

# **LIVING IN THE RISING TIDES**

**STRATEGIES, STRUCTURES AND SYSTEMS OF COASTAL RESILIENCE  
THE CASE STUDY OF BAIE DE SOMME**

**Máster Universitario en Paisajismo MbLandArch Trabajo Final de Máster  
Universitat Politècnica de Catalunya. ETSAB-UPC**

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## Eternity

He who binds to himself a joy  
Does the winged life destroy  
He who kisses the joy as it flies  
Lives in eternity's sunrise

*William Blake - 1757-1827*

## Eternidad

Quien a sí encadenare una alegría  
malogrará la vida alada.  
Pero quien la alegría besare en su aleteo  
vive en el alba de la eternidad.

*William Blake - 1757-1827*



# MEMORIA

In physics we learn that the kinetic energy of an object is described by two elements: speed and direction. When two moving objects meet they exchange energy and the end result depends on the directions of the objects. If the objects move in opposite directions then the energy is lost, but if the objects are more or less aligned the energy can be added from the one to the other. In the same way we can look at the landscape and climate change. Maybe some times if we fight climate change then we will loose much more energy than if we align forces with climate change and accept loss.

In Baie de Somme man has been fighting with nature over the last 1000 years. In the begging natural sedimentation was in favor and man by slowly draining the low wet lands and building dykes to protect from the high tides transformed the landscape from an estuary to an agricultural mosaic accompanied by heavy irrigation systems. But things have changed since the last century.

The construction of hard infrastructure in the mid 20th century on the south of the coast diminished the transport of sediment to the coast of the low fields. As a result erosion made the south coast sensitive and flooding by storm started occurring. Man wanting to protect "his" territory responded with the construction of a series of groins on the eroding zone of the coast but this soon was not enough. The next response was to provide sediment to the coast in the east part. This sediment in

the form of medium sized gravel stones would travel from the South to the North-West over the period of few years, breaking down in the process of being perpetually crushed by the waves. Although this practice is effective in case of one storm, or storms of low intensity, it is unsustainable because intensity and frequency of storms are growing over the years at the same time an intense storm has the power to consume big amount of gravel that equal for a few years of sediment nourishment. Sediment nourishment in this case is not only very expensive to provide but also unsustainable.

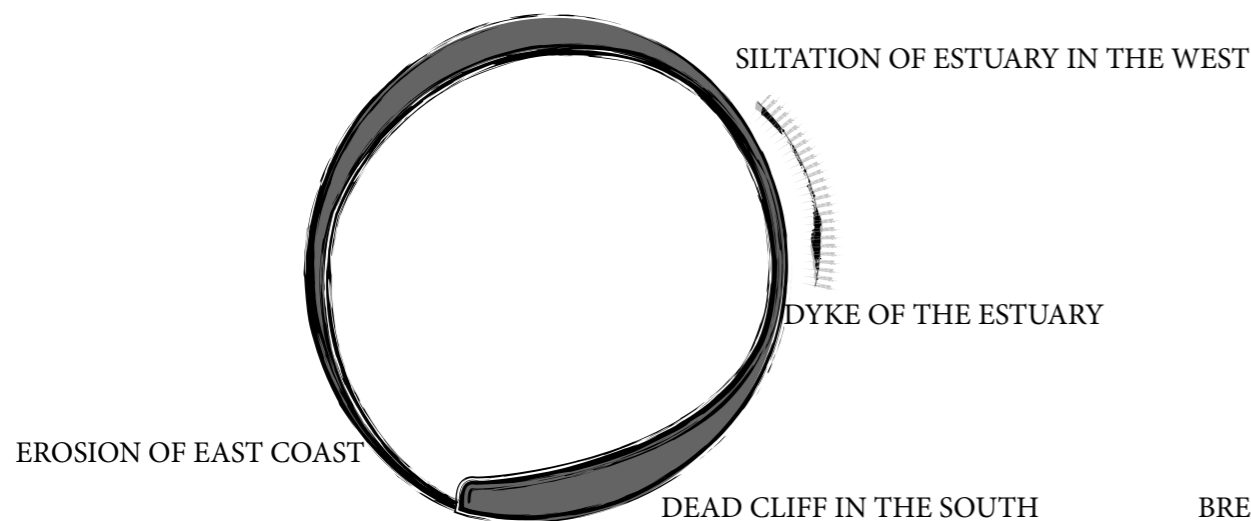
The landscape is enclosed in a envelope that, by natural or man-made conditions, acts as a membrane isolating the entities from hydrological interaction. On the south of the coast is the erosion zone where the series of man made actions tend to protect, on the north there is the natural accumulation zone where dunes are formed, on the west there is a dyke that divide the estuary from the low fields and to the south there is what remains from the "dead" cliff dividing the low fields from the Plateau of Vimeu. And although the structures are meant to protect, unfortunately the combination of them creates the condition for perpetual flooding due to rain and rise of the phreatic water.

