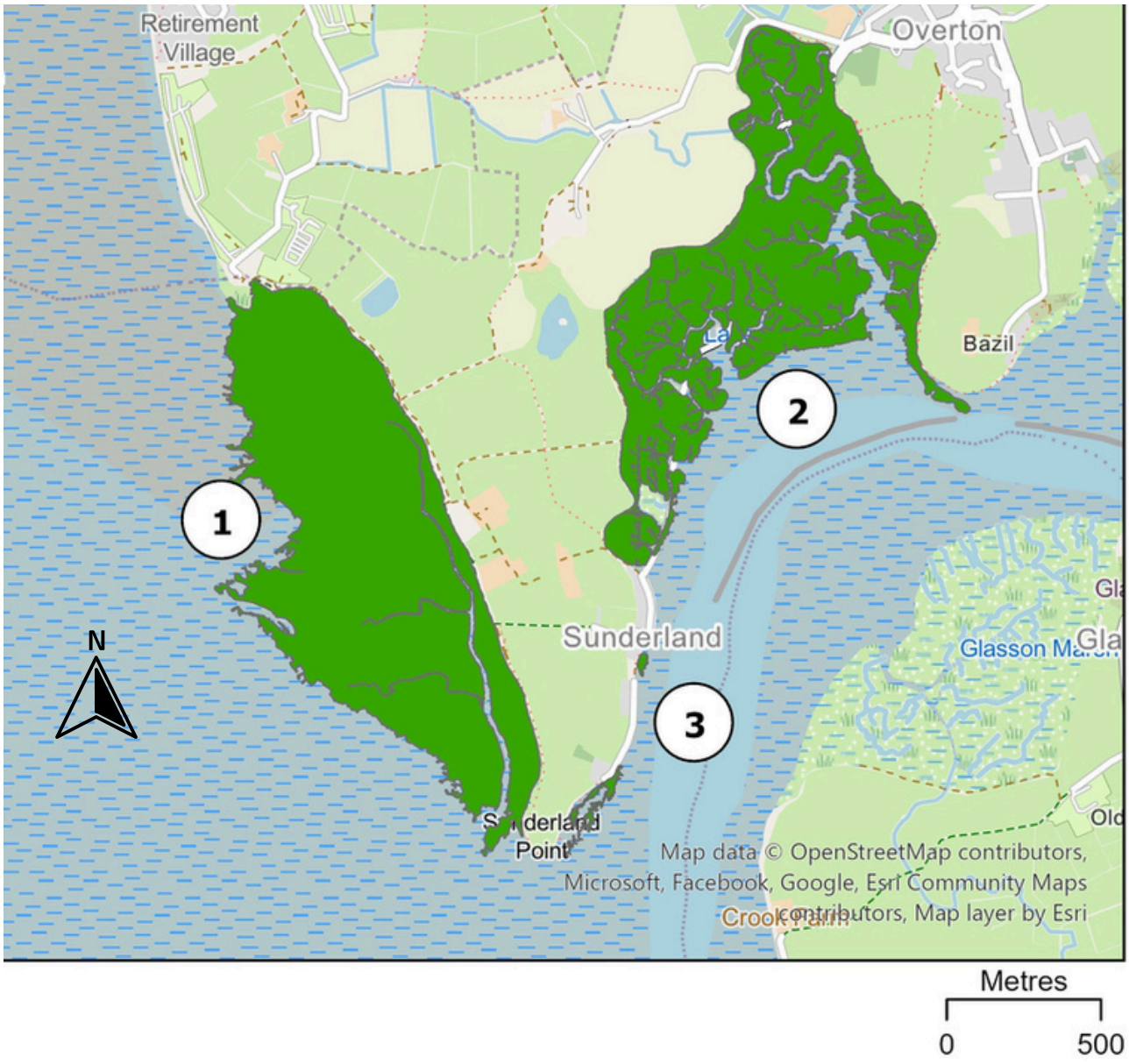


Fig. 1 Map showing the three saltmarsh zones around Sunderland Point. Marsh extent highlighted in dark green.© Charlotte Evans, Sunderland Point Baseline Coastal Processes Report, 2025.

West Shore

The earliest Ordnance Survey (OS) map we have that depicts saltmarsh on West Shore was surveyed between 1844 and 1845 and published in 1848 (Fig. 1). The symbol for marsh is used in a thin strip along the foreshore between Sunderland Brows and Point End, between the words ‘Mark’ and ‘Sands’ on the map. Unfortunately, they are faint and not always distinguishable from the shingle and so it is almost impossible to accurately measure them in mapping software.

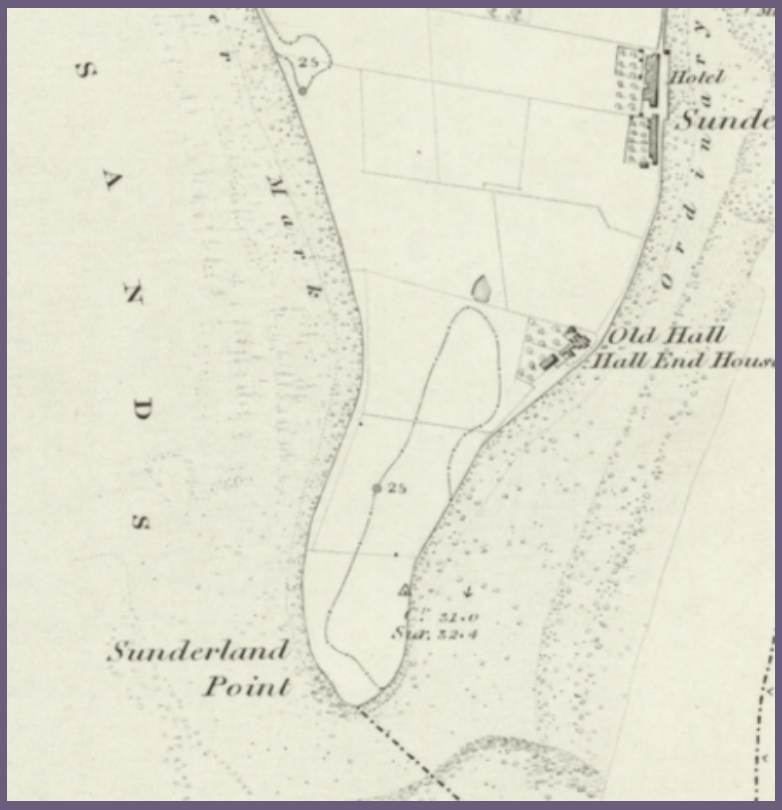


Fig. 2 Ordnance Survey, Six-inch England and Wales, Lancashire Sheet 34, Surveyed: 1844 to 1845, Published: 1848 CC-BY National Library of Scotland

Fig. 3 Extract from Admiralty Sea Chart, Morecambe Bay, Commander Denham, R.N. 1844

Fortunately, a navigation map of the sea and coast between Formby and the Solent was made by the Admiralty in 1844. This map is not as accurate at showing land-based features as the OS is but it shows coastal features which might impede the movement of a ship in great detail. On this map we were able to draw around the saltmarsh and measure its area. This tells us that in 1844 the saltmarsh at West Shore covered approximately 17.62ha (0.18km^2). In 2023 the saltmarsh measured 0.88km^2 meaning it has grown by 399% over the 179 years for which detailed maps are available.

Since 1844, the area of the saltmarsh at West Shore has been mapped several times. As there are large jumps in time between many of the maps now available it is not possible to calculate how the rate of growth has changed over time. However, the data we do have suggest that this growth has been fairly consistent.

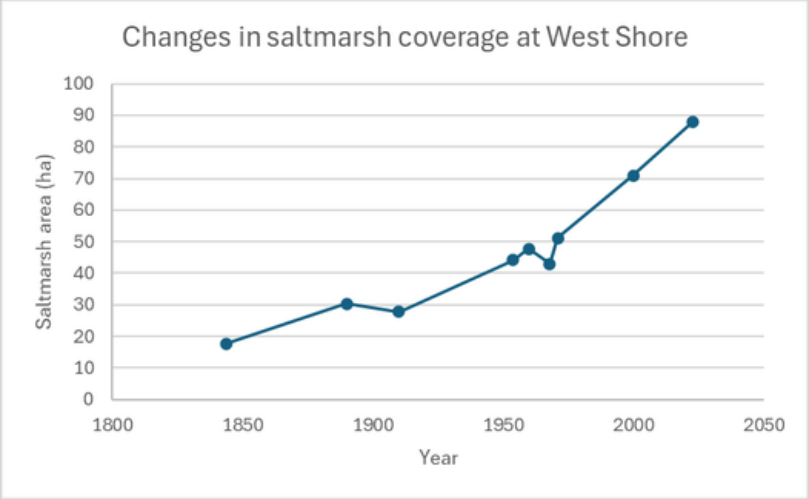


Fig. 4 Chart showing growth trend in the saltmarsh at West Shore on OS maps between 1844 and 1971

There are some notable exceptions where we see erosion of vegetation. The greatest loss was between 1890 and 1910, when 3.48ha was eroded. While we do not have direct evidence for the cause of this loss, we do know that there were severe flood events in 1890, 1899, and 1907 which may have contributed. After a period of regrowth we then see another decline between the 1954 and 1968 maps, this time of 1ha. It is possible that more of the marsh was lost at this time. An aerial photograph taken in 1963 shows that it had grown by 3 ha since 1954, meaning that 4 ha had been eroded between 1963 and 1968. This may, however, be due to a discrepancy in how saltmarsh was mapped by the Ordnance Survey and how we identified saltmarsh in the aerial photo.

