Promoting adaptation to changing coasts

T2.2.1 Socioeconomic Framework

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Contents

Foreword

The Promoting Adaptation to Changing Coasts (PACCo) project is cross-border initiative which is financially supported by the INTERREG VA France (Channel) England project co-financed by the European Regional Development Fund.

The broad aim of PACCo is to demonstrate that it is possible to work with stakeholders in estuarine regions to deliver a range of benefits for people and the environment by adapting pre-emptively to climate change. It has a total value of €26m, with €17.8m coming from the European Regional Development Fund (ERDF).

The project focuses on two pilot sites: the lower Otter Valley, East Devon, England and the Saâne Valley in Normandy, France.

For more information see: [Promoting Adaptation to Changing Coasts (pacco-interreg.com)]

Acknowledgements

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1. Introduction

1.1 PACCo

Promoting Adaptation to Changing Coasts (PACCo) is a cross-border initiative, led by the Environment Agency and financially supported by the Interreg V A France (Channel) England programme. The goal of PACCo is to demonstrate that it is possible to work with stakeholders in coastal and estuarine zones to deliver a range of benefits for people and the environment by adapting early to climate change. The project focuses on two pilot sites: the lower Otter Valley, East Devon, England and the Saâne Valley in Normandy, France. The ecological functionality of these two estuarine locations is currently negatively impacted by historical human modifications, with their current societal value threatened by climate change. Together they present an opportunity to create a transferable model for sustainable management of coastal and estuarine areas that can be used by other projects and show how multiple problems can be addressed to create multiple benefits.

1.2 Introduction to the Framework

Using the two PACCo sites as case studies, this framework will document how socioeconomic benefits can be realised by creating new rare intertidal habitat, improving ecosystem services, managing threats to the environment and human health, and adapting existing public facilities and infrastructure to the impacts of climate change. It will do so by setting the two project sites in their historical context and by examining the case studies and stories that have emerged over the course of the project. It will compare and contrast the challenges of delivering adaptation at each site and draw out lessons for consideration by other sites.

In line with the project proposal, the framework will focus in particular on the existing facilities and infrastructure that will need to be relocated, realigned, recreated or adapted. These include relocating a campsite at the Saâne and a cricket club at the Otter; creating new car parking facilities; realigning footpaths (including new bridges) and modification of historic flood embankments; creating new recreational facilities (bird hides, viewing platforms, fishing spots); creating a new waste water treatment plant in the Saâne Valley; protecting a tip from future erosion in the lower Otter; and improvements to two roads to maintain access to businesses and recreational facilities (one at each site).

Using the two sites as case studies, this framework will examine the history of the modifications, the evolution of the problems caused by these modifications, and finally the socioeconomic solutions and benefits that the project will bring. Following this structure, three key areas will be examined where the project will show a change in socioeconomic value over time: the estuaries as transport and trading routes; the importance of the two estuaries for agriculture and food production (including fishing); and leisure and living (including tourism and wellbeing). Environment and climate change will run as a cross-cutting theme throughout.

1.3 What is this framework for?

The objective of this framework is to help other coastal communities assess socioeconomic risk related to infrastructure and climate change and how this can be reduced by learning from the adaptation experiences of others. This includes improving understanding of how histories of estuary management and infrastructure development can make estuaries more vulnerable to climate change and how adaptation is possible. Focussing specifically on infrastructure, this framework acts as a guide to share examples and findings from two managed realignment pilot sites.

1.4 Who is this framework for?

This framework is for coastal communities - particularly those associated with estuaries - who are looking for case studies and evidence of projects that have planned to deliver sustainable socioeconomic uses of estuaries through early adaptation to climate change.

1.5 How to use this framework

The framework has been split into sections that address the key infrastructure elements likely to be present in historically modified estuarine areas: transport (road, rail etc.); food production (farming, fishing etc.), and public access and services for the local population (leisure amenities, practical services e.g., the tip, the wastewater treatment facility etc.).

The Table of Contents has hyperlinks to relevant sections of the document and will allow you to navigate to the areas that are most relevant to your site. The framework provides details of actions taken at each site regarding these infrastructure elements, and outlines the associated processes and related costs where possible.

For specific project risks and solutions related to physical delivery, more detail can be found in PACCo Deliverable T1.1.1 and T1.1.2.

For a specific case study and evidence on the tip present in the lower Otter valley, more detail can be found under PACCo Deliverable T1.4.1, “Tip Case Study” by Ben Fouqué.

2. The sites

2.1 Introduction to the lower Otter

The lower Otter valley is heavily modified with several flood embankments, a road, a disused municipal tip, a cricket club, an aqueduct and an old railway line all artificial structures occurring within the floodplain. These impede the ability for flood water to ebb and flow and reduce habitat quality and biodiversity. The River Otter itself is also disconnected from its floodplain, following the installation of embankments in the early 1800s and the concurrent straightening of the river channel. Current climate scenarios predict a rise in sea level (currently 1.5mm/year) of up to 640mm by 2110 and increasing storminess with flood flows in the river becoming more frequent.[1] This is causing more frequent over-topping and erosion of the structures within the floodplain which are becoming ever more difficult and expensive to maintain as a result. The flood embankment is also likely to fail entirely in the near future. In 2018, for example, it was within one tidal cycle of breaching catastrophically and it was only due to rapid and two expensive public agency interventions that it was repaired. The footpath that runs along the top of the embankment has a high socioeconomic value supporting 250,000 visits annually. This was closed for six months at this time as a result.

[1] https://sealevel.nasa.gov/ipcc-ar6-sea-level-projection-tool

2.2 Introduction to the Saâne Valley

The Saâne is a coastal river in Seine-Maritime, measuring 34 km in length and situated to the west of Dieppe. As with many of the coastal rivers in Normandy, its outlet to the sea consists of a drainage pipe and a valve. The Saâne's old estuary is disconnected from the sea by a dyke-road that runs along the coastline, connecting Dieppe with the Pays de Caux. Beginning in the 16th Century, the Saâne estuary has undergone a number of dramatic modifications. Prior to this period, the Saâne flowed into a brackish marsh, separated from the sea by a pebble beach.

The first works on record were undertaken for military purposes between 1560 and 1768, with the aim of frustrating English attempts at invasion. During the 18th Century, a network of drainage dykes was built in an effort to promote agriculture in the lower valley. In 1864, the Saâne Estuary's first wooden drainage pipe was installed. Its purpose was to facilitate water drainage and limit the impact of sea water on agricultural land and associated infrastructure. In addition, the valley began to welcome its first recreational bathers as early as 1856. Between 1963 and 1973, the Quiberville campsite was built. Situated alongside the Saâne and behind the dyke-road it has allowed the development of local activities important for the local economy such as fishing, restaurant services and water sports.

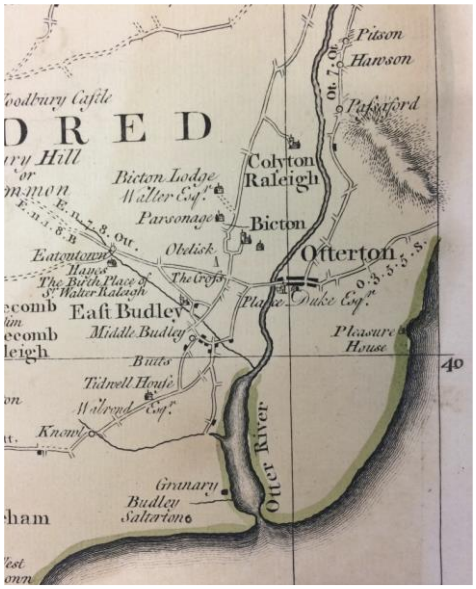
This area is subject to several risks: coastal erosion, river flooding and coastal flooding. Past agricultural practices, such as the conversion of pastureland to cropland, has exacerbated the effects of flooding by increasing erosion and runoff of rainwater laden with mud and silt. These changes have had negative impacts on water quality and soil fertility. Furthermore, the development of local tourism and the increasing attraction of the Cauchois coastline have also brought about changes to land use, with increasing modification of land and waterproofing of surfaces impacting on natural water flow and drainage. All of these factors worsen the effects of flooding. In recent years notable river floods have been recorded in January 1995, December 1999 (the most extensive ever recorded) and May 2000, as well as a coastal flood in 1977. The area is vulnerable, and the effects of climate change serve only to accentuate this situation, as demonstrated by Storm Eleanor in January 2018.