The estuary of Baie de Somme located in the north-west of the low fields gives its name to the greater territory. This is an inter tidal habitat of brackish water that floods twice per day by the ocean tides. When the tide coefficient is high the pressure

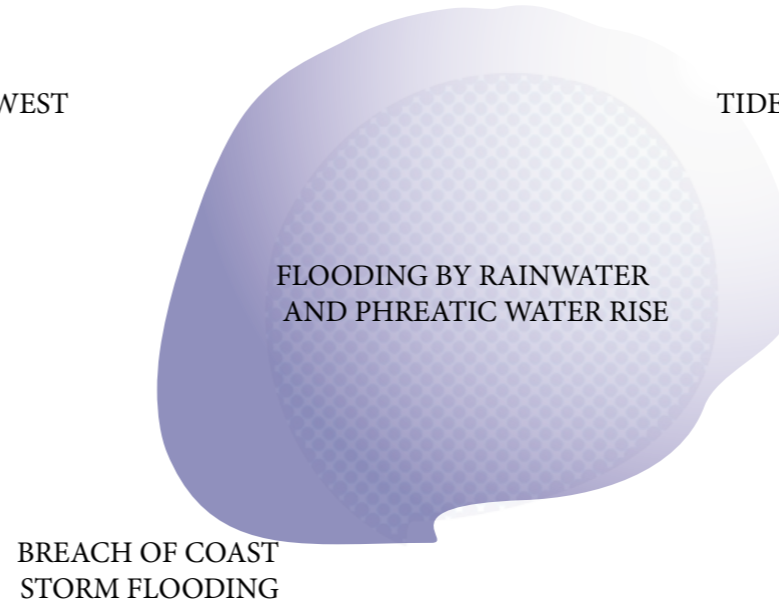
from the ocean tides that have entered the estuary block the natural drainage of the low fields. As a result the whole territory can get inundated easily by frequent rainfalls and the rise of phreatic water. Flooding by phreatic water are slow so evacuation is possible, but they can last a few months because the drainage is not possible because of tides.

What can we think about the future of this territory? How can we address the already highly problematic conditions that are only going to get worst due to climate change?

NATURAL ACCUMULATION NORTH COAST



IDEOGRAM OF CONDITIONS OF COAST RELATIVE POSITIONS



IDEOGRAM OF CONDITIONS OF FLOODING



IDEOGRAM OF RISKS  
Precarious Conditions Of Shore  
Regular Conditions Of Flooding

# MEMORIA

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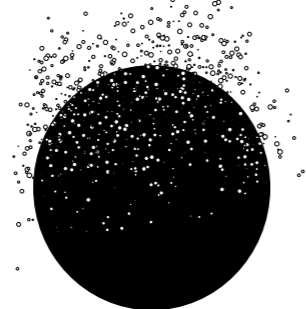
“Wu wei is an ancient Chinese concept literally meaning “inexertion”, “inaction”, or “effortless action”... It was most commonly used to refer to an ideal form of government, including the behavior of the emperor.” [en.wikipedia.org/wiki/Wu\\_wei](http://en.wikipedia.org/wiki/Wu_wei)