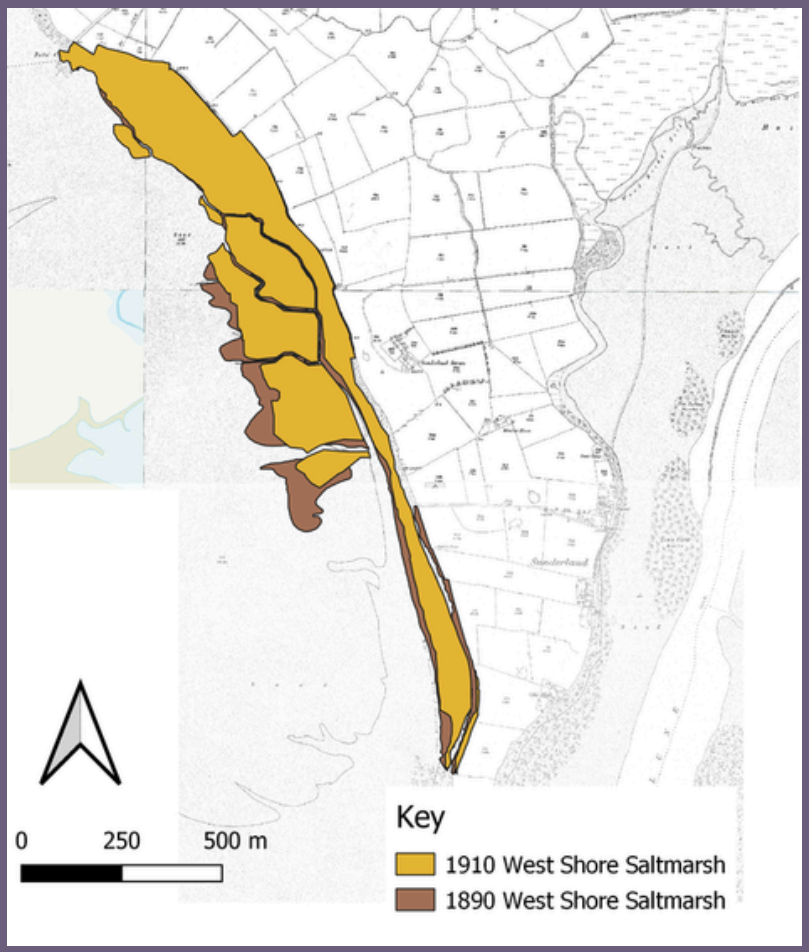


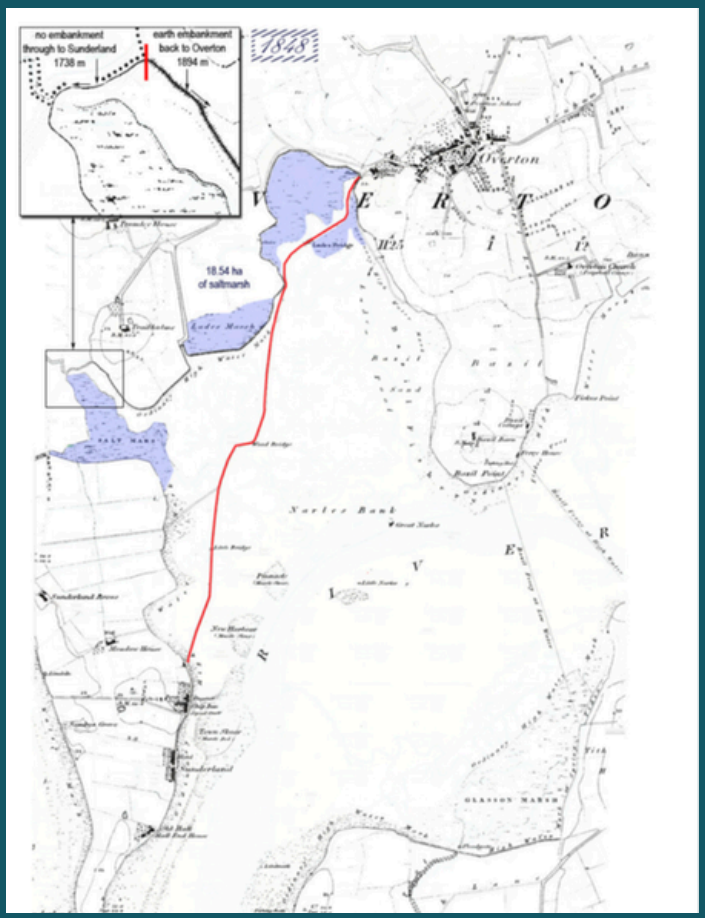
Fig. 5 Extent of saltmarsh on the 1890 and 1910 OS maps, overlaid on the OS England & Wales, Six inch, Lancashire Sheet XXXIV, Surveyed: 1890, Published: 1895 CC-BY National Library of Scotland

The largest fluctuations in the area of saltmarsh were in the central part of the peninsula, between the road north of Sunderland Brows Farm and Sambo's Grave.

Lades Marsh

A similar historic map study, focussing on Lades Marsh, was conducted by Ian Hughes as part of his undergraduate dissertation on Morphological and Anthropological Processes Acting on the Intertidal Area of a Macro-Tidal Estuary in North West Lancashire: The River Lune in 2016. Hughes found that between 1848 and 1893 saltmarsh grew by 21.88 ha or 118%. He suggests that this growth may have been triggered by the training wall that was built in the mid-estuary between 1847 and 1851. Hughes also notes that the Overton Sea Embankment was completed during this period and the reclamation of this part of the marsh may have triggered growth in front of the bank.

Hughes found that the saltmarsh then remained roughly the same size until the 1950s and concludes that this likely meant that the construction of the lower estuary training wall in 1893 made little difference to the growth of the saltmarsh. Further information has since come to light suggesting that the training wall built in 1893 was the one built between Bazil Point and Glasson, with several sources showing the Sunderland wall was in place long before then.



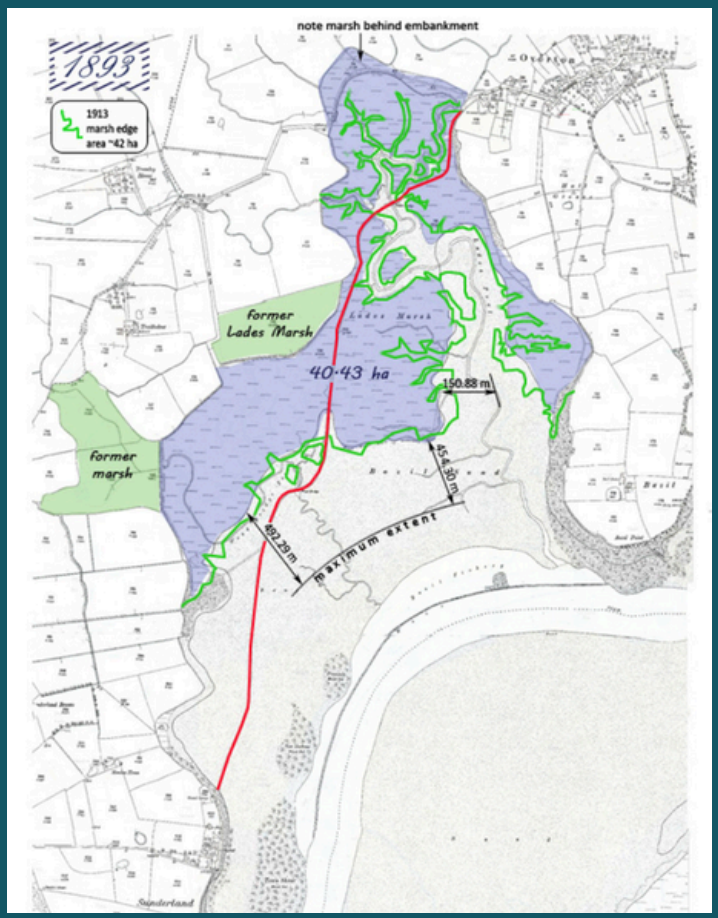


Fig. 6 (left) The Lower Lune estuary 1848 OS First Edition map 1:10,000. Blue areas denote the extent of saltmarsh (18.54 ha) from Hughes, I. 2016 Ap. 1-4

Fig. 7 (right) The Lower Lune estuary 1893 OS First Edition map 1:2,500 Blue areas denote the extent of saltmarsh (40.43 ha) from Hughes, I. 2016 Ap. 1-5

The assertion that the saltmarsh had not grown between 1913 and 1955 also needs closer inspection. Although the National Grid map (Fig. 9) was published in 1955, the revision information on the map sheet states that it was based on a survey conducted before 1930, in all likelihood the 1913 edition. Only where there had been major changes on the ground were they included in the new map. This becomes clear when you compare the saltmarsh channels on the two maps, they are almost identical. This seems to have created some problems with Hughes' measurements of the marsh (Fig. 8), as he has only traced the solid lines of the channels which have been copied over from the 1913 map. A close look at the 1955 map shows that the area of marsh drawn has expanded beyond the 1913 extent with a dashed line, the standard method for drawing vegetation where there is no hard boundary. This shows that while marsh accretion had considerably slowed since 1893, it was still growing.

Hughes mentions that a section of the low estuary training wall was built by 1865, and that the channel was dredged seasonally for four years, flattening the gradient of the river and removing skears, which could have affected marsh accretion. The shape of Hall End Skear also changed dramatically between 1848 and 1893, potentially changing how sediment moved into and out of the estuary.

Hughes finds that the rapid growth of the marsh after 1955, by 73 ha or 82%, proves that accretion was occurring independently of work on the training walls. This study has since found evidence in the Lancaster Port Commission minutes, however, that show considerable repair work had been done on the walls between 1952 and 1955, and that in 1956 work was progressing well with raising the height of the training wall by two feet. This would also explain why the wall appears to be the same height above low water, despite up to a metre of siltation.

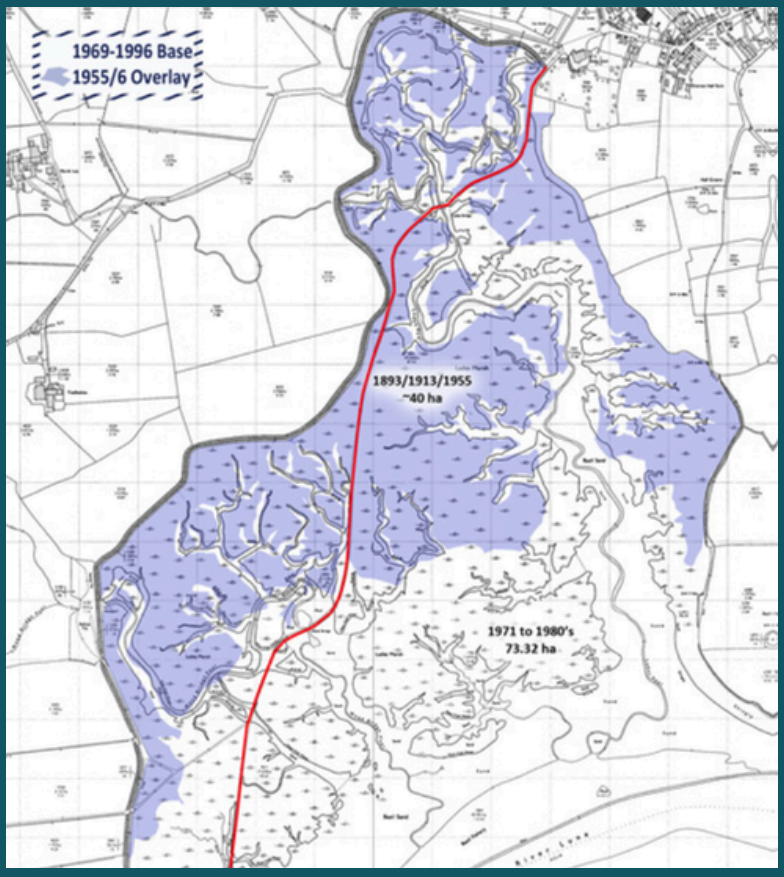
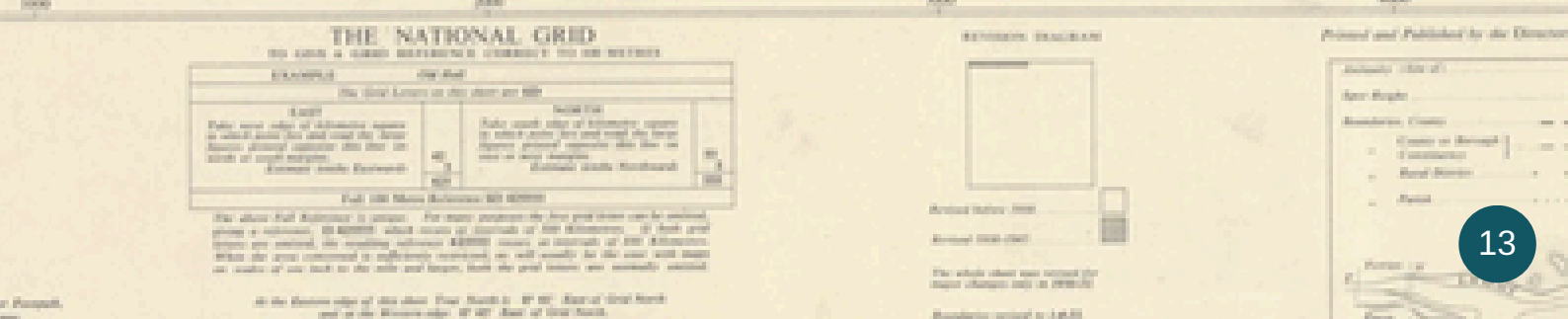


Fig. 8 The Lower Lune estuary 1st Edition, 1971, National Grid 1:10 000 Blue areas denote the extent of saltmarsh in 1955 (40.43 ha) (incorrect) from Hughes, I. 2016, Ap. 1-6.