3. Transport & Trade

Both sites have been subject to modifications to support transport and trade for hundreds of years. Key changes that have affected the socioeconomic fabric of the area are included below, alongside those that are now impacting the site because of climate change and related sea-level rise.

3.1 Lower otter valley

3.1.1 The history of the modifications



From the 1400s, wharfs, docks and quays lined the river, with trade occurring up to Otterton 3.5 km upstream from the estuary mouth. Granary, Bankley and Kersbrook Quays served the settlement of East Budleigh, which was as an important settlement alongside Otterton at this time. Otterton itself would have been the main trading hub during this period for goods such a salt (a key preservative in food). Also important in the area were coal (or culm) and limestone that were needed to make lime for agriculture, and the export of wool. Otterton Mill (at the northern end of the project site) was used for grinding corn.

B12 Donn's Map 1765 of Exe Estuary

The river was particularly important for trade during this period as, prior to the 1800s, the notorious Devon mud and lack of roads meant access to the area by road was difficult. Roads were improved during the early 1800s in line with the national trend. This would have included the building of South Farm Road, which lies across the floodplain, providing access to South Farm, and the homes and businesses that remain there to this day.

The other major significant structure to be built at this time was the flood embankment (more on this here), which separated the river from its natural floodplain and made possible the creation of a railway as well as the draining of land for agriculture. The railway line was first built in 1888 along the western edge of the valley, with improvements made in 1933 to facilitate greater mobility for the local populations and the growing tourism industry. After it stopped being a working railway in 1967 it became a private farm track for moving dairy cows. It was also hoped that the straightened (or 'canalised') river would improve access and navigability up and down the river for trade although these intended benefits never really materialised.

Land infrastructure became increasingly important after the natural growth of the shingle bar at the mouth of the Otter estuary from the mid-1400s, with the silting up of the river and shallowing of the channel also reducing the importance of water transport. This silting

was progressive from the Middle Ages and was the same across the whole country; boats gradually grew larger too and needed deeper waters to navigate.

3.1.2 The evolution of the problems

The old railway line restricts natural processes and impedes water flow at the more northern end of the site in times of fluvial (river) flooding. Typically, water is trapped behind the railway line as it flows downstream with only a few culverts allowing water to pass underneath it.

Problems associated with the building of the embankments can be found under the Agriculture and Food Production section.

South Farm Road runs at right angles across the valley. This represents an additional obstruction impacting on the ability of the floodplain to function. It is also negatively impacted in the event of flooding. Severe and more frequent flooding events in recent years (notably, 2013, 2018 and 2021) have caused the road to become impassable days. Most years the road is impassable on some days for at least a few hours after heavy flooding. This restricts access to South Farm and the homes and businesses that lie on the eastern side of the river valley.

3.1.3 The solutions and benefits

As part of PACCo, South Farm Road will be raised so it will no longer be at threat from fluvial or tidal flooding. This will allow year-round access to South Farm with businesses on the eastern side of the valley future-proofed against increasingly extreme weather events and rising sea levels due to climate change. A 30m road bridge will be created on the western side of the floodplain so that fluvial and tidal food waters will be able to pass naturally up and down the valley. The planned improvements for South Farm Road will be the biggest impact on transport in the area, particularly for businesses and visitors on the eastern side of the valley. These include South Farm, businesses in units at South Farm Court, as well as residential properties. The raising of the road also safeguards a national cycle route (National Cycle Network Route 2), with a new dedicated pathway separated from traffic also improving access for pedestrians.

A new car park will also be built at the western end of South Farm Road to create formalised parking in the local area. This will provide better quality flood-proof parking than the informal previous offer where cars had to use verges within the floodplain or encroach within the boundaries of the Otter Estuary SSSI. There will also be disabled spaces and bicycle racks to ensure equality of access.

3.2 Saâne Valley

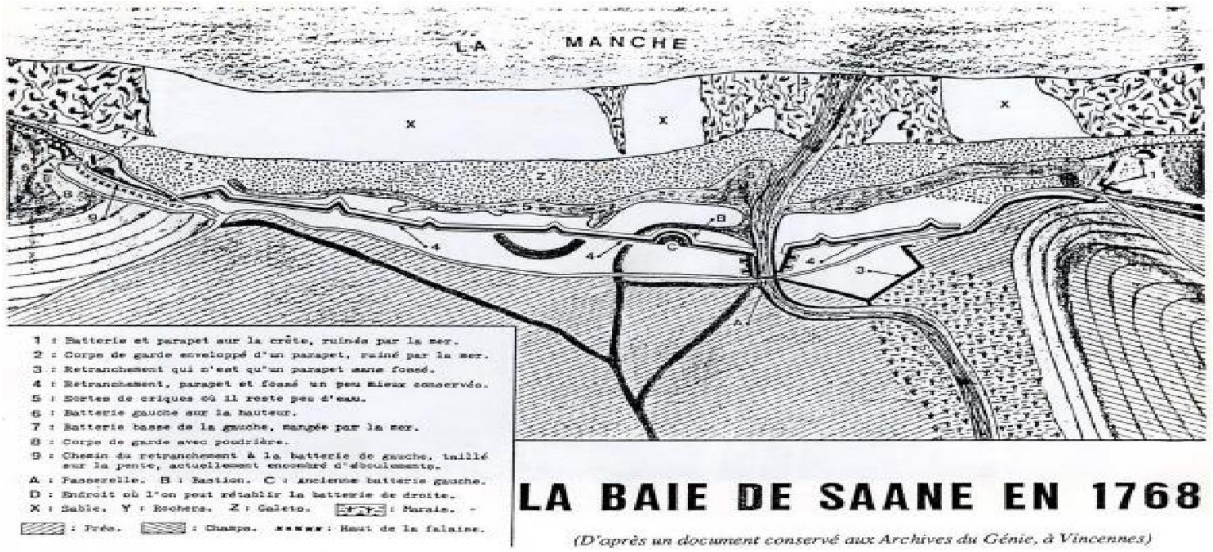
3.2.1 The history of the modifications

The lower Saâne valley has undergone numerous developments over the centuries. The oldest signs of settlement date back to around 58-50 BCE, with evidence of a Gallo-Roman villa on the hills above Sainte-Marguerite-sur-Mer (La Butte de Nolent). In the Middle Ages, archaeological evidence suggests that there was some maritime activity and a small fishing port in Longueil as demonstrated by *la route de la pescherie*. Various written artefacts mention "the port of Longueil" and the tithe of 3,300 fresh herring to be given by the fishermen of Longueil to the Abbey of Longueville. There is no doubt that there was a port in Quiberville in Medieval times. It was the "port to the Saâne" located in this coastal river's estuary area and accessed via "le chemin du Petit Port" [Little Port Lane]. It is difficult to locate exactly where the old port was. We imagine that the boats were dotted along the estuary up as far as Longueil, taking advantage of the flooding and ebbing of the tide. Current street names have clearly drawn upon the history of the area.[2] At that time, the lower valley was an estuary, with the sea reaching Ouville-la-Rivière (5km upstream) at high tide. The Saâne flowed into a salt marsh which was separated from the sea by a pebbled strip of beach. The mouth of the Saâne was located 70m upstream from its current path. In the Saâne valley, over 50 mills were constructed along the waterway over the centuries since it offered sufficient hydraulic power and a consistent flow rate.