Like objects already set in motion, each area of the territory has its own distinct problematic. The south coast suffers by erosion breach, the city of Cayeux-sur-mer gets flooded by storms, the north profits from accumulation, the estuary is siltating and the low fields are flooded. At the same time humans live and work in this territory, humans that want to keep living there. How can they live with the problems? How can humans live with the rising tides?

Four projects that are composed by landscape structures and strategies form a system of solutions that realign the territory to what is perceived as its natural state of homeostasis. These four projects can simple be understood through four actions of emptying and filling. Empty being the the latent space to welcome flooding (increase in floodplaine) and black being the new limits (diversification of protection) where traditional dry human life can keep occurring. This system of solutions not only treats the individual symptoms of each problem but they all work together one supporting each other.



HABLE D'AULT  
Submersion of the Land



CAYEUX-SUR MER  
Storms Entering the City

Before



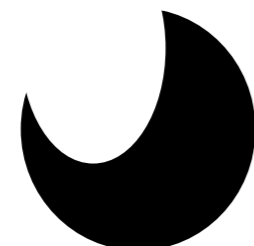
SOMME-ESTUARY  
Siltation of the Estuary



LOW FIELDS  
Multiple Floodings



HABLE D'AULT  
Returning Land to the Tides

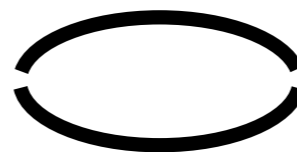


CAYEUX-SUR MER  
Loosing and Winning Coast

After



SOMME ESTUARY  
Getting Sediment from the Estuary



LOW FIELDS  
Giving Room for Flooding

## IDEOGRAM OF ACTIONS

AS ELEMENTS OF RELATIVE EMPTINESS AND FULLNESS

Let us examine the actions individually starting from the eroding coast. The proposed strategy is called **Managed Realignment**:

“Managed realignment is a measure that usually results in the creation of a salt marsh by removing costal protection an allowing for an area previously protected from flooding to become flooded. Managed realignment is a measure dealing with sea level rise and coastal erosion. It is also often a method that replaces hard coastal defense measures with soft coastal land-forms. Rather than relying on hard structures for defense, managed realignment depends on natural defenses to absorb or dissipate the force of waves.” [.coastal-management.eu](http://coastal-management.eu)

Next in line is the city of Cayeux-sur-mer where flood is no longer a problem but a quality. The proposed strategy is **Managed Retreat**:

“Managed retreat involves the purposeful, coordinated movement of people and buildings away from risks. This may involve the movement of a person, infrastructure, or community.” [en.wikipedia.org/wiki/Managed\\_retreat](http://en.wikipedia.org/wiki/Managed_retreat)

“Managed retreat or managed realignment is a coastal management strategy that allows the shoreline to move inland, instead of attempting to hold the line with structural engineering. At the same time, natural coastal habitat is enhanced seaward of a new line of defense.” [e-education.psu.edu](http://e-education.psu.edu)