Fig. 9 National Grid maps, 1944-1975, SD45NW & part of SD35NE - A
Surveyed / Revised: Pre-1930 to 1955, Published: 1955 CC-BY National Library of Scotland



East Shore

Most historic maps do not show any saltmarsh on the eastern shore of Sunderland Point in the area we are calling Zone 3. There are two exceptions to this, the OS 1890 six inch to the mile and the OS 1910 25 inch to the mile.

These two maps only show a very tiny amount of marsh growth, 0.12 ha in 1890 and 0.11 ha in 1910, but importantly, these patches were in areas that we would like to grow saltmarsh today.

There is no clear trigger for these periods of growth and they appear to have been quite short lived. It is possible that the changes to the shape of Hall End Skier between 1844 and 1890 played a role, either through allowing more sediment to be brought in by the tide, through wave action eroding the land and distributing sediment on the skiers. The partial building of the low estuary wall in 1865 may also have contributed to this, although the wall itself does not reach that far.

The wall could also have played a part in the 1910 accumulation of saltmarsh between Old Hall and Second Terrace. It is also worth noting that this map shows that groynes had been placed just north of Old Hall by this time, which would also have changed sediment movement.

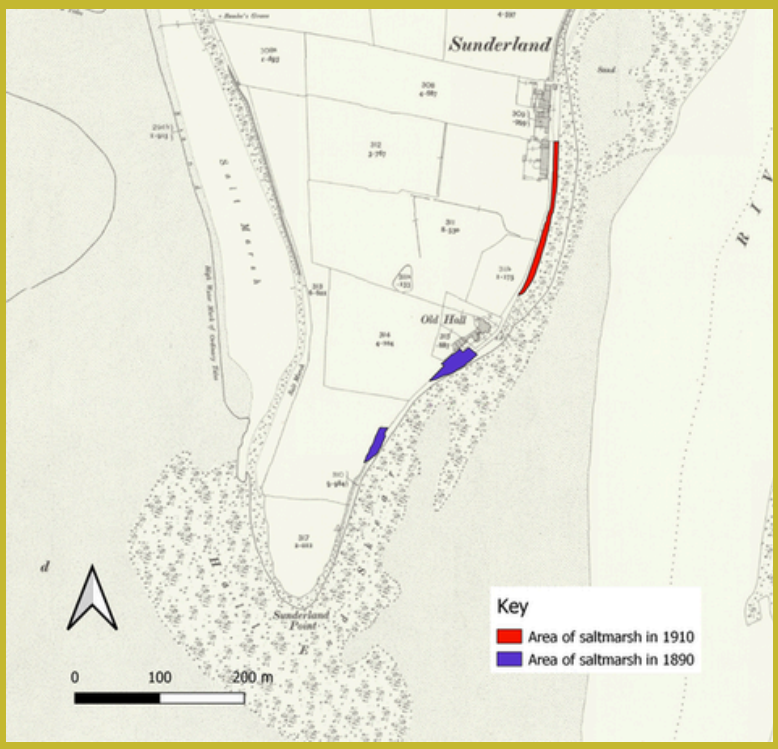


Fig. 10 Extent of saltmarsh shown on 1890 and 1910 OS maps overlain on OS 25 inch England & Wales Lancashire XXXIV.9 Revised: 1910, Published: 1913CC-BY National Library of Scotland

Fig. 11 Photo of the groynes outside of the Old Hall, around 1900. Lancashire Red Rose Collections

Although the available historic maps do not show any additional saltmarsh along East Shore, and none at all close to First Terrace, photographs do show that it has been present in several locations at different times. Many of the photographs only show very small clumps of vegetation, but images from the 1970s to 1990s and in the 2010s show larger stretches of marsh.

Fig. 12 Undated photo of foreshore in front of Old Hall showing small clump of grass. Gilchrist Collection, courtesy of Lizzie Gilchrist.

Most of foreshore images which show saltmarsh are of the stretch between Old Hall and Point End, or in the sheltered area between the terraces. There is however, an image on the Historic England Aerial Photo Viewer from 2012 which features a tiny clump of grass growing in front of First Terrace.

Fig. 13 Saltmarsh between the terrace, 2010, courtesy of Katharine Green.

Further photos can be viewed at earth.google.com/earth/d/1ZD0380KwLop4rEenj-jTyzkLS6K0kt_1?usp=sharing

Fig. 14 Foreshore looking towards Point End, late 1990s/early 2000s, courtesy of Katharine Green.

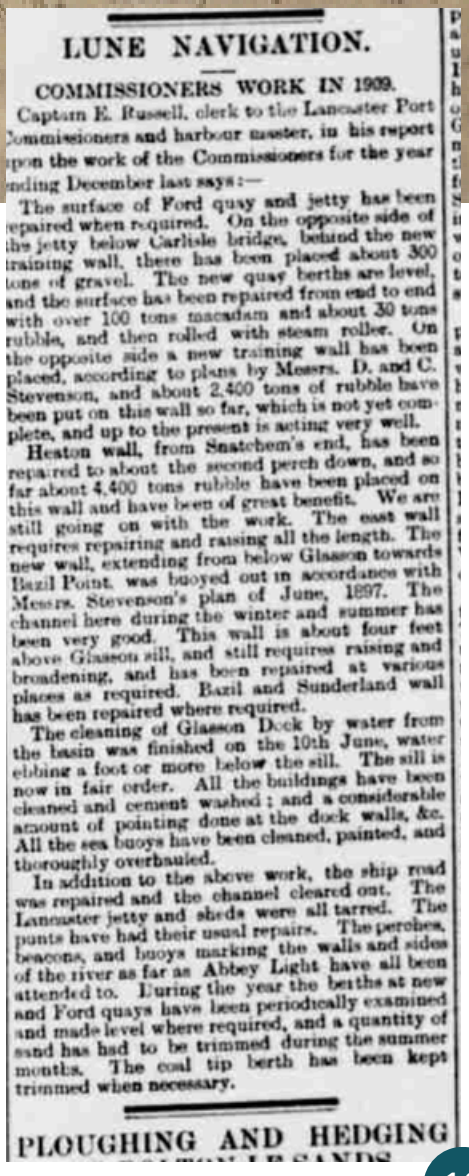
Fig. 15 Extract from Admiralty Sea Chart, Morecambe Bay, Commander Denham, R.N. 1844

The River Lune

The River Lune flows southwest from the Howgill Fells in Cumbria, with tributaries from the Yorkshire Dales, and the Forest of Bowland, and out into Morecambe Bay at Sunderland Point. The estuary is 12.8km long, with the normal tidal limit reaching Skerton Weir, east of Lancaster.

Like many river estuaries, the lower reaches of the Lune channel naturally wander across the soft sands but have been constrained by past human interventions.

This section looks at the changes people have made to the river and the possible effects this has had on flooding and saltmarsh growth.



LUNE NAVIGATION.

COMMISSIONERS WORK IN 1909.

Captain E. Russell, clerk to the Lancaster Port Commissioners and harbour master, in his report upon the work of the Commissioners for the year ending December last says:—

The surface of Ford quay and jetty has been repaired when required. On the opposite side of the jetty below Carlisle bridge, behind the new training wall, there has been placed about 300 tons of gravel. The new quay berths are level, and the surface has been repaired from end to end with over 100 tons macadam and about 30 tons rubble, and then rolled with steam roller. On the opposite side a new training wall has been placed, according to plans by Messrs. D. and C. Stevenson, and about 2,400 tons of rubble have been put on this wall so far, which is not yet complete, and up to the present is acting very well.

Heston wall, from Snatchem's end, has been repaired to about the second perch down, and so far about 4,400 tons rubble have been placed on this wall and have been of great benefit. We are still going on with the work. The east wall requires repairing and raising all the length. The new wall, extending from below Glasson towards Bazil Point, was buoyed out in accordance with Messrs. Stevenson's plan of June, 1897. The channel here during the winter and summer has been very good. This wall is about four feet above Glasson sill, and still requires raising and broadening, and has been repaired at various places as required. Bazil and Sunderland wall has been repaired where required.

The cleaning of Glasson Dock by water from the basin was finished on the 10th June, water ebbing a foot or more below the sill. The sill is now in fair order. All the buildings have been cleaned and cement washed; and a considerable amount of pointing done at the dock walls, &c. All the sea buoys have been cleaned, painted, and thoroughly overhauled.

In addition to the above work, the ship road was repaired and the channel cleared out. The Lancaster jetty and sheds were all tarred. The punts have had their usual repairs. The perches, beacons, and buoys marking the walls and sides of the river as far as Abbey Light have all been attended to. During the year the berths at new and Ford quays have been periodically examined and made level where required, and a quantity of sand has had to be trimmed during the summer months. The coal tip berth has been kept trimmed when necessary.