In 1477, the governor of Dieppe, Mr De Manneville, ordered that salt pans be created to harvest this very precious commodity – France had a salt tax (la gabelle) at the time. The course of the river through the lower valley was then deliberately altered, adding a number of meanders and shallow evaporation pools to capture and retain the sea salt. So, some of the meanders in the lower Saâne are actually man-made! Although there has been an artificial reduction of the estuary mouth, the estuary has not been entirely cut off from the sea. Sea water still reaches as far as Longueil during high tides. However, the estuary has been very much scaled back, as illustrated by the 1560 farm rents paid to Nicolas Duschene, a farm-owner in the Longueil fisheries. Duschene was compensated after the Saâne harbour was blocked by order of the Duke of Bouillon, governor of Normandy, who feared an attack from the English.[3]

[2] Extract from "Account of the lower Saâne valley site" – Victor Theet – Agence de l'Eau Seine-Normandie, July 2022

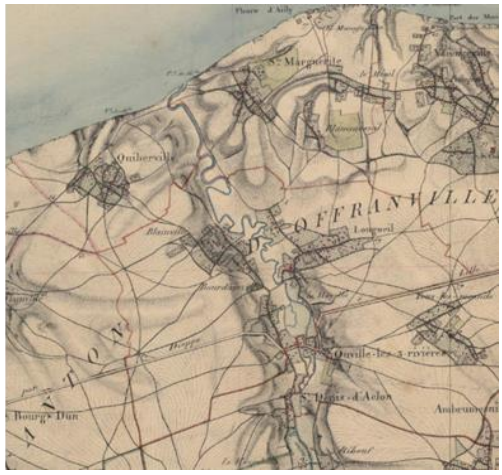
[3] Extract from "Account of the lower Saâne valley site" – Victor Theet – Agence de l'Eau Seine-Normandie, July 2022



Map of the Saâne's access to the sea in 1768. (Source: AREA-SOGREAH, 2008)

It was only during the 16th century that the Saâne estuary underwent radical changes. Until that time, the mouth of the river was open which allowed it to advance and retreat with the ebbs and flows of the tide. Initial modifications to the estuary, carried out between 1560 and 1798, were military in nature in order to combat possible invasions by the English. At that time, both sides of the river had a guardhouse and an artillery battery with two cannons (Cassini map 1756-1789).

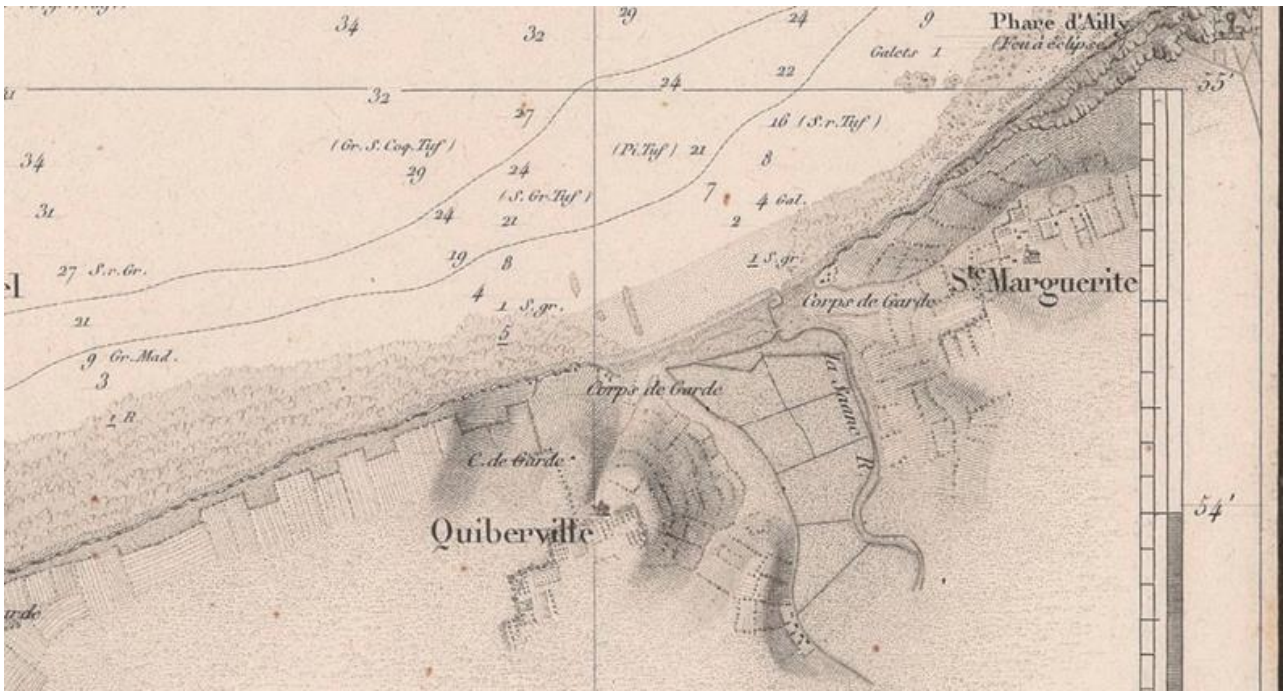
Cassini map



Ordnance survey map (1820-1866)

During the 18th century, the main focus of human activity related to the Saâne estuary shifted from military to agricultural. The site was modified with a system of dykes to promote agricultural development. Behind these dykes, marshes were drained and replaced by pastures. Adaptations were again made in the 18th century, likely during the time of the Seven Years' War (1756-1763). There is evidence of several initiatives to try to regulate rising sea levels. The sea-front dyke was built at this time which protects the

coastal road. There was also a transverse dyke put in and other digging to allow water to run off to the sea.[4]



Map of the lower Saâne valley by Charles-François Beauchamps-Beaupré 1834

In 1864, the first culvert pipe in the Saâne estuary was built from wood. This construction concluded works to improve the agricultural land by making it easier to drain, limit the impact of sea water on the farmland and, according to the received wisdom at the time, combat malarial fever. The installation of the culvert pipe was accompanied by new drainage work. The first measures implemented by the monarchy in 1768 ordered drainage work to be carried out, encouraged by tax exemptions for drained land. In 1793, the National Convention ordered the draining of all the country's wetlands to combat the ravages of malaria that remained a scourge until the end of the 19th century, since the origin of this disease was still unknown at the time (several texts from that period

[4] Extract from “Account of the lower Saâne valley site” – Victor Theet – Agence de l’Eau Seine-Normandie, July 2022

reference these epidemics). From that period, the site began to resemble the one we know today and the lower valley lost the features characteristic of an estuary.

With the industrial revolution and the boom in popularity of sea bathing, Quiberville welcomed its first bathers in 1856. This new trend of sea bathing brought about developments on the seafront and gave rise to new road infrastructure to improve access for visitors. A road was built connecting Quiberville and Sainte-Marguerite-sur-Mer. On the beach, initial developments involved the installation of rudimentary groynes. Between 1912 and 1947, a railway line was constructed along the entire Saâne valley to the station at Ouville-la-Rivière, connecting it to the main networks (Rouen to Le Havre and Dieppe Fécamp). In 1914, the current rock armour was put in place and new groynes were also built. Altogether, 14 transverse groynes were built after the construction of the first culvert pipe in 1864 in order to strengthen the seawall.

The introduction of paid holidays and its proximity to the Paris region made the Normandy coast extremely attractive to holidaymakers. The lower Saâne valley underwent a transformation in the post-war years (1950-1960). In 1955, the current concrete culvert pipe was installed after the previous one was partially destroyed by a storm in 1953. At a length of 52m, it discharges the river water onto the foreshore around 50m from the seawall. Two years later in 1957, the seawall and causeway were restored based on the initial seawall and causeway built in 1920. At a length of 700m, it was built along the beach to protect the valley from risks of sea intrusion and flooding and to connect Dieppe with the Pays de Caux by following the coastline on the departmental road 75.