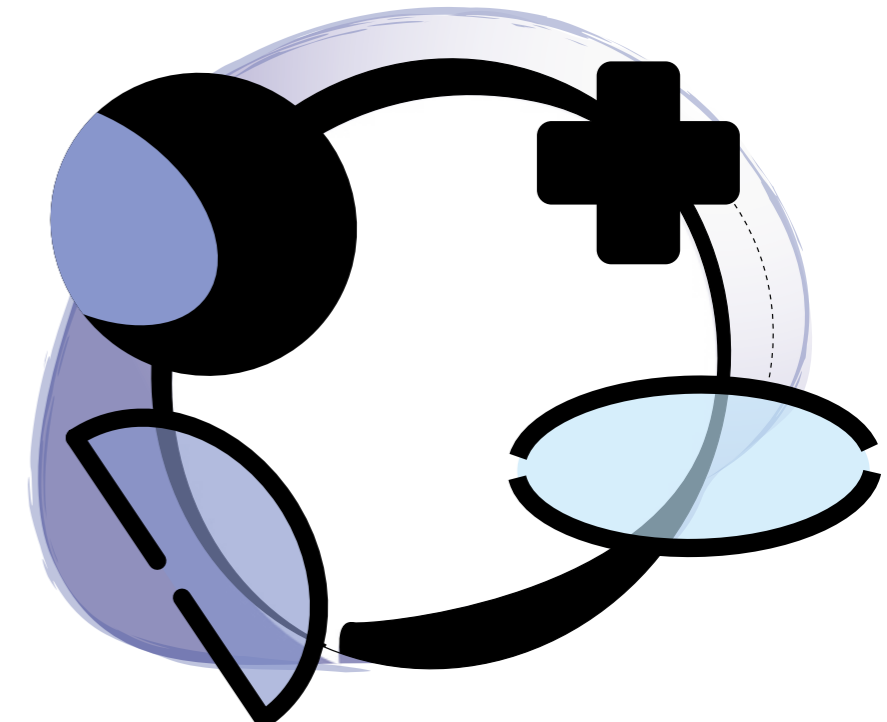
In the Somme estuary the surplus sediment is transformed to construction material and material for sediment nourishment.

The proposed strategy is **Sediment Ripening**:

“The art of clay ripening and consolidation as a Building with Nature concept lies within the connection between the need to dredge and the need for sediment as a building material. Namely, the dredged (waste) material can be used as a building material: beneficial use of ‘gebiedseigen material’ (native material for local application) paving the path toward a circular economy. [.ecoshape.org](http://ecoshape.org)

Finally in the low fields we treat the problem of flooding by providing a waiting room where excess water gets collected and then flushed into the estuary in low tides all at once. Reference to this is the strategy of **Room for the River**:

In the Netherlands, Room for the River (Dutch: Ruimte voor de Rivier) is a government design plan intended to address flood protection, master landscaping and the improvement of environmental conditions in the areas surrounding the Netherlands’ rivers. The project was active from 2006–2015. Measures in the plan include: placing and moving dykes, depoldering, creating and increasing the depth of flood channels, reducing the height of the groynes, removing obstacles, and the construction of a “Green River” which would serve as a flood bypass. [en.wikipedia.org/wiki/Room\\_for\\_the\\_River\\_\(Netherlands\)](http://en.wikipedia.org/wiki/Room_for_the_River_(Netherlands))



IDEOGRAM OF ACTIONS IN RELATIVE POSITIONS

**THANK YOU** to everyone who has supported me knowingly and unknowingly.

I would like to thank the students Lu, Erwann, Margaux and Thea for working together on ATLAS of landscape in ENSP-Versailles.

Thanks to local actors Michel DELÉPINE (Mayor of Mers-les-Bains), Jean-Paul LECOMTE (Mayor of Cayeux-sur-Maire), Yves MAQUINGHEN (Head of the environment for GSM) and Sébastien GRANDSERT (manager of the ASA des Bas-Champs) for being available to share their knowledge about their territory.

A big thanks to Étienne Leseigneur for introducing me to Prof. Olivier Bain, hydrogeologist and specialist of Baie de Somme, who shared his knowledge with me openly.

Thanks to my academic family in UPC, to Prof Dr José A Jiménez, Prof. Anna Zahonero and Prof. Ioanna Spanou for their attentive support.

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Finally thank you to my family for providing the material assistance so generously.