PLOUGHING AND HEDGING

Fig. 16 Article from The Lancaster Observer and Morecambe Chronicle 1910

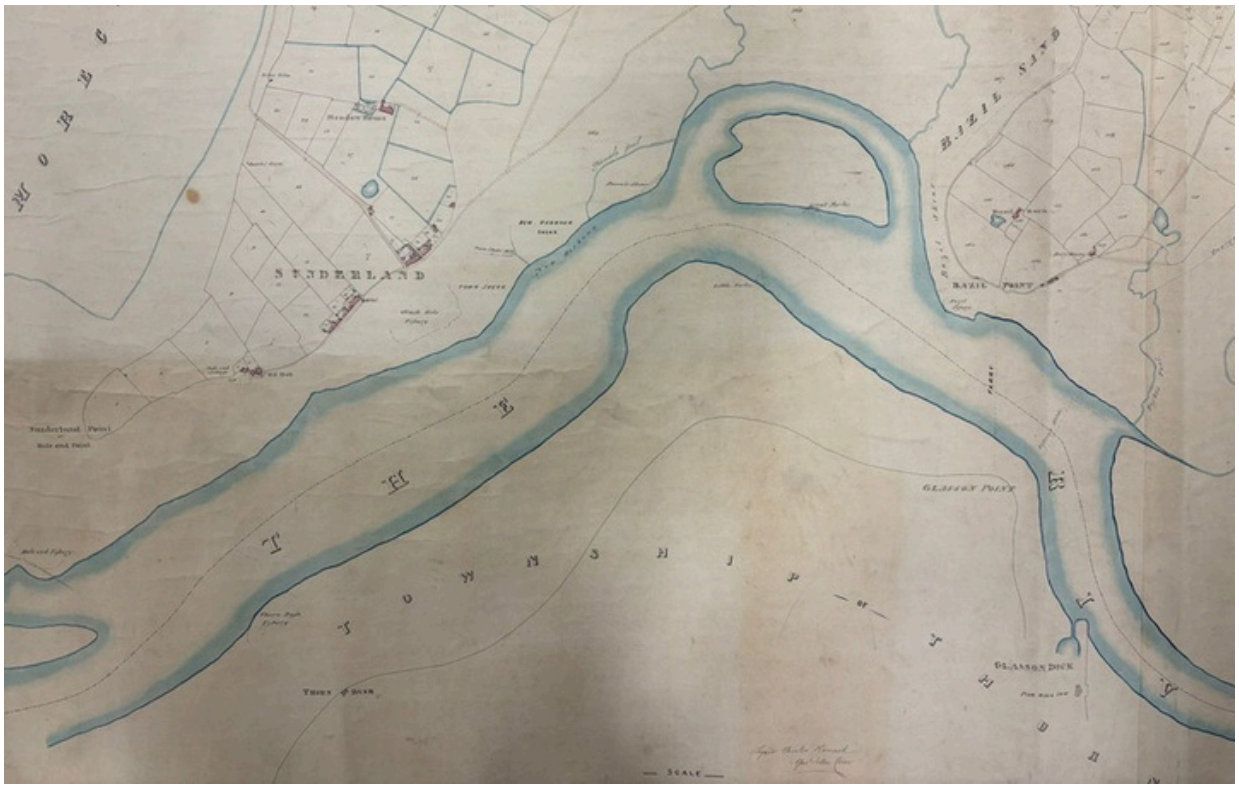


Fig. 17 Extract from the Overton Tithe Map, 1844, Lancashire Archive Service DRB/1/145

Historic maps show that in 1844 the course of the Lune between Lancaster and Sunderland split into smaller channels in multiple places. The depth of the channels varied significantly along the river, and there were many sand bars and skears to navigate.

The condition of the Lune had at this point already been a longstanding issue for Lancaster trade. As described in excellent articles about navigation and the quays on the Sunderland Point website, at the end of the 17th century most vessels were expected to unload at least part of their cargo at Sunderland Point before continuing up the river.

The first quay was registered at Sunderland Point, probably in front of the Old Hall, in 1681, although it was likely in use long before then. It was replaced by a larger quay between Old Hall and First Terrace in 1723. These quays would have made use of the gradual slope of the shore, rather than any built structures until they were replaced once again in 1739 by the wharf we see in front of First Terrace today.

Fig. 18 Undated photograph of ship anchored on sands in front of Old Hall. Gilchrist Collection, courtesy of Lizzie Gilchrist.

Even having lightened the ship, allowing it to sail in shallower waters, vessels were expected to hire a pilot to guide them the rest of the way to Lancaster. Navigation instructions published in 1737 give directions up to Sunderland Point, noting that there is little water in the channel at low water, but that any description of the river from here towards Lancaster would be useless as the channel changes so regularly.

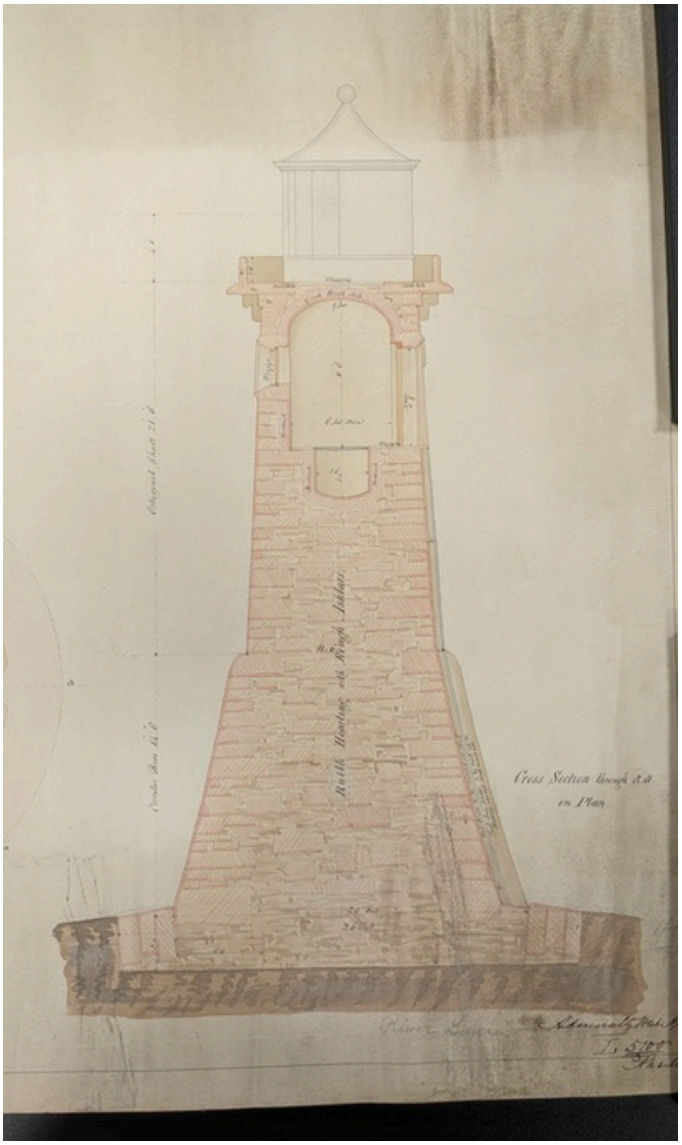


Fig. 19 Design for proposed lighthouse in the Lune channel, 1851. Lancashire Archive Service BOT/316.

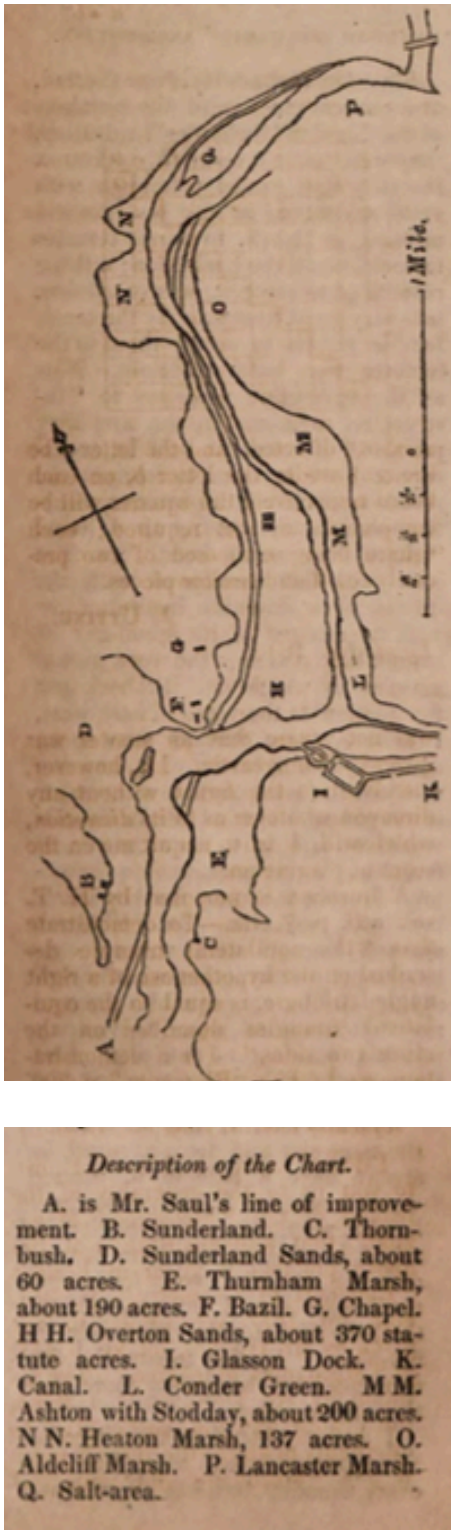
As international trade grew in Lancaster, mostly related to the slave trade, the poor condition of the river became a bigger problem. In 1749 an act of Parliament was passed to allow improvement to the navigation of the Lune. The act described the Lune as ‘difficult and dangerous’ due to the shoals and other obstructions in the river and stated that many ships had been overturned or damaged while harboured.

The act allowed:

- The building of a new quay in Lancaster (St George’s Quay)
- A safe harbour to be made at the mouth of the river
- Buoys to be placed at the entrance to the river
- Landmarks erected for guiding vessels to and from the town
- Ships using the port to be charged taxes to pay for these improvements

The act also allowed for a Port Commission to be set up to make these improvements, collect taxes, and make bye-laws related to the use of the port and river. A 1789 amendment to the act gave the Port Commission powers to increase taxes on ships, as they had not been enough to pay for improvements, and to build lighthouses in Morecambe Bay.

Some of its provisions directly affected the shape of the river, changes which continue to have an impact today. The first was the right to remove obstructions from the Lune, including shoals and skears, and to straighten, scour, and deepen the river wherever they felt it necessary. It also allowed for stones to be taken, to be used for ballast, anywhere below the high water mark.



Description of the Chart.

A. is Mr. Saul's line of improvement. B. Sunderland. C. Thornbush. D. Sunderland Sands, about 60 acres. E. Thurnham Marsh, about 190 acres. F. Bazil. G. Chapel. H H. Overton Sands, about 370 statute acres. I. Glasson Dock. K. Canal. L. Conder Green. M M. Ashton with Stodday, about 200 acres. N N. Heaton Marsh, 137 acres. O. Aldcliff Marsh. P. Lancaster Marsh. Q. Salt-area.

Fig. 20 Extract from *Improvements in the River Lune*, The Mechanics' magazine, museum, register, journal, and gazette v. 13 (1830) p.249.

Note: Point ‘Q’ labelled as ‘salt area’ is now Salt Ayre.

Despite these permissions being given, it seems that changes to the channel were limited to small-scale hand removal of obstructions for many years. Skidmore’s investigation into dredging in the Lune found one instance of removal of stones in 1751 in the Port Commission minutes but this was likely happening more regularly.

Larger scale interventions began higher up the estuary where navigation was more difficult. The first of these was in 1771 when walls were built to reduce the width of the channel above Scale Ford to increase the scouring force of the water. This combined with digging out the riverbed at the ford served to deepen the channel allowing larger vessels to pass.

Navigation was clearly still difficult, as in 1782 work was begun on the construction of Glasson Dock, to provide a safe harbour at the mouth of the river, which was completed in 1787. This, however, did not solve the problem as initially goods still needed to be brought up the river from Glasson to St George’s Quay. In fact, new issues arose as the channel repeatedly meandered north towards Bazil Point leaving the dock entrance dry.