In 2008, the flap valve was removed due to a fault. It has never been reinstated. Though not the result of any political or environmental initiative, removing the valve has brought about a moderate return of sea water to the waterways and the lower valley during high tides.[5]

Shops

With the arrival of tourists to the valley, especially during the high season, various businesses, mainly restaurants, have opened up along the seafront. In the winter and during the low season, most restaurants remain closed. The overwhelming majority of shops and businesses are based in Quiberville and Sainte-Marguerite-sur-Mer. A local shop is open all year round in Quiberville, with longer opening hours in the summer.

[5] Extract from “Account of the lower Saâne valley site” – Victor Theet – Agence de l’Eau Seine-Normandie, July 2022

3.2.2 The evolution of the problems

The lower Saâne valley is unusual in that it is not directly connected to the sea. The seafront is made up of a seawall and causeway, meaning the outlet of the river is restricted by a culvert pipe.

Various developments have worsened the problem of flooding in the lower valley. Indeed, the layout of the coastline (a seawall and causeway enclosed between higher land on both sides) and the outlet of the Saâne (narrow culvert pipe) have accentuated the impact of these problems by making it harder to drain water away and worsening periods of flooding, both in terms of duration and height. When water levels are high, the flow rate of the Saâne can reach 30m3/s, while the maximum flow rate of the culvert pipe is only 10m3/s.

However, the culvert pipe has caused problems ever since it was installed. It needs to be clear of debris in order to function correctly, but the longshore drift causes pebbles to build up. These pebbles have to be removed on a regular basis. There have been a number of problems and the culvert pipe has quickly become worn. It has been a Sisyphean task to keep it working. Further building works to fit spurs to reduce the problem of blockages were carried out in 1887, 1889, 1914 and 1924. They were designed to tackle longshore drift, which often causes the beach to be filled with pebbles and this creates accretion upstream and erosion downstream.[6]

Some key elements of the local economy are located at the foot of the seawall, including the Quiberville municipal campsite and the fishermen's point of sale. This point of sale is only 5 metres above sea level and is regularly flooded during storms. In recent history, the lower Saâne valley has seen numerous episodes of flooding: in January 1995, December 1999 and May 2000, coastal flooding in 1977 and more recently, storm Eleanor in January 2018.

Inland, the lower Saâne valley has to combat problems of run-off from farmland into the waterway. The road network, which has often been constructed in the direction of the slope, concentrates and channels the run-off from surrounding fields, including the road through the valley that follows the direction of the slope (the road from Quiberville to departmental road 127 near the future tourist site). This problem of run-off leads to flooding, especially in the areas at the base of the slopes where the main roads are located. During periods of flooding or heavy rain, the road connecting Quiberville to Longueil is impassable to traffic.

Shops

Tourism is the leading economic sector in the valley and infrastructure in the area depends on outside visitors. The closure of beaches due to poor water quality or natural events (high

[6] Extract from "Account of the lower Saâne valley site" – Victor Theet – Agence de l'Eau Seine-Normandie, July 2022

water levels and coastal flooding) harms the shops and businesses in the three municipalities. Visitors mainly come to the lower valley to enjoy the beach and the activities on offer. In terms of reputation, the repeated closure of the beach could have a negative impact on the number of visitors to the area.

3.3.3 The solutions and benefits

The installation of a 10m-wide rigid-framed bridge is planned as part of the lower Saâne 2050 Territorial Project to give the mouth of the Saâne a more natural look once more. Upstream from this rigid-framed bridge, the route of the Saâne will be extended with the creation of a meander with more gently sloping banks. Thanks to the removal of the culvert pipe, during periods of high water levels and coastal flooding, the opening in the bridge will enable the water to drain away more quickly and efficiently. This opening in the seawall and the pebbled strip will consequently make it 4 to 6 times quicker to drain the valley. This development will also allow the road link between Quiberville and Sainte Marguerite-sur-Mer to be maintained, while also reducing the vulnerability of the area.

Between Quiberville and Longueil, departmental road 127 along the base of the slope becomes partially flooded during high water periods and cannot therefore be used by motorists. A raising of the roadway has been planned, especially near the Sturdza farm, in order to limit the impact of flooding in the future. Work to raise the road will ensure that there is a reliable road connection between the seafront and the lower valley.

Work is also planned on the road running perpendicular to the lower valley, which will run alongside the future tourist site (Route de la vallée). Water from the village and neighbouring fields run along this road, leading to flooding of departmental road 127 below. This issue will be taken into account when work is carried out to construct the access to the new campsite in Quiberville. Adjustments will therefore be made based on the level of run-off recorded over the last decade.

Shops

The project will help to ensure medium- and long-term economic activity, especially for the tourism sector in the lower valley. Tourism-related businesses are predominant in the municipalities of Sainte-Marguerite and Quiberville. The campsite in Quiberville is one of the economic pillars of the lower valley and enables the continued operation of various businesses in the local area.

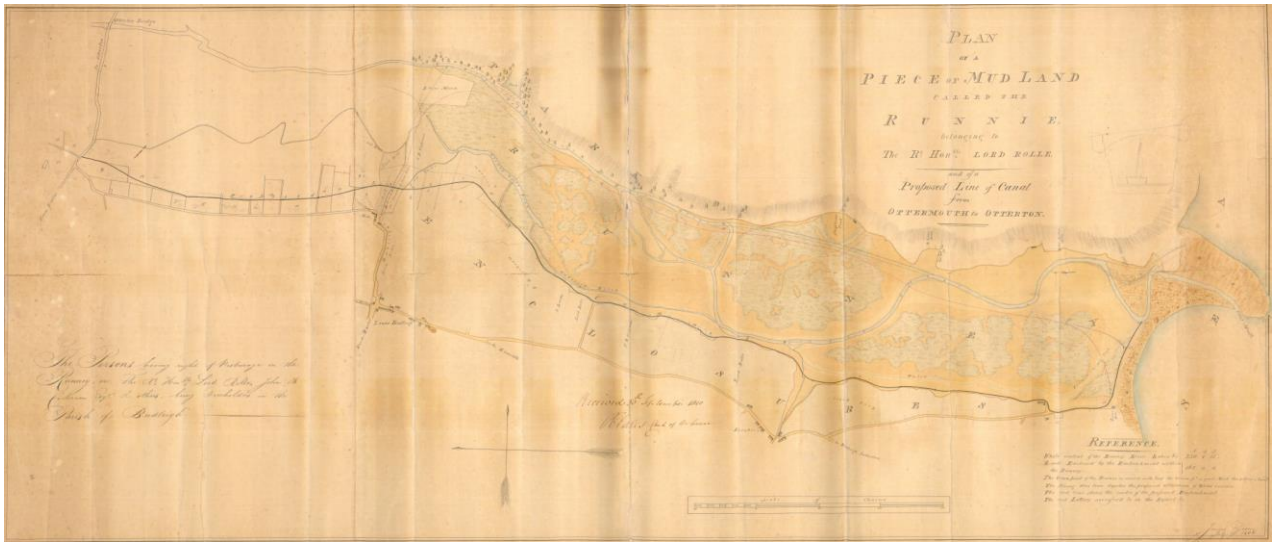
4. Agriculture & Food Production

Critical activities associated with food production (whether through agriculture, fishing or the stocking of local shops) has taken place in both estuaries for hundreds of years, even before formal infrastructure was introduced. Changes over time, including the impact of flooding, climate change and sea level rise, have impacted the type of food that is provided by the estuary sites and the level of its availability. This next section will look at economic activities, including agriculture and fishing.

4.1 Lower otter valley

4.1.1 The history of the modifications

Starting in 1810, Lord Rolle financed the construction of the main embankments and “Little bank” that are still present in the lower valley today, using designs by James Greene. This Napoleonic era modification is arguably the most significant human change to happen in the lower Otter estuary in the last 200 years. The motivation behind the installation of the embankments was to reclaim and enable the drainage of land to the west of what is now the main river channel for agriculture. The second was to straighten the river, “canalising” it with the aim of improving access and navigability up and down the river for trade (See Transport and Trade). Both of these endeavours were challenging engineering projects and in line with the fashion at the time to control nature for man’s benefit. The embankments have since been claimed as key footpaths, with up to 250,000 annual visitors along some stretches (more on this here). A section of the embankment is part of the South West Coast Path.