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# 01 OBSERVE

*THE PRESENT AND PAST*



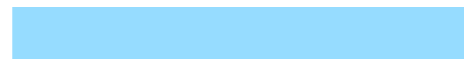
**CHALKY CLIFFS** of *Ault*



**PEBLE SHORE** of *Cayeux-sur-mer*



**DUNES** of *Brighton*



**WETLANDS** of *Bas Champs*



**ESTUARY** of *Baie de Somme*





TOUTES DIRECTIONS

MAISON DU TOURISME

Résidence Club

























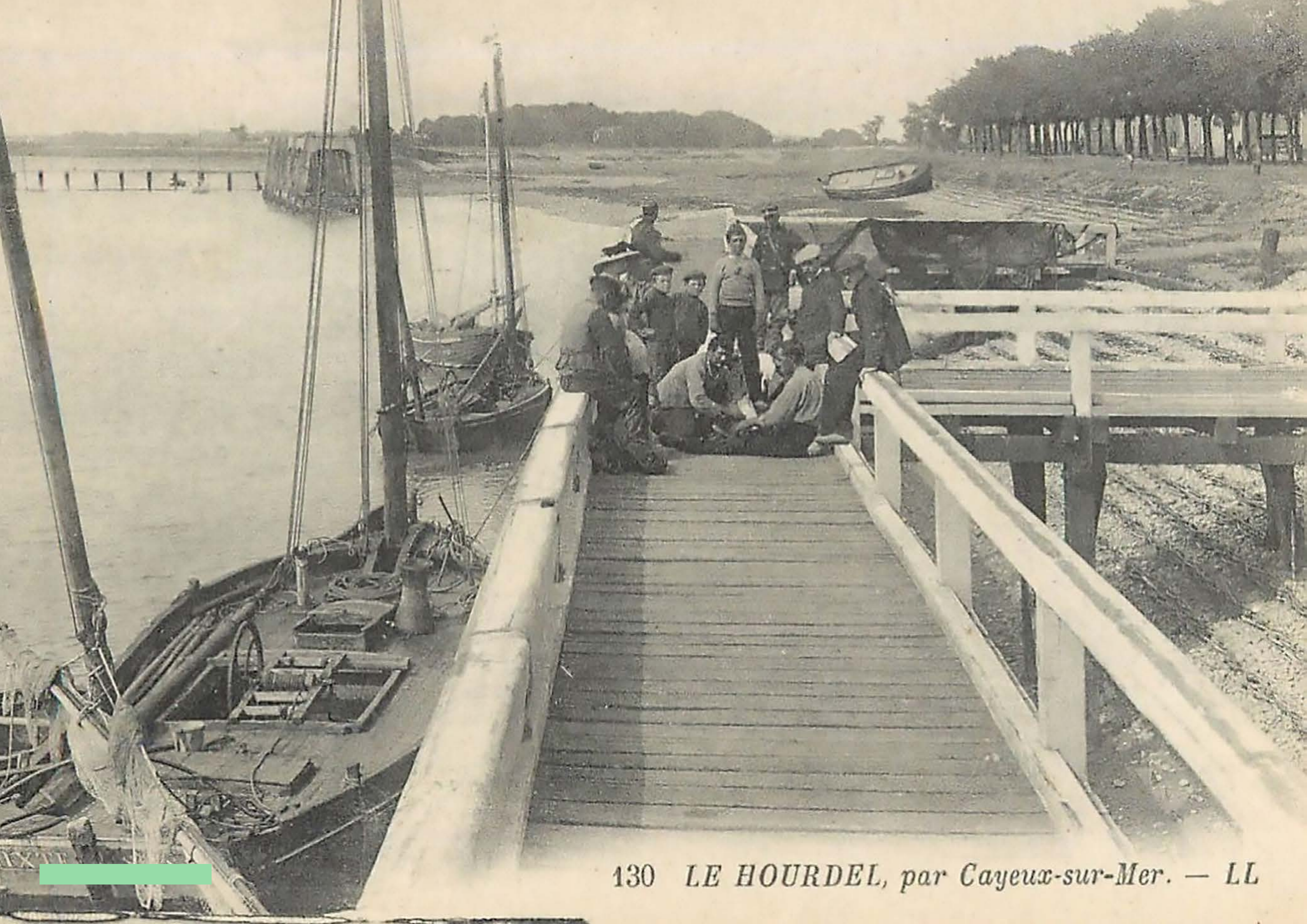




194. - CAYEUX-sur-MER. - Débarquement du Poisson







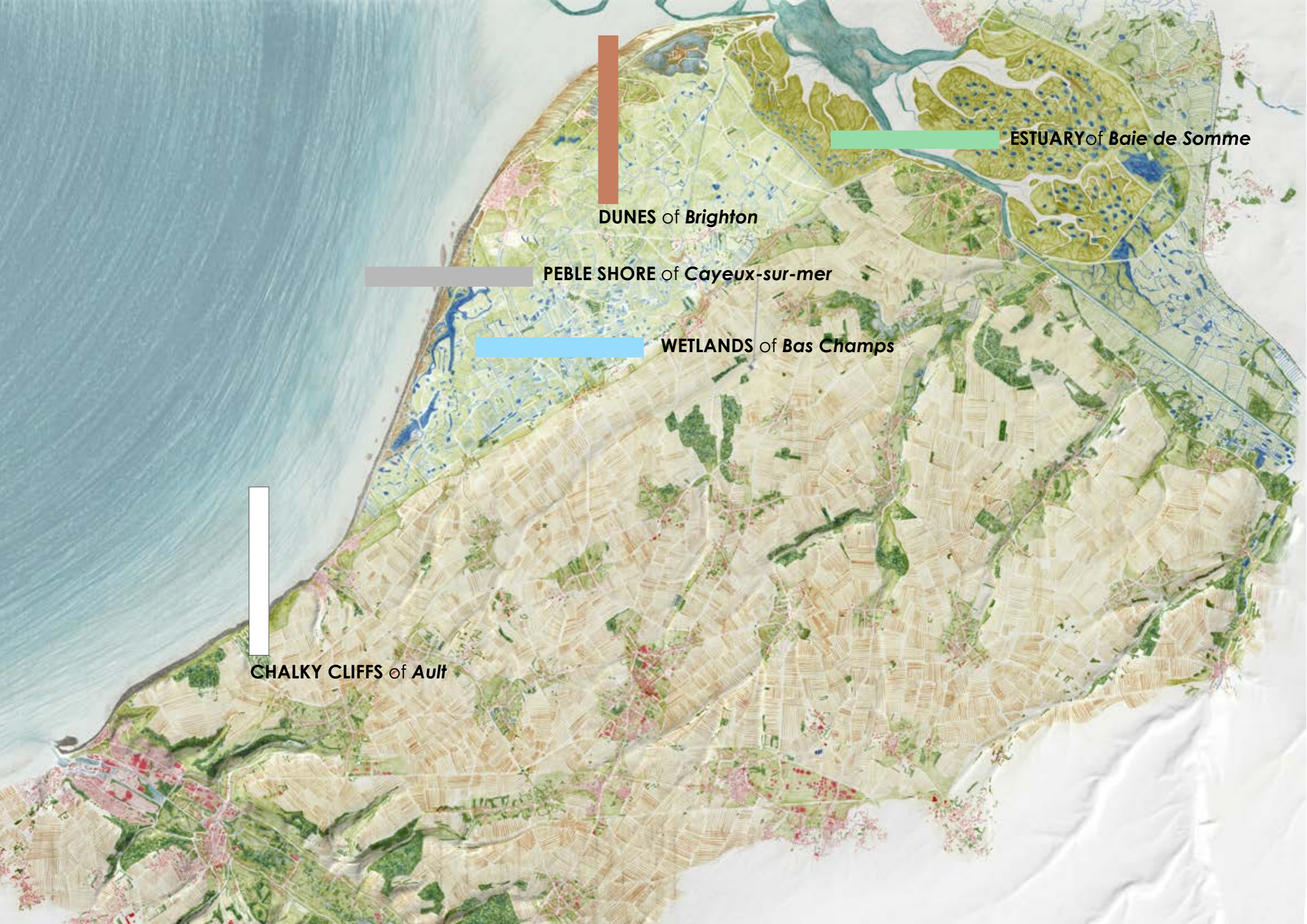


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27 CAYEUX. — La Plage à Marée Basse. — LL.





**ESTUARY** of *Baie de Somme*

**DUNES** of *Brighton*

**PEBLE SHORE** of *Cayeux-sur-mer*

**WETLANDS** of *Bas Champs*

**CHALKY CLIFFS** of *Ault*



# Chapter 01

## Links of Images

1) [www.cayeux-sur-mer.fr/tempete-eleanor-a-cayeux-mer-de-leau-rues-digue-a-bien-resiste/](http://www.cayeux-sur-mer.fr/tempete-eleanor-a-cayeux-mer-de-leau-rues-digue-a-bien-resiste/)

2) [en.wikipedia.org/wiki/Ault,\\_Somme](http://en.wikipedia.org/wiki/Ault,_Somme)

3) <https://www.cayeux-sur-mer.fr/travaux-de-recharge-ment-en-haut-de-plage/>

4) <https://www.cayeux-sur-mer.fr/la-tempete-ciara-a-cayeux-sur-mer-la-mer-est-passee-un-peu-mais-pas-trop/>