Concerns about the state of the river continued to be raised in Port Commission meetings for several decades, with limited results. In 1830, we see an article in the mechanics magazine, inviting a national audience to participate in a competition for ideas to improve the navigation of the Lune, accompanied by a map made by Physick and Bush (Fig. 20).

Responses received from readers of the magazine felt that dredging alone was not enough to keep the channel open and would likely worsen sand bars. Suggestions to improve the river included making a pool at Overton Sands to steadily release water providing a scouring effect, using flood gates to drain the marshes at Oxcliffe and Salt Ayre so that tidal waters would be focussed on the main channel, adding to the force of the scour, and building a breakwater to direct the force of the tide along the same path as the freshwater flow.

Shortly afterwards, in 1833, a special committee was formed to permanently improve the navigation of the river but no practical action was taken, likely due to lack of money. In 1838, the committee commissioned civil engineers Robert Stevenson and Sons to survey the river between Glasson Dock and Lancaster. His survey found that at high water at normal spring tide in parts of the river the depth of water was only 12 feet deep. As the draft of vessels of ordinary tonnage at the time was 10-11ft, Stevens recommended that the channel be dug out to 16ft along the whole length.

After consulting with Captain Denham of the Royal Navy, and gaining permission from the Admiralty work began on this manually until powered dredging became available in the mid-19th century. The process continued with a diesel-powered ladder dredger between 1847 and 1851. After this initial period of work the vessel was sold and dredging temporarily ceased. Port Commission minutes and letter books record regular periods of dredging since 1860, primarily focussing on Glasson Dock entrance but also used to remove sediment build up elsewhere in the river.

It was soon proven that dredging was not enough to maintain the course of the river and additional training walls were designed to deepen the upper stretches of the Lune, alongside removal of some of the sharper bends, by 1856.

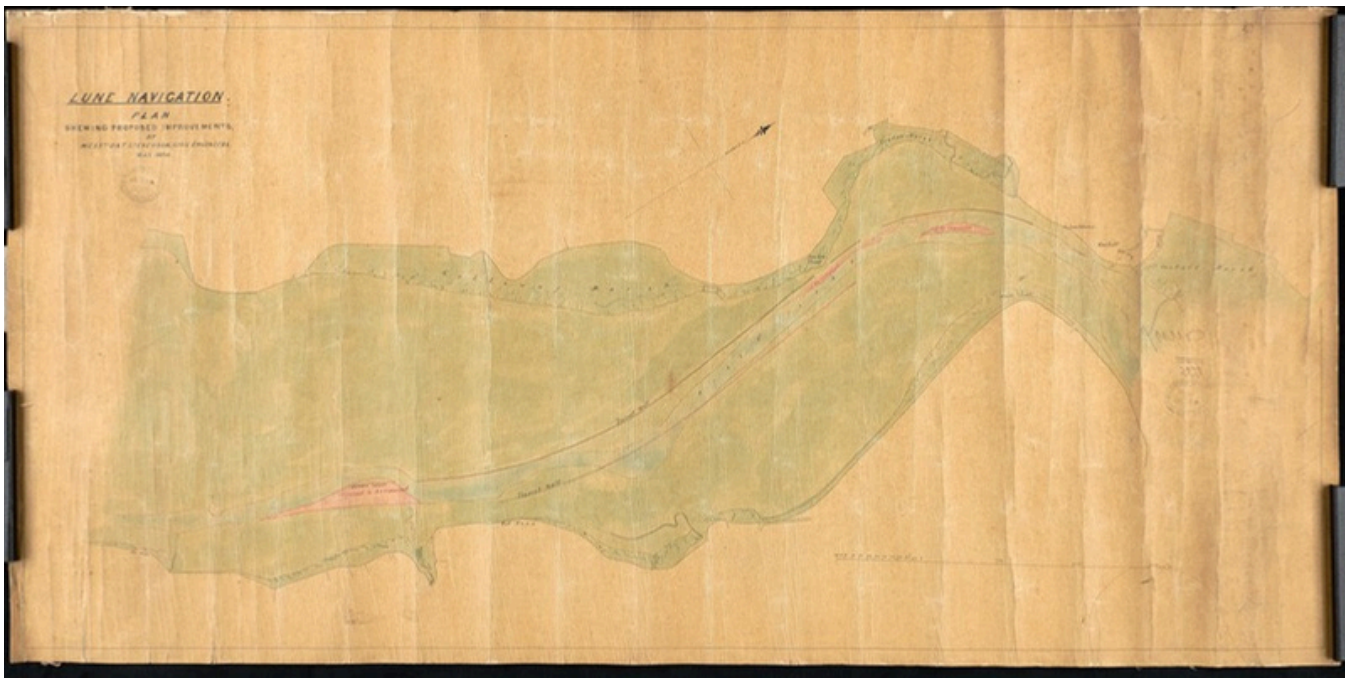


Fig. 21 Plans for improving the navigation of the upper River Lune, 1856. Lancashire Archive Service BOT/171.

By 1860, a small breakwater had been built from Bazil Point halfway across to Sunderland (shown in black in fig. 23 below) and already needed repairs.
An extension of this wall was approved by the Admiralty in 1862. At the same time there was a plan to build a weir to redirect Lades Pool into Wood Bridge Pool, and reclaim some of the marsh between Sunderland and Bazil Point, it is unclear why this did not go ahead, but may have been due to objections from the Duchy of Lancaster.

This earlier date for the construction of the training wall suggests that it may have had more of an impact on the growth of the saltmarsh than previously thought.

Fig. 23 Plan for the extension of the River Lune low water guide wall. Existing wall shown in black, extension in red. 1862. Lancashire Archive Service BOT/268

A further training wall was built between Bazil Point and Glasson Dock in 1893, and newspaper reports say it was marked out by buoys in the same way as the Sunderland wall. The river here continued to change position and there were plans for a wall closer to the Glasson side in 1897 and 1899 but neither were built, likely due to the decline in sea trade.

The effects of training walls on estuary flooding are not well known. Recent studies show that training walls and dredging narrow the channel as well as lowering it, especially when combined with land reclamation. This means that although average water levels are lower, and drainage can be quicker, storm surges cause more damage as the narrowing increases the force of the water, and flood plains have been removed.

Land Reclamation

Aerial photograph of Lades Marsh, 2018
© Northwest Regional Coastal Monitoring Programme

The training walls in the Lune were designed for a dual purpose. Although improving the navigation of the river was the primary concern of the Quay Commissioners, it was always intended that the cost of the work would be offset by enclosing and selling the newly drained land the scheme created.

The most drastic version of this plan, came from coastal engineer W. Hague in 1840. He suggested that a ship canal should be cut between Lancaster and Poulton (now Morecambe) and the Lune diverted through it, then an embankment could be built across the Lune estuary and the riverbed drained.

This may have saved the Commissioners much of the trouble they had making the Lune navigable in later years, however, given the estimated cost was £500,000 (over £66m today) the idea was not taken seriously.

As Hague's plan was to eventually embank and drain the whole of Morecambe Bay, his scheme was unlikely to benefit the port long term.

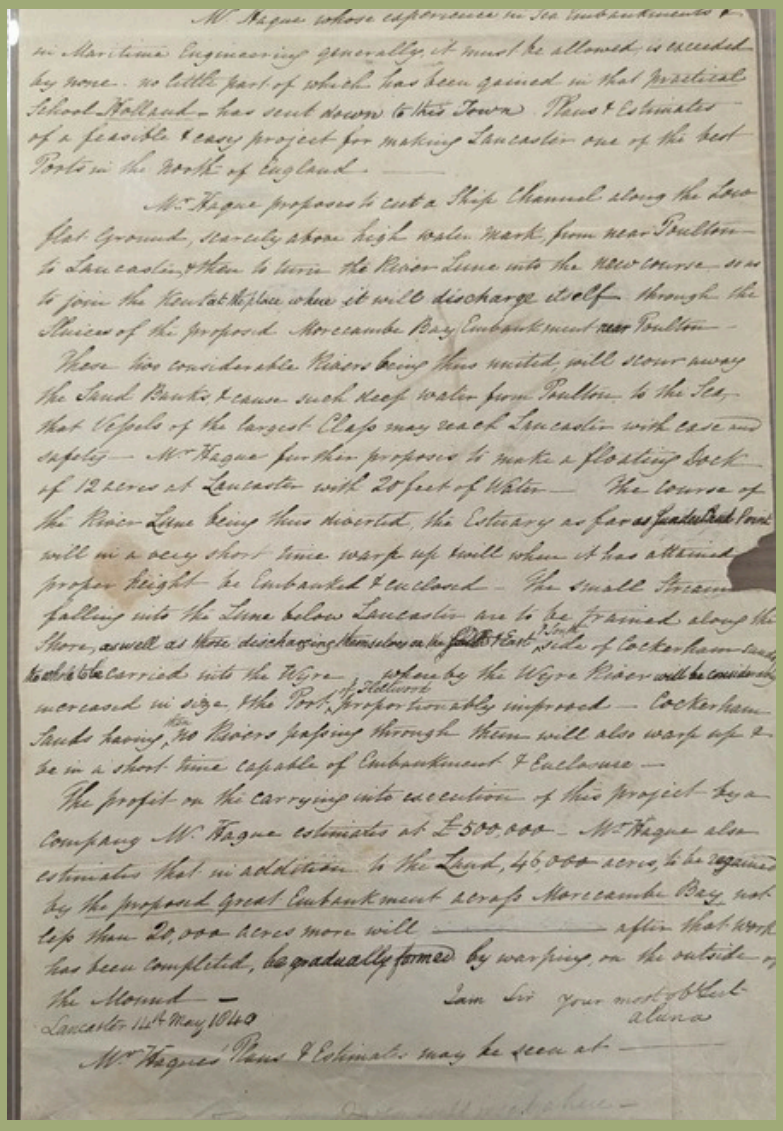


Fig. 24 West Cumberland and Morecambe Bay Enclosure, Mr Hague's plans, 1840. Lancashire Archive ServiceDDX2743/MS2887

While Hague's plan did not come to fruition, many smaller scale enclosures of the Lune's former flood plain were successful, before and after the building of the training walls.

We have already seen that parts of Lades Marsh were being enclosed at the time of the 1848 OS map, and were completed along the present line when the next map was published in 1893. Indeed, the works must have been complete by 1853 when Bazil Point landowner James Satterthwaite called a meeting to discuss the urgent need for the repair of the embankment to stop flooding of the land between Overton and Sunderland. The meeting also called for the construction of a new embankment, closer to the river, between Sunderland and Bazil Point, as shown in figure 25 (please note, the map was drawn with south east at the top).

It is unclear why this plan was not enacted. Discussions between land owners continued until at least 1870, surveyors were appointed for the purpose, and a plan was approved by the Admiralty. According to the Lancaster Observer, by 1897 the embankment was once again in a state of disrepair which had caused the flooding of 150 acres of arable land.

Prior to Stevenson's plans for training walls in the Lune, his scheme for deepening the river closer to Lancaster involved embanking marshland at Ovangle and Colloway. Although these marshes did expand rapidly in the late 19th century, they had only been partially enclosed by 1931.