Historical drawing for the original 19th century embankments by James Greene

The embankments allowed the landowner/tenants to reclaim land for grazing livestock, though it was largely too wet for growing crops. A little later, a further embankment “Big bank” was added at the northern end of the site to further reduce water logging of Pulhayes Farm. Pulhayes Farm is the oldest farmstead on the western bank and to this

day operates in the floodplain as a large dairy farm. Changes to adapt and protect the future of their business in the face of climate change are listed below.

In a final attempt to remove water from the site, Budleigh Brook aqueduct was built ca. 1920 to carry the Budleigh Brook over the fields to make them less waterlogged and more suitable for grazing.

Fishing in both estuaries has always been an important activity, both for the provision of food for local people, but also as a commodity that was traded. Pre-Reformation (1540) fish would have been eaten rather than meat on Fridays and throughout Lent. Post-Reformation this has remained true for Catholic countries in Europe. There was little human modification in the lower Otter associated with fishing, though natural salmon pools existed at the southern end of the site, at the current location of Lime Kiln car park.

4.1.2 The evolution of the problems

There are three clear interventions listed above to reduce water in the reclaimed agricultural land: the first and second embankments, and the aqueduct. This is a wet site, and one that is not hugely well suited to farming for this reason. From a socioeconomic perspective, there is the initial cost of building these structures. There has also always been the associated cost of maintaining them, itself very expensive! These costs have been incurred from the time of building to the present day. Construction of the embankment itself was hindered by high tides and flooding, and the embankment breached for the first time as soon as 1825, hinting at the problems to come. Two breaches occurred in the 1950s with one requiring a temporary railway to be built to facilitate repairs. In 2018 the embankment was within one tide of failing altogether. It was only due to the quick intervention of the Environment Agency that a catastrophic breach was averted.

Although there would have been a rational originally in creating more land for agriculture to make money at a time of food shortage (Britain was at war at this time), these benefits have almost certainly been outweighed due to maintenance costs over time. Until relatively recently, the fields needed to be drained through the use of diesel pumps. Farming within a flood plain is also inherently risky with the potential for activity to pollute the river, through slurry and agricultural run-off, for example.

The building of the embankment straightened or “canalised” the river. This had previously meandered across the floodplain allowing the tide to flood in and out across the entire valley floor inland for several kilometres with fluvial flood water also able to drain out easily to sea. The draining of the reclaimed land for agriculture also resulted in the loss of rare and biologically important saltmarsh and mudflat habitats associated with tidal inundation. The river itself is now almost entirely disconnected from its floodplain in its lower reaches. Water flooding downstream from higher up the catchment is now trapped behind the embankment. Unable to join the river and from there drain out naturally to sea, instead it pools at the bottom of the valley flooding the cricket club to a depth of several metres.

There are also historic reports of farmers losing livestock in the event of heavy flooding. This dates back to at least the 1850s and continues almost to the present day.

There is also no longer commercial fishing on the Otter, but it acts as a nursery ground for bass and thin-lipped grey mullet.[7] The majority of fishing done on the estuary now is completed recreationally, in contrast to the Saâne Valley where there is still an established fish market.

Budleigh aqueduct caused Budleigh Brook to become disconnected from the floodplain and the main river. It had once been known as an important trout stream.

4.1.3 The solutions and benefits

A 70m breach will be made in the embankment close to the mouth of the estuary to reconnect the River Otter to its historic floodplain, to allow fluvial flood water to drain and the tide to once again move up the valley. The return of tidal waters to the valley will allow the re-creation of 55 hectares of inter-tidal habitat, which is an internationally important habitat for invertebrates, fish and birds. A footbridge will be built to span the breach to ensure continued access along the embankment which serves as an important public footpath and right of way.

Under PACCo, Pulhayes Farm has been adapted and restructured so their business can remain viable in the long-term. This has included the installation of a borehole (to protect fresh water supply for livestock); installation of three-phase power (to protect business long-term and deal with additional capacity needed for bore hole); and the relocation of a silage pit for the storage of fermented grass (silage) away from the floodplain to feed the dairy cattle. This is to protect the long-term viability of their business and reduce environmental risk. They have also been compensated for land lost to salt marsh and mudflat resulting from the scheme with adjacent land outside of the floodplain.

Food production for humans from this land will inevitably decrease as a result of the project, although there have been successful intertidal ventures in saltmarsh lamb, samphire and oysters at other sites.[8] Dairy cows will also continue to be grazed at the most northern end of the site.

The new estuarine environment will also act as an important nursery ground for commercial and non-commercial fish. Examples of commercial fish include bass and thin-lipped grey mullet.

[7] Colclough, S. (2021). Lower Otter Restoration Project Fish Surveys – September 2021.
[8] www.gowersaltmarshlamb.co.uk

4.2 Saâne valley

4.2.1 The history of the modifications

Agriculture

During the 16th century, the first military developments were constructed in the lower Saâne valley. Two centuries later, a network of dykes was built to assist the development of agricultural activities. As a result of these developments, the salt marshes in the lower valley dried out and gradually made way for wet meadows. Following a number of rapidly abandoned trials, crops are only grown on the slopes, while the bottom of the valley is simply mown or used for grazing. Today, in addition to the dykes that were built, ditches and valves are also used to control the water levels as much as possible in the wetland areas. To limit the intrusion of salt water, a non-return valve was fitted inside the culvert outlet pipe to the sea. This valve was destroyed by a storm in 2009 and was never repaired.

There are currently 11 cattle (meat, dairy and mixed) and polyculture farmers operating across the lower valley, but none of them promote their produce through direct sale. The bottom of the lower valley chiefly consists of “permanent pasture, predominantly grass (little or no woody fodder)”. Wheat, flax, winter barley, beetroot and potato crops are grown on slopes either side of the valley, along with a few plots of maize silage. The overwhelming majority of this production is exported and used in the agro-food industry. There are only two direct points of sale offering local products in the lower valley. One is in Quiberville (*Les Minis de l’Arbalète* - donkey milk-based cosmetic products) and the other is in Sainte-Marguerite-sur-Mer (Saturday morning market with local producers)[9].

Fishing

Fishing has been an integral part of local traditions for centuries. Anglers use small flat-bottomed boats called ‘Dories’, which used to be made of wood and are now aluminium. Three professional fishermen are still operating and sell their catch directly from their stalls in Quiberville. The boats go out to sea for nine months of the year and are towed back up onto the seawall by tractor. This fishing and direct sale is one of the noteworthy features of the lower Saâne valley.

Oysters have historically represented a significant business in Seine-Maritime as they were used in soups and sauces. From 1840, both the French and the British used dredging to farm the flat oyster beds. Large reefs allowed Saint Valéry-en-Caux to prosper. The activity declined, however, due to overfishing. In Quiberville, oyster farming began before the Second World War and came to an end 25 years ago. An emblematic coastal activity, the oyster industry is a testament to the history of this small fishing village. In recent years, oyster farming has been trialled between Quiberville and Saint-Aubin-sur-Mer with a view to eventually bringing the activity back to the Pays de Caux, from which it has all but vanished.

[9] Source: Mon Panier 76

4.2.2 The evolution of the problems

Agriculture

When there are cattle in a wetland areas, the risk of the river being polluted by slurry and the banks being trampled by the cows is increased. The territory of the lower Saâne valley is subject to problems of run-off, especially in the municipalities of Longueil and Sainte-Marguerite-sur-Mer. This is combined with human developments in the area, which intensify these problems and accentuate their consequences. Arable agriculture on the valley sides intensifies these problems. The land consolidation work in the 1970s removed various obstacles to run-off and increased the size of agricultural plots. Between 1988 and 2010, in the lower Saâne valley, the grass-covered surface area fell from 43% to 35.9%. Loamy soils have promoted the formation of slaking crusts[10] on farmland and furrows are often in the direction of the slope, further facilitating run-off. In addition, the road network has often been constructed in the direction of the slope. These roads channel the water downwards. These impermeable roads prevent the water soaking into the soil, thus accelerating the speed of the run-off.