5) <https://www.fotocommunity.fr/photo/les-dunes-de-cayeuxmer-brighton-therockets7/26853771>

6) <https://ccvimeu.fr/regards-sur-la-baie-de-somme/>

7) <https://www.delcampe.net/baie-de-somme/>

8) <https://www.delcampe.net/fr/cartes-postales/europe/france/80-somme/le-hourdel>

15 9) <https://www.delcampe.net/cayeux-sur-mer/>

10) <https://www.delcampe.net/cayeux-sur-mer/>

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**02**

**APPROACH and STUDY**  
*THE TERRITORY*



# APPROACH THE TERRITORY: General Introduction / Learning by Local Actors

## APPROACHING THE TERRITORY

The approach of the territory is consisted by four elements: 1) the physical exploration of the territory over a period of three day, 2) the interviewing of important actor of the territory, 3) the production of cartography and 4) bibliographical survey.

Initially we went on the field by car from 20/10/21 to 23/10/21. We had a car for the whole group and we stayed in an Airbnb in Friville-Escarbotin, a town that we chose for its "central" position in relation to the entire study site. Before our arrival, we had contacted various actors of the region in order to present them the reason of our arrival and to propose them an interview. Our stay was organized around these different meetings. We were able to meet 4 actors: Michel DELÉPINE (Mayor of Mers-les-Bains), Jean-Paul LECOMTE (Mayor of Cayeux-sur-Maire), Yves MAQUINGHEN (Head of the environment for GSM) and Sébastien GRANDSERT (manager of the ASA des Bas-Champs). Apart from these meetings, we explored on foot or by car. Everyone took pictures, notes, sketches at our own pace, even if the weather was not always kind.



Jean-Paul LECOMTE  
Maire de Cayeux-sur-Mer



Sébastien GRANDSERT  
Gestionnaire de l'ASA des bas-champs



Michel DELEPINE  
Maire de Mers-les-Bains



Yves MAQUINGHEN  
Responsable environnement pour GSM

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Learning about the territory from Yves MAQUINGHEN responsible for environmental management of GSM



Learning about the territory from Sébastien GRANDSERT manager of the l'ASA in the Low Fields



Learning about the territory through the habitants of the territory



# APPROACH AND STUDY OF THE TERRITORY: General Introduction

## Context of Study of Baie de Somme

The "Landscape Atlas" is part of the second year of training for the State Diploma in Landscape Architecture at the ENSP of Versailles. This module starts in September with the choice of the study site and the constitution of the teams. Our team was made up of 5 students.