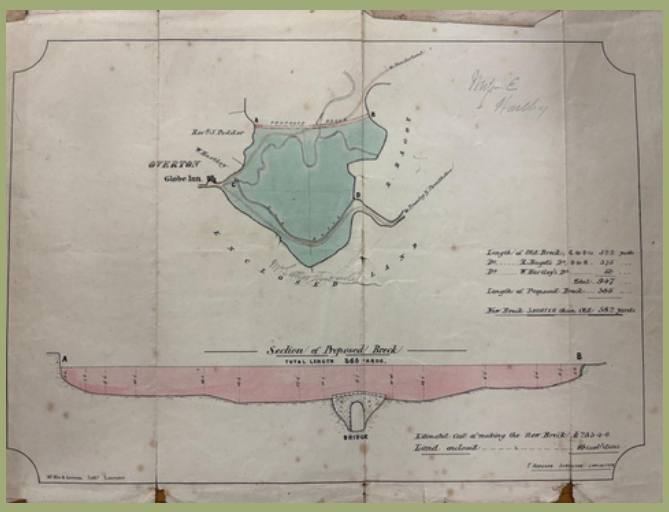


Fig. 25 Map showing proposed reclamation of Lades Marsh, c. 1853. Lancashire Archive Service DDX1947

CONTEMPLATED ENCLOSURE OF MARSH LANDS.

We understand that a government survey has been made of the marsh land lying between Knott-end and Cockersand Abbey, with a view to the reclamation of the same from the sea. It is said that the government have offered their rights to Colonel Wilson Patten on condition that he would make the necessary embankment, and this offer having been declined, it is probable that a company will be formed for the purpose of enclosing this marsh and adding several thousands of acres to the productive land of our country. We also learn that a similar survey has been made of the marsh lying between Bazil Point and Sunderland, with a view to its enclosure; and we feel certain that the accomplishment of this scheme, besides the improvement of the navigation of the river Lune, would prove a profitable speculation, more especially as there appears to be no doubt but the government would concede their rights upon very liberal terms.—*Lancaster Gazette.*

Fig. 26 Newspaper article discussing contemplated enclosure of marsh lands, 29th December 1860, Ulverston Mirror and Furness Reflector.

Fig, 27 Extract from Stevenson's depth survey of the River Lune from Lancaster to Glasson, 1838. Lancashire Archive Service NWW/1/2/4.

Some geological background

The roots of Sunderland Point's vulnerability to flooding go back thousands of years to the creation of the superficial (surface level) geology of the land northwest of the Lune. The map below (fig. 28) from the British Geological Survey shows how this process began with the melting of the glaciers which once covered northern Britain.

The blue areas of the map are deposits of glacial till, a mixture of soil and rocks that became trapped in the glacier and were left behind when it melted, these form most of the high points around Sunderland peninsula today, as well as the skears.

As the glacier melts we see two things happening. The first is that the water released from the ice makes its way into the rivers and seas, raising the water level and flooding areas that were once dry, including the valley that is now Morecambe Bay. The second is that, as there is no longer a heavy glacier on top of it, the land surface begins to rise, a process called isostatic rebound.

These two processes mostly happen very slowly, over thousands of years, but not always at a constant rate. When one occurs more quickly than the other we see a rise or drop in sea level relative to the land height. When the sea level rises quicker than the land all of the flat areas between the mounds of glacial till are flooded bringing in layers of marine clay and silt. When the relative sea level falls again this build up of layers is left behind and forms a new raised land surface, with the same characteristics as the tidal flats. This last occurred between 5000 and 6000 years ago, where it is suggested that the sea flooded up to 2km inland, and is what makes up the green area on figure 28.

In the middle of the Sunderland peninsula we also see a raised storm beach deposit, where gravel is thrown onto the beach by violent storms. The position of this gives us a very good indication of where the coastline was when the sea level was relatively higher.

Since then, the clay layers have kept the land waterlogged allowing peat bogs to form between Sunderland Point and Morecambe, represented in dark blue on figure 29 (below).

Pollen samples from these peats in Heysham Moss show that the vegetation changed from salt tolerant species to freshwater plants over time, mostly remaining freshwater after 4300 years ago. The bogs cycled between wetter and drier conditions several times until the end of the Roman period, after which they stayed wet until they were drained by humans in the 18th and 19th centuries.

Although the peat bogs will have had different plant communities and conditions to the saltmarshes, there would not have been a clear boundary between them, and changes to water levels in one would have affected the other.

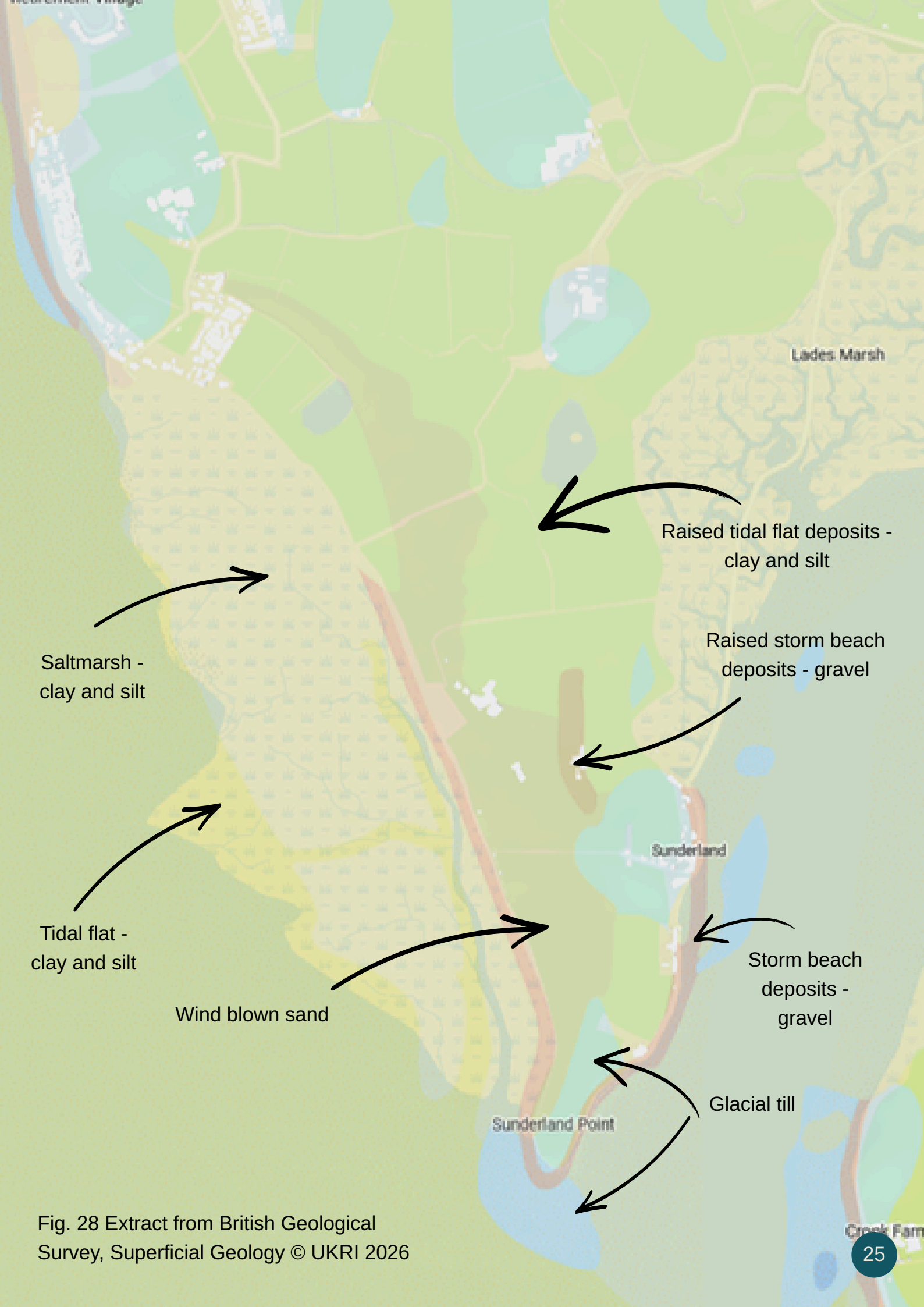


Fig. 28 Extract from British Geological Survey, Superficial Geology © UKRI 2026

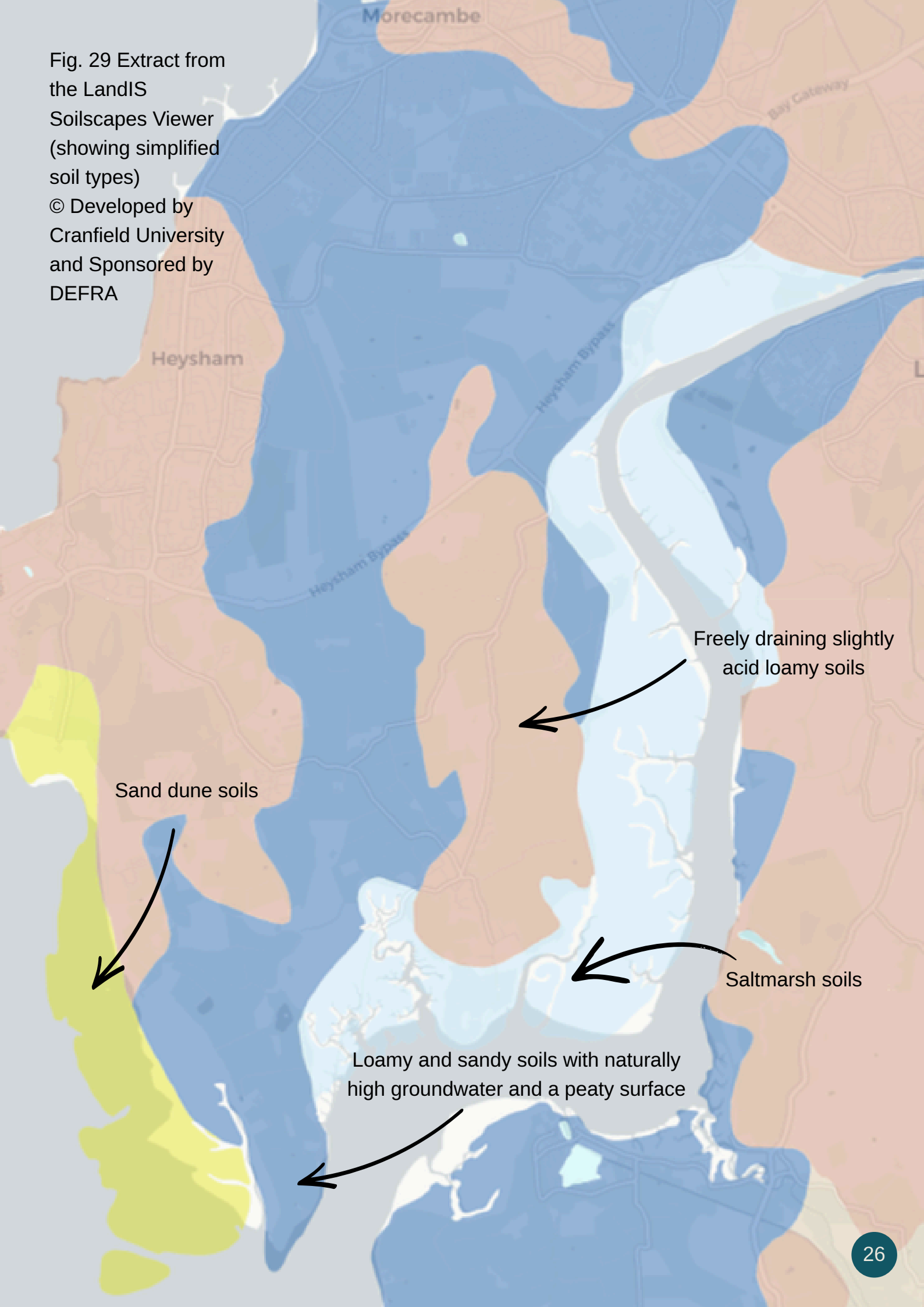


Fig. 29 Extract from the LandIS Soilscapes Viewer (showing simplified soil types)
© Developed by Cranfield University and Sponsored by DEFRA

Direct archival evidence of when parts of the Sunderland Peninsula and surrounding landscape were drained and enclosed is sadly lacking locally, but there can be no doubt that the process started before the 19th century.