These run-off problems have an impact on the quality of the water. The topography of the area channels all the run-off from the slopes into the lower valley. These slopes are mainly made up of ploughed fields, which increases the transfer of sediment during episodes of off-run following heavy rain. This sediment ends up in the Saâne and leads to a deterioration in water quality. The sediment from the slopes can also contain phytosanitary products used in intensive farming.

Fishing

In just a few years, the construction of the first culvert pipe led to a significant drop in quantities of fish caught in the Saâne valley. This was first observed back in 1875[11]. Nowadays, river fishing is purely recreational in nature and various spots, such as the bridge at Longueil, are popular among amateur anglers. Despite being prohibited, some anglers fish close to the culvert pipe to catch fish that wait there for high tide in order to swim back up the Saâne. These anglers pose a threat to the already dwindling population of fish in the river.

Quiberville is not just a recreational fishing spot, but also one of the only direct points of sale for freshly caught fish. This notable feature attracts people on a daily basis. The small sales

[10] Slaking crust: This is a compact surface crust formed by droplets of rain and the breaking up of aggregates on the surface of the soil. The formation of crusts leads to a reduction in the infiltration of water into the soil and thus increases run-off. Slaking crust also leads to crop germination and emergence problems. (Source: Joséphine PEIGNE – ISARA Lyon)
[11] Source: LiCCo

huts are located behind the seawall and are regularly affected during periods of extreme weather. They are often flooded and cannot be used, causing financial losses for their owners.

There is no longer any oyster farming in Quiberville and the buildings have been abandoned. These buildings are becoming derelict and, as well as being an eyesore and a blot on the landscape, they also pose numerous safety issues.

4.2.3 The solutions and benefits

Agriculture

As part of the Territorial Project and the PACCo project, agriculture will undoubtedly be affected by the re-establishment of the connection between the Saâne and the sea. This reconnection will increase the length of time the land is submerged from tidal flooding and will also raise the salinity of the waterway, thus bringing about a change to the environment. Currently occupied by cattle, farmers will need to adapt to this new environment and change their production methods to ensure that their businesses remain profitable. One solution could be to change livestock by switching to certain breeds of sheep that are suited to salt marshes, like those in the bay of Mont-Saint-Michel.

Fishing

The construction of a rigid-framed bridge to replace the culvert pipe will allow the sea to be reconnected with the historic flood plains in the lower valley. Letting the water back in will help to create new intertidal areas, which are excellent for the development of biodiversity. Above all, these areas will encourage migratory fish to enter and swim up the Saâne and will offer spawning and nursery areas for these species. Thanks to these developments, fish populations should gradually return to the Saâne.

5. Leisure & Living

This next section will investigate socioeconomic uplift based on changes to wildlife and the environment, as well as the leisure pursuits in each estuary, including bathing, cricket (Otter valley only), camping (Saâne valley only) , tourism, fishing, and hunting (Saâne valley only). Environmental benefits will be plentiful, but this will also have a knock-on effect for human health and wellbeing outcomes.

5.1 Lower otter

5.1.1 The history of the modifications

In 1765 Otterton and East Budleigh dominated the local settlements with Budleigh Salterton (to the west of the mouth of the river) barely registering on a map of that period because of its small population size. To the east of the valley, there were also very few buildings or signs of settlement, with land ownership still spread out and with farmhouses mostly found in villages. This all changed as trade slowed between the coast and Otterton due to the growth of the shingle bar and the silting up of the river channel.

Instead, Budleigh Salterton became a centre for tourism and population growth. The area saw a rise in leisure pursuits such as swimming or “sea bathing”, as it became a hotspot for healthy outdoors pursuits.

With a rising population came the need for improved facilities to deal with demands for basic amenities and infrastructure. As are result, several pieces of infrastructure were installed or improved. The municipal tip was created within the floodplain to deal with waste from an increasing number of local residents as the town’s population grew. The tip grew slowly until the 1970s, after which it expanded rapidly to the west of its original site to deal with a growing population and amount of waste.

There was also increased pressure on the local water / sewage pumping station as the number of local residents grew with an overflow sewage pipe built along the back of the shingle bar draining out to sea near the mouth of the estuary.

Due to encroachment into the floodplain from the many structures listed in this framework, there was also the installation of a trunk drain to deal with excess water that feeds through to the main beach, and a smaller trunk drain that carries water under the main embankment at the southern end of the site. As discussed earlier, the embankments have also been claimed for footpaths and are among some of the most popular in Devon.

The cricket club was even ambitiously moved to its current location in the floodplain in 1930 to accommodate the area’s rising demand for outdoor sports and recreation.

5.1.2 The evolution of the problems

As it stands, ground to the west of the embankment (the fields, grazing pasture and cricket club) mainly drain to the sea through a pipe that takes water from the fields via a ‘trunk drain’ at the western side of the floodplain. The outfall of the trunk is close to the low tide mark on Budleigh beach and is prone to regular blocking with shingle due to on shore drift. The outfall is regularly cleared at significant cost to the local authority with sea level rise making clearance ever harder. Another small outfall drains into the estuary itself, but this is at a higher level and is frequently tide locked so drainage is limited. This project recognises these risks will increase the severity of flooding and seeks to deliver a more sustainable way by adapting to climate change and managing the area by working with natural processes, rather than trying to control them.

The sewage pumping station originally released its sewage on every falling tide, but improvements were made to the ageing outfall pipe and now it only functions in emergency situations, for example, at times of high rainfall when existing sewage systems are in danger of being overwhelmed. This presents an environmental risk and threatens the bathing water status of Budleigh beach which is a popular tourism destination.

More frequent flooding events also make access by the public unsafe, negating the health and wellbeing benefits of access to the site. In 2018, costs made to the embankments by the Environment Agency cost c.a. £180,000.

The cricket club is also flooded regularly. In its current location, it sits about a metre below the level of the river because of silting up that has occurred in the main river channel and accretion in the estuary. This makes it extremely vulnerable to flooding, as we have seen in recent years. When fluvial floods do occur, there is nowhere for the water to go except through the two small trunk drains so it can sit for days before draining. This halts play and causes water damage to the clubhouse (to the value of approximately £20,000 a year).

Budleigh Salterton Cricket Club underwater, December 1959

Public access via footpaths is also jeopardised. In 2018, the main footbridge over the embankment nearly failed due to fluvial erosion (if not for repairs mentioned above). In October 2021, the paths were overtopped by flood water, also halting access to the site for the public. These footpaths are important access routes for local businesses, including Otterrton Mill.

5.1.3 Solutions and benefits of the project

Access for walkers will be maintained as a new footbridge will be built across the 70m breach in the embankment at the southern end of the site. Sections of the western footpath will also be raised and improved to ensure long-term access to the site for pedestrians. This is important as research has shown the physical health and wellbeing benefits of access to green space. For the South West Coast Path (SWCP) in particular, sections of which run through the lower Otter site, research as shown that the physical health and wellbeing benefits from walking the SWCP amount to as much as of £69.1million a year.[12]

As mentioned above, a new car park will also provide formal parking and a steady income for the local government and the Pebblebed Heaths Conservation Trust, who will jointly be responsible for management of the site. This will also provide disable parking provision to ensure equality of access for all visitors, as well as bicycle racks to promote sustainable travel to site.

The cricket club has been relocated to higher ground, and funding found for the creation of a world class club house and cricket facilities.

The tip will also be capped and protected around its sides to prevent future erosion or leakage. Multiple environmental surveys were also carried out to ensure nothing toxic was present.

Long-term, the changes will protect the site from sea level rise and increasing severe weather events as a result of climate change. The cost of maintaining the flood defences long-term would not be viable and this managed realignment allows assets to be protected, while adapting the site to long-term changes.