The Wetlands of North Lancashire study in 1995 found a document stating that drainage works were taking place in nearby Poulton and Torrisholme Mosses in the late 18th century, although the document implies that much of the moss was already drained at this point. There are hints in the National Archive catalogue, to be followed up in future research, that suggest an early 17th or possibly even mid-16th century date for the drainage closer to Sunderland Point.

More concrete evidence of where these changes have been made can be seen in later sources. The 1844 Overton Tithe map (Fig. 30) marks drainage ditches in blue showing that, aside from the small glacial drumlins where towns and farms have been built, much of the land north of The Lane to Heysham was wetland before humans intervened.

Larger scale OS maps provide more clues in the form of place names. Carr Lane, Moss Lane, Trailholme, and Little Fylde (literally 'little field' but meant to convey its similarity to the heavily drained peatland around the river Wyre), all indicate a wet landscape. Even the name Sunderland suggests that the peninsula was more isolated than it is today.

It is not entirely clear which of these reclaimed lands were saltmarsh and which were moss. Indeed, Tudor land records make little distinction between saltmarsh, moss, and other types of pasture. The Tithe apportionment similarly groups together meadow with pasture, and marsh with sand. The positioning of the earlier embankment, from the top of Lades Pool, across to Trailholme, before turning southwest to West Shore, gives a good indication that the area behind it was subject to tidal inundation.

Fig. 30 Extract from the Overton Tithe Map, 1844, Lancashire Archive Service DRB/1/145

LiDAR surveys, a system where lasers are used to make a digital terrain map plotting tiny changes in ground height, can shed some light on this as they can show the sinuous paths of former saltmarsh channels. Figure 31 clearly shows the straight parallel lines of the land drains used to dry out the fields, alongside the remains of these old channels.

These patterns suggest that all but the very highest parts of Sunderland Point were once wetland and that sea level rise or failure of the embankments could make them so again.

Fig. 31 Extract from ESRI LiDAR DTM 50cm-1m, England. CC-BY National Library of Scotland

Erosion at Point End before the rock armour was installed. Courtesy of Lizzie Gilchrist.

Erosion

Since 1848 approximately 8,359 m2 of land, just over the area of a football pitch, has been lost from the end of Sunderland Point. As houses have not been directly affected by this loss it has not been prioritised for protection by external agencies. However, as well as being valuable farmland, it is possible that Point End provides a barrier to storm surges entering the estuary, and further losses could make the village more vulnerable to flooding.

Fig. 32 Extent of land loss shown on historic mapping overlain on Six-inch England and Wales, Lancashire Sheet 34, Surveyed: 1844 to 1845, Published: 1848 and Google Earth imagery CC-BY National Library of Scotland.

We have compared historic maps to estimate the amount of erosion that has occurred at different times in the past. Figure 32 shows the results of this. Unfortunately, maps are not available at regular intervals, so it is not possible to find an exact rate of erosion, but we can identify times when there has been more, or less, change.

Time period	Land lost in m2	Percentage of overall loss
1848-1890	3416	40%
1890-1910	2601	31%
1910-1971	407	4.8%
1971-present	1935	23%

Fig. 33 Erosion of Point End in 2010 before installation of rock armour. Courtesy of Katharine Green.

The data show a rapid rate of change in the mid 19th century, worsening from the 1890s into the early 20th century, when it slows considerably.

As we do not have any earlier accurate maps, there is no way to know whether this was an increase in erosion from previous centuries.

It is likely that the late 19th century erosion of the point was related to changes in the shape of Hall End Skear (see figs. 34 and 35). It is unclear whether the point and skear were both damaged by the large storm surges which caused flooding in the village, or whether human interference with the skear left the point vulnerable to wave action.

We know from newspaper articles and minutes of the Port Commission that shingle was being removed from the skear for a variety of reasons, including:

- clearing and straightening the channel for improved navigation
- collecting ballast for ships
- raking for mussels
- repairing the roads

An article in the Globe newspaper in May 1903 blames the loss of half an acre of land that year on these removals, and suggests the practice ought to be banned.

Hall End Skear is not the only one that suffers during this period. The 1848 map shows an almost unbroken line of shingle and mussels between Pinnacle Skear and Point End, which recent studies show would likely slow wave action. By 1890, the skears have shrunk dramatically leaving large gaps between them.

Fig. 34 Ordnance Survey, Six-inch England and Wales, Lancashire Sheet 34, Surveyed: 1844 to 1845, Published: 1848 CC-BY National Library of Scotland

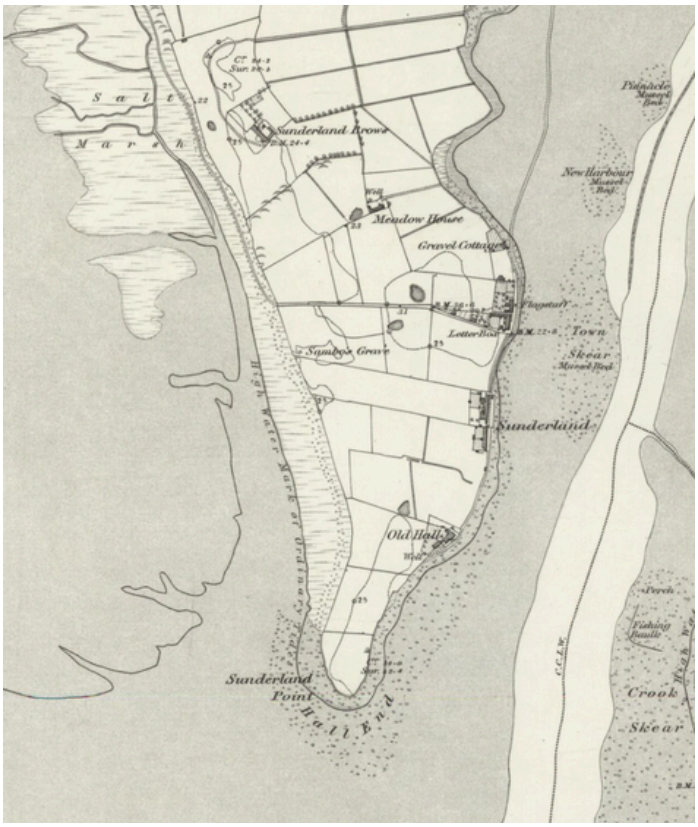


Fig. 35 OS England & Wales, Six inch, Lancashire Sheet XXXIV, Surveyed: 1890, Published: 1895 CC-BY National Library of Scotland

Fig. 36 National Grid Map SD4255-SD4355 - AA Revised: 1970, Published: 1971 CC-BY National Library of Scotland

Between 1910 and 1971 the rate of erosion at Point End was much reduced. Strangely, the 1954 OS 1:25,000 map and the 1968 2nd Land Utilisation Survey both show that Point End was slightly larger than the earlier map. This is likely, however, to be an issue of scale and reuse of earlier maps. These maps were also at least partially drawn using RAF aerial photos, which will have affected the accuracy levels compared to earlier mapping.

Fig. 37 Air photo of Sunderland Point taken by RAF as part of Operation Revue, 1948. Lancashire County Council

During this period, we see increasing numbers of sea walls and embankments constructed around the point, giving it some level of protection. Only one major flood was reported and few minor floods, which seems to have been due to a calmer period of weather rather than effectiveness of the defences. Interestingly, 1971 is when groynes first appear on the map around Point End, although we see references to ‘stakes’ for trapping sediment around the point much earlier than this.

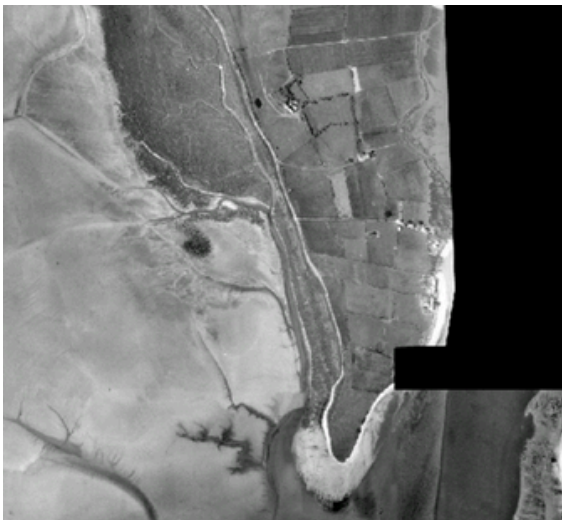


Fig. 38 Air photo of Sunderland Point commissioned by Lancashire County Council 1963-1968

After 1971 erosion increased again, dramatically. Records show an increase in the number of floods, particularly major storm surges. At this time we also see Hall End Skear shrink again. The south eastern spur disappears, along with much of the shingle in front of Old Hall. The strip around Point End becomes narrower, rounding into the shape we see today.

Further up the peninsula, erosion has not had such a lasting effect. While there are reports of strips of land being washed away in storms on the west shore, these have largely been reclaimed with the rebuilding of a sea defence, and in some places land has been taken in from the marsh.

Flooding

Flooding is a constant concern for the residents of Sunderland Point, and records show that this has been the case since at least 1849.

The following pages summarise what we know of the conditions that led to these floods and how they affected Sunderland Point. These data have been collected from newspaper articles, personal letters, and local memories.

There is a great deal of variation in the amount of information available about each flood. Tide and weather data are not often available at a local level and newspaper reports do not always give the detail we would like, particularly for minor floods.

Fig. 39 Photograph of the aftermath of the flooding of 21-23 Second Terrace in 1907. Note that the area in front of the houses was grass before the flood. Gilchrist Collection.

We have classified these floods as either major or minor depending on the amount of damage done to properties. Although improvements in the flood defences at Sunderland Point makes it difficult to make direct comparisons this way, it is still a useful guideline. Floods have been classed as major if they have entered and caused damage to buildings. Minor floods may have submerged fields or gardens and eroded land but not affected houses.