In addition to the infrastructure mentioned above, the removal of the existing barrier (the embankment) will allow daily tidal inundation. This means in the following years saltmarsh and mudflat will develop. This is amongst our rarest and nature-rich habitats. It is the hope that the site will become a destination for wildlife enthusiasts, NGOs and interest groups, and year-round tourism (the green economy). It is expected that the arrival of rare overwintering birds will encourage steady tourism all year round, rather than just the boom in the summer, generating a steady income for the local area.

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[12] Petersen, C. (2021). The South West Coast Path Health and Wellbeing Assessment Report 2020.

The saltmarsh and mudflat will also act as an effective carbon sink, within a far higher sequestration potential than the poor grazing pasture it replaces. As sediment accretes through daily tidal inundation, the saltmarsh and mudflat will capture and store carbon in significant quantities in the years to come.[13] Saltmarsh has been established as one of the most effective habitats for carbon sequestration.[14]

Finally, the value of ecosystem services cannot be overlooked. The T2.1.1 Protocol will outline increase in ecosystem services.

5.2 Saâne Valley

5.2.1 The history of the modifications

The lower Saâne valley started to welcome its first bathers back in 1856. The trend for bathing in the sea had begun in Dieppe nearly three decades earlier thanks to the Duchess of Berry, and now bathers were beginning to come to the beach at Quiberville. The arrival of these first bathers led to the development of the seafront to host these new visitors. Entry roads and beach huts popped up, as did villas on the hills surrounding Quiberville. The municipalities of the lower Saâne were keen to continue the development of leisure and tourism.

While the seafront welcomes the bulk of the visitors, the rich historical and cultural heritage of the entire lower valley offers numerous highlights, including the churches of Longueil and Sainte-Marguerite-sur-Mer, which were classified as historical monuments in 1976 and 1921 respectively. The dovecote of the château of Sainte-Marguerite-sur-Mer is also listed as a historical monument. All of the monuments in the municipality of Sainte-Marguerite are included in the architectural, urban and landscape heritage protection zone (*zone de protection du patrimoine architectural, urbain et paysager*/ZPPAUP). Remains of the Atlantic Wall built by the Germans during the Second World War are still visible along the coastline. The emblematic up-ended bunker on the foreshore at Sainte-Marguerite-sur-Mer stands as a testament to the erosion of the cliffs and attracts many curious tourists each year.

Today, the lower Saâne valley has a range of leisure and outdoor activities available for visitors. Officially marked out since 1977, the GR 21 (*Grande Randonnée*) hiking trail runs for 180km and crosses through the valley, connecting le Tréport to le Havre. A second trail, GR 212, starts from the beach in Sainte-Marguerite. It heads upstream along the Saâne, ending at Duclair on the banks of the Seine for a total distance of 70km.

[13] Mossman, H, et al. (2021). Pre-restoration assessment of carbon at the Lower Otter Restoration Project.
[14] Mossman, H. et al (2022). How much carbon can salt marshes capture? Results from a study of managed realignment and regulated tidal exchange sites in England.

Located close to the lower valley, the Lin cycling route passes through the Saâne valley at Ouville-la-Rivière and connects Dieppe to Fécamp. Since 2018, it has provided an additional draw for tourists in the lower valley. The Saâne valley is also renowned for its vast array of outdoor activities. As well as the two hiking trails, GR 21 and GR 212, the lower valley offers other activities such as kayaking on the river, paragliding, swimming and nature watching.

Quiberville has a Yachting Club, which offers watersports in the summer months (sailing). Founded in 1960, it was essentially a club of yacht owners, brought together by their shared passion. The sailing school was opened in 1999. Bathers also come to enjoy the scenery. These activities (visiting the beach, launching boats) take place around the existing infrastructure at either end of the beach (Quiberville on the west side, Sainte-Marguerite-sur-Mer on the east). In contrast, the middle section is not busy at all.

The visitor capacity is relatively low and inconsistent in terms of quality:

The main hub is the beach campsite in Quiberville, which is an important part of the local economy and the municipal budget. After the Second World War, caravans began parking illegally on the ground behind the causeway. At the same time, caravans also began appearing on the other side of the Saâne in Allée des Crevettes in Sainte-Marguerite-sur-Mer. A local authority-run campsite was set up between 1963 and 1973 to meet the needs of the massive numbers of new tourists.

From the 1970s, the caravans in Allée des Crevettes in Sainte-Marguerite-sur-Mer began to be replaced by the chalets you still see today. The campsite was built between 1963 and 1973. Located just behind the seawall, it plays a critical role in maintaining the lower valley's economic development. Every year, it hosts several thousand people coming mainly from France, Germany, the Netherlands, Switzerland, Belgium and the UK. After damage from floods, there was a €1 million investment in the campsite in 1995 and the renovation took it from 2 to 3 stars. Four years later, after the flooding in 1999, 28 pitches had to be lost to build mounds to protect against futureflooding and waterlogging.[15]

The municipality of Quiberville also contains two other campsites (Camping GCU and Camping Le Castel des Vergers) located just outside the borders of the Territorial Project. Due to their location (on the plateau near the village centre), they are much less popular than the beachside municipal campsite. As well as campsites, the municipalities of Quiberville, Sainte-Marguerite-sur-Mer and Longueil have a great deal of accommodation for seasonal hire, including gites, guesthouses, hotels and Airbnbs, able to meet the summer demand and the requirements of visitors.

Fishing is authorised on a section of the Saâne. The Saâne is a ‘category 1’ river (mainly on account of it supporting salmonids), with people chiefly fishing for sea trout (salmon fishing is not permitted on the Saâne). There are two fishing areas, one in Longueil (suitable for

[15] Extract from “Account of the lower Saâne valley site” – Victor Theet – Agence de l’Eau Seine-Normandie, July 2022

children) and one along the pathway at Sainte-Marguerite-sur-Mer and on the land under the responsibility of the *Conservatoire du Littoral*. Since the right to access the banks was refused by private residents (often farmers), fishing is not permitted along the rest of the river. On the beach, people also practice surf fishing, mainly during low spring tides (prawn fishing).

Hunting of wildfowl is another activity that is well established in the lower Saâne valley. People hunt individually on private land rather than as part of an association. There are three hunting areas at the bottom of the valley in Quiberville with six hides. The clients of these areas (less than 100 regular users) are mainly regional hunters. A hide can be rented by the day from the owner of the hunting areas, two of which have been developed (23 hectares) and are leased by SCI La Vallée (two owners). One farmer also rents his land out for hunting.

5.2.2 The evolution of the problems

The impacts of climate change could have consequences for tourism. Indeed, the municipal campsite, located on the seafront, has already been flooded three times in 20 years, including two substantial floods (1.5m of water in the buildings) due to the Saâne bursting its banks. The campsite is also exposed to the risk of coastal flooding. There are two types of risk for the future:

- The campsite could be flooded again, which would cause material damage, and potentially endanger human life. Each time, these floods carry a financial cost as the campsite needs to be restored and brought back up to standard.
- Eventually, the campsite may need to be closed by prefectoral order (administrative closure, flood risk prevention plan/*PPRI*).

The beachside campsite in Quiberville is the main tourist hub in the lower Saâne valley. With an average turnover of €50,000 per year, it represents 10% of the municipality's income. Its appeal is also beneficial for the local economy with direct benefits to cafés, bars, restaurants, groceries, etc.

The water quality in the wetland and bathing areas is regularly affected by peaks of polluted water, especially during periods of heavy rain. This pollution can be explained in part by the lack of water treatment facilities in Longueil (non-collective sewage system no longer compliant with standards). Along the coastline, this polluted water impacts the quality of the bathing water. Although the quality of the bathing water in Quiberville is relatively good, it is worse in Sainte-Marguerite-sur-Mer due to the currents which flow in that direction. In 2011, Sainte-Marguerite-sur-Mer was the only municipality in the department to receive a ‘C’ grading (temporarily polluted). The Saâne valley is highly dependent on its coastal tourist activities, especially bathing. However, a series of problems with the quality of the bathing water have been recorded over recent years. These water quality problems led to the temporary closure of the beach. These closures represent a huge loss of earnings for both coastal municipalities. Beyond the economic impact, banning people from swimming has an

impact on the image of the lower valley, which eventually may have consequences for the number of visitors to the site.[16]

Various activities practised in the lower valley have led to the deterioration of the natural environment and could be sources of pollution.

5.2.3 Solutions and benefits of the project

The Basse Saâne 2050 Territorial Project includes the construction of a waste water treatment plant in Longueil to meet the requirement of modernising the sewage treatment system. In addition to the construction of this waste water treatment plant, the installation of an enhanced sewage system (requiring around 30km of new pipes) is also planned to connect private homes to this new facility with a capacity of 4,300 residents. This waste water treatment and sewage system work will prevent waste water being discharged directly into the lower valley and will improve the quality of the water in the river as well as the seafront where people go to swim.

The relocation of the campsite outside the flood-prone area will remove the flooding risk for the tourist site entirely and eliminate the potential reconstruction costs in the event of flooding as well as reducing the risk to people. This project will ensure long-term, viable and enhanced economic activity in the Quiberville area.

In the long-term, the relocation of the campsite and the re-establishment of the link between the sea and the river will help the area to adapt to climate change and will protect human activities on the site against a rising sea level. The cost of maintaining flood defences and the economic activities in the flood-prone area is not practical in the long-term and would jeopardise the whole local economy. Therefore, the objective of the project is to anticipate the consequences of climate change by adopting a long-term vision in order to preserve the area's economic assets.

[16] Quality of bathing water in the Seine Maritime department, ARS

6. Conclusion

With both projects, the relocation and / or improvement of infrastructure is a key part of the socioeconomic value of the project.

In the Saâne Valley, ensuring the longevity of the campsite is a major objective since it currently provides 40% of the local economy. Similarly, in the lower Otter, the raising of the road will protect the value and future of the businesses and properties and South Farm and South Farm Court. Maintaining public access and enhancing the biodiversity of both valleys supports good health and wellbeing outcomes for the local area, and supports green tourism, a key income for both sites. Improving facilities such as the tip and the waste water treatment plant enhance environmental and public health outcomes for local residents and reduce environmental risks that would be worsened with the tidal flooding of each site, including leaching or escape of waste materials.

Overall, the protection of infrastructure assets is a huge part of the value of the project for both sites. Not only will the project help adapt and mitigate climate change, and improve wildlife outcomes, it will also support both local economies, improve sanitation and waste related infrastructure, and ensure both sites remain important for local businesses, leisure, residents and health and wellbeing outcomes in the long-term.

6.1 Programme of works

Project phase	Action	Additional information & questions	Stakeholders	Timeline
Project set up	Identify infrastructure assets in the proposed project area that would require relocating or improving.	How is the site used for leisure? E.g. footpaths, fishing etc. What are the businesses that will be affected and evaluate how they are being impacted e.g. farms, farmers, tenants, shops, fishermen etc.? Are there amenities that support the local population that would be affected? E.g. sewage systems. Do you have important footpaths, roads, railways etc. at risk in the project area?	Project partners General public	3 – 5 years
Project set up	Ascertain who are the relevant stakeholders.	Who owns and / or manages the assets? Who owns, manages or leases/rents the land on which the asset is present? Understand stakeholder concerns/liabilities	Local government, authorities and councils Local service providers (water, power etc.) Landowners or managers	3 – 5 years

			Tenants Public	
Project set up	Quantify the value of these assets (the creation of the Business Case).	What is the value of the site for business, wildlife, residents, tourists etc.? Is the value significant enough to justify relocating, realigning or improving the site? *For the Saane Valley, the campsite provides approximately 40% of annual income locally.* Are there legal obligations in place that require you to protect this infrastructure? *For the lower Otter, South Farm Road had to be raised under Highways England regulations.*	External experts using information from groups above, or commissioning new studies, if required.	3 – 5 years
Project set up	Carry out monitoring (e.g. environmental, structural etc.) to ensure works can go ahead.	Are there any environmental regulations or restrictions that could halt the progress of the project? *For example, environmental monitoring was carried out on the tip in the lower Otter to find out the level of protection required. An Environmental Statement was also produced before either project could proceed. In both valleys, in-depth hydrological assessments were completed to prove the project was viable*	External experts and contractors.	3 – 8 years

		with not causing increased flood risk to properties being an important focus of study in the Otter valley A fauna, flora and habitat survey was also undertaken during project development to provide baseline data to build the business case for the schemes to ensure the benefits and disbenefits to biodiversity into account were adequately evaluated.		
Project set up **Design and planning** **(And continuing throughout the project: Implementation and construction)**	Engage with relevant stakeholders.	Are they in favour of the project? *PACCo Deliverable T2.4.1 provides a critique of engagement undertaken as part of the Lower Otter Restoration Project and Basse Saâne 2050 project and provides a 'Best Practice Guide' and timeline for engaging stakeholders.* Could they improve or help inform the design or support financially to improve or relocate the asset as part of the project? What is their position? Which of their requirements must be met for the project to move forwards? For many managed realignment schemes, public opposition is a key reason that schemes do not progress. Ensure	Local government, authorities and councils Local service providers (water, power etc.) Landowners or managers Tenants Local interest groups e.g. wildlife, community or history groups Local residents	Indefinite *(Saâne Valley 20 years, lower Otter over 10 years)*

		consultation is genuine and sufficient to ensure public support for the project.		
Design and planning	Secure planning permission for works.	Prepare paperwork and public consultation in line with country specific planning laws.	Local councils and authorities Project partners General public	1-2 years once all monitoring and paperwork in place.
Design and planning **Implementation and construction**	Establish legal contracts with relevant parties involved.	This will likely relate to any changing tenancies on the land or future management of the site post-project. *For example, in the Otter valley the cricket club had to draw up a new agreement as part of their relocation whilst new land had to be found to compensate a tenant who was losing land. In the Saâne valley, a public service delegation is to be hired for the new municipal campsite. For the previous municipal campsite, it was an in-house management.*	Lawyers Relevant parties	2 – 5 years
Implementation and construction	Employ contractors to deliver the work.	Project partners are unlikely to have the in-house capability to improve, relocate or realign identified infrastructure assets.	Project partners Contractors – to a) design, b) implement,	1 – 5 years

		Appropriate procurement processes must be followed to tender for the best contractors to deliver the infrastructure works.	and c) monitor the scheme etc.	
Implementation and construction	Engage and communicate clearly with project partners and members of the public.	Ensure communication channels are clear and effective (internally and externally) throughout the project to avoid delays and confusion.	Project partners Contractors General public	Duration of the project delivery
Implementation and construction **Post-construction**	Monitoring – during and after	Complete weekly / monthly reports on progress. *E.g. Weekly Environmental Clerk of Works reports.* Understand the change in value and use of new assets during the project and post-project. *The Protocol report highlights key changes in socio-economic value.*	Project partners External experts Community stakeholders (citizen science monitoring if relevant)	Duration of the project delivery Post-project (up to 10 years+)

6.2 Lessons for other sites

Phase	Item
Project set up	The steps involved with relocating, realigning or recreating important estuarine infrastructure can take years to agree with relevant parties before physical works begin. Begin consultation early with relevant organisations and the public and undertake preliminary investigations (environmental, economic, social) early to assess project viability. Understand the technical and environmental constraints and the many project benefits and disbenefits!
Project set up	Ensure the project development is adequately resourced, as a dedicated project team is required for successful delivery.
Design and planning	Activities will evolve and develop throughout the implementation of your scheme. Be open to new ideas and be prepared for the project to evolve and change. Compromises will likely be required.
Design and planning	The financial cost can be considerable but is often more cost effective to act pre-emptively than after a catastrophic flood or weather event.
Design and planning	Funding for items can be complex as money might come from different funding pots or organisations.

Project set up, Design and planning, Implementation and construction	Partnership working is key, as are developing and maintaining good relationships with stakeholders, including the general public. Develop a stakeholder map and communication/engagement strategy as early as possible Internal and external communication are key to achieving project success.

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