Fig. 40 Image from a newspaper article showing some of the damage of the 1977 flood. The Visitor, Flood of 1977 : Courtesy of Guardian Newspapers via sunderlandpoint.net

Flooding

Year	Extent of flooding	Damage levels	Conditions
17th Jan 1849	Submerging lower part of Lancaster to depth of several feet. Recently erected sea wall swept away, carrying off 30 tons of stone. Damage more extensive on west shore, all sea walls suffered, one entirely gone, and strip of land 500 yards long and 2 wide swept away.	Minor	Strong westerly gales. Unusually high tide
27 Dec 1852	Roads inaccessible, road to Middleton “axle-tree deep in water”. Embankment washed away, water flowed to Heysham Mosses. 1st Terrace, ten yards of rampart washed down to foundation. Lower floors of houses around the Ship flooded. Road leading from Ship Inn to hotel & wall rising above it nearly destroyed, allowing tide to enter fields never previously flooded. Old rampart in front of hotel washed up. 2nd Terrace considerably damaged. Wall around field of Sambo’s grave washed away as well as 4-10ft of land, all along the coast. Similar storm never experienced before	Major	Gale, almost a hurricane, from the south west, in conjunction with high tide. Two days short of high spring tide. Tide expected to be 16ft arrived 2 hours early
1870s	No data	Major	No data
Nov 1881	Waves dashed over the Point. 25 feet high. Road between two terraces completely washed away. Tide washed through Sunderland Hall.	Major	Storm. Waves 25ft high.
Sep 1890	No data	Major	No data
1899	No data	Major	No data
1902	Washed onto terrace but did no damage.	None	Rough high tide

Flooding

Year	Extent of flooding	Damage levels	Conditions
16 March 1907	Properties on east shore inundated and much damaged. Belongings washed out onto the green on 2nd Terrace. Sunderland Peninsula 'obliterated'. 'Worst havoc for fifty years'. Walls along west shore down.	Major	Heavy rains raised river level, 22ft 7in spring tide, 80mph south west gale which raised the tide to about 29ft. River burst banks
1927	Storm surge on both east and west side. Properties inundated. Land flooded. Western sea wall demolished & blocks thrown 30ft.	Major	Storm, wind speeds almost 80mph recorded in Ireland. Spring tides reaching highest.
Jan 1934	Hole washed into the green, at the far end near the pump. Several yards of the sea wall gone. Washed out posts. Post Office flooded. A foot of water in surrounding fields, but drained quickly.	Minor	Gale
Sep 1934	Well at Old Hall flooded. Some damage done around the Point, washing out many stakes. Houses not flooded as wind changed direction earlier in day.	Minor	Westerly wind. High tide
1952	No data	Minor	No data
11th or 15th November 1977	Homes on terraces filled with mud and stones. Walls towards the Point End washed away. Field walls destroyed. Floods from east and west met. High ground behind 2nd Terrace covered in debris.	Major	Storm surge, tide 7.3m above normal. Southerly wind at Force 10, gusting to Force 12. 92mph wind.
1983	No data	Major	No data

Flooding

Year	Extent of flooding	Damage levels	Conditions
1990	No data	Minor	No data
1993	Other areas flooded locally, property level flood defences worked. Some minor damage.	Minor	Northwesterly winds. Gusts 50-70km across west coast, tide at Liverpool 6.22m.
1997	No data	Minor	No data
2005	No data	Major	No data
2013	Damage minimal due to improved flood defences, but conditions worse than previous storms. Water covering all land fronting the river.	Major	Storm surge of 1.25m chart height of over 11m.
2014	No data	Minor	No data
2020	Sea came onto the terraces.	Major	No data

The available records give details of 22 major floods between 1849 and 2020, and eight minor floods. The majority of major floods have occurred when a high spring tide coincides with strong south westerly winds.

Details of minor floods are limited but damage has been less severe when winds blow from other directions or when storms occur outside of the highest spring tides.

Records also show that since the 1990s, although storm conditions have not lessened, property level defences have significantly reduced damage to buildings.

Fig. 41 Photograph of flood water on First Terrace around 1898. Lancashire County Council Red Rose Collection

Options for Nature Based Solutions

Saltmarsh

West Shore

The saltmarsh here has seen almost constant growth since 1848, although there has been some recent shrinkage around the main channels. The size of marsh makes it a good defence as long as it does not continue to degrade. There is potential for the marsh to grow further across sand bank but this is the place it is most likely to do so without intervention. The most helpful approach here is likely to be small scale repair around the major channels and after big floods.

Fig. 42 Aerial image of Sunderland Point, West Shore in foreground, 2018 © Northwest Regional Coastal Monitoring Programme

Fig. 43 Postcard showing the tidal road in the midst of Lades Marsh c.1930. Height of the saltmarsh much lower than today. Lancashire County Council Red Rose Collection NLA29012009001

Lades Marsh

The saltmarsh here is reasonably stable at present. Some horizontal erosion is occurring and this is most likely caused by tide reflection as the estuary turns, and deterioration of training wall. Repair of the training wall could help to restore marsh, however, this is not sustainable long term and may have adverse impacts by narrowing the channel and increasing storm surges.

A better option here may be for managed realignment of Overton Embankment, flooding some of the former marshland around the top of the peninsula to reinstate some of the flood plain. This would have to be monitored closely given how much of the area west of Lancaster is former marshland as it might push the issue onto Overton and Middleton.

East Shore

Evidence for saltmarsh on the east shore of Sunderland Point in the distant past is extremely limited. The fast current and rocky skears may have been unsuitable for marsh growth.

Despite this, small patches of vegetation are visible in photographs of both terraces from the early 20th century onwards. In recent years, saltmarsh has been much more extensive in the bays in front of Old Hall and between the terraces.

It is possible that the gaps left by the erosion of the skears allowed sediment to build up in the calmer weather of the 1960s, forming a sheltered area for marsh species to thrive.

These areas have been badly damaged by the storms of the 2000s and 2010s but could be encouraged to spread given some protection from the current.

Fig. 44 Photograph looking south along the wall at First Terrace, showing grass growing in the shingle, 2024. Courtesy of Katharine Green.

Fig. 45 Photograph looking south across the bay between the terraces, 2023. Courtesy of Katharine Green

Fig. 46 Photograph looking south from Old Hall showing much more saltmarsh than today, late 1990s/early 2000s. Courtesy of Katharine Green.

Structures

Encouraging new saltmarsh growth around Sunderland Point will likely require barriers to protect it from being washed away.

Wooden groynes and stakes have been used around the point in the past to reduce movement of sediment along the shore. Records show that these were frequently washed away by storm surges. Anchoring barriers into the muds and shingle of the beach is a difficult task.

One option may be to take inspiration from the fishing community which made its home here for generations. Before the practice was banned in the 19th century, salmon were caught using fixed fishing baulks (see fig. 47). A line of stakes was set in a low stone wall, and willow withies were woven between them to trap fish.

Fig. 47 Photograph of fishing baulk at ‘new’ Plover Scar lighthouse. Undated, post 1847, pre 20th century. Courtesy of Lizzie Gilchrist.

A similar method was used on Lades Marsh in 1957. A ‘brushwood retard’ was installed in an attempt to regenerate the turf cut from the marsh to cover the newly repaired embankment. The marsh had regenerated rapidly by 1960, but the Port Commissioners were concerned that growth would slow before it could fully recover.

Another form of barrier being used to reduce coastal flooding around the world are biogenic reefs, or shellfish beds.

Fig. 48 Mussel Picking, a watercolour by William Page Atkinson Wells, circa 1908. Courtesy of Lizzie Gilchrist.

Pollution and over fishing has catastrophically damaged the mussel beds which once surrounded Sunderland Point. Traditionally in Morecambe Bay, mussel colonies were regenerated by relaying young mussels on depleted beds. Elsewhere in the world, shellfish have been encouraged by returning empty shells to the reef, providing a hard surface to grow on. These techniques could be used to revive the skears around the point if pollution was reduced sufficiently.

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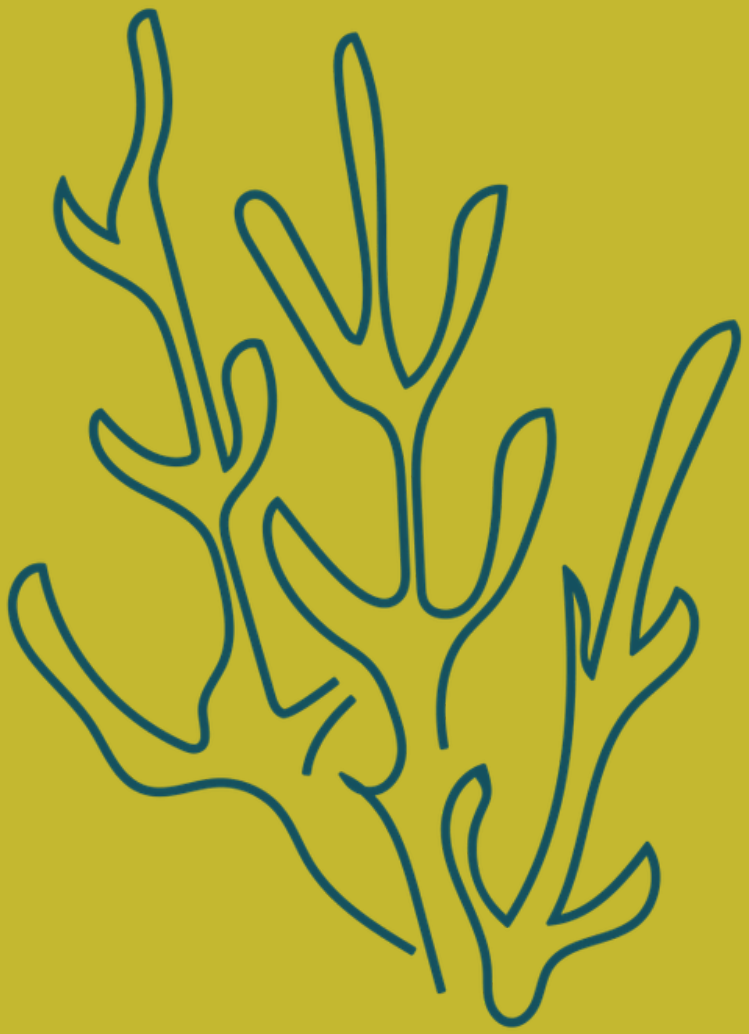
Our Future Coast



Our Future Coast is collaborating with communities and stakeholders around the North West to work with nature to safeguard coastal communities.

This project is part of the DEFRA funded Flood & Coastal Resilience Innovation Programme, which is funding 25 national projects to build resilience to climate challenges like flooding and erosion through practical innovations.

The Our Future Cost project is focussing on two key innovations, community engagement and nature-based solutions, sustainable and natural alternatives to traditional hard engineered defence structures.

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www.thefloodhub.co.uk/ourfuturecoast

OUR FUTURE COAST

Morecambe Bay Partnership

Department for Environment Food & Rural Affairs

Environment Agency

Flood and coastal resilience innovation programme

Part of the £200m Flood and coastal innovation programmes