During the first year of training and the module "Reading the landscape", two people of the group had already been able to visit the south of the Somme Bay in June 2021. It is from this first survey that the choice of the study site was made for the "Atlas". The Bay of the Somme presents a variety of landscapes, from coastline to farmland, and a rich environmental and ecological context that appealed to the whole team.

We chose more precisely the south of the Bay of the Somme, an area including a part of the bay, the lowlands, an agricultural plateau and valleys. This area corresponds to the map IGN 2107 OT of the blue series 1/25000th: "Le Tréport - St-Valery-sur-Somme". This territory is thus inscribed from the south of the Somme bay in the Somme department (80) to the Bresle valley in the Seine-maritime department (76).

We were only able to visit the site once. Despite the will to go back in December or January, we finally did not find the time we needed. Given the limited time available, we preferred to do bibliographic research. This lack of time in the field did not allow us to survey the entire site. Some areas would have deserved a longer survey, notably the Vimeu plateau which we only crossed by car.

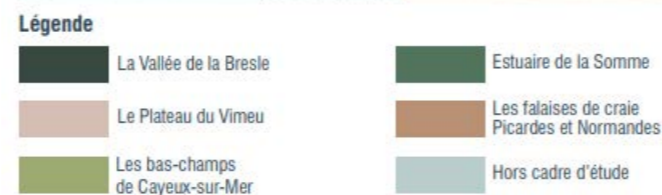
In this study, we will approach the different **landscape units** identified in this territory, starting from the land with the Vimeu plateau and the Bresles valley, then moving towards the coast with the living cliffs, the low fields and the Somme estuary.

The chosen territory is marked by the Bay of the Somme and its estuary to the north and the Bresle valley to the south. The Vimeu plateau rises up to 135m above sea level and the low fields exist in the tidal altitudes.

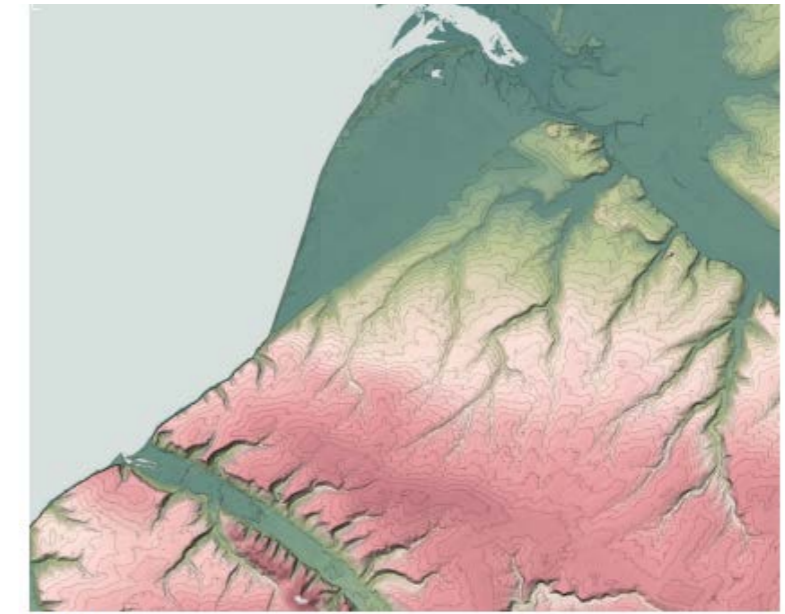
This progression aims to show the geomorphological, historical and environmental link between these units. The landscape as it exists today in the Bay of the Somme tells us the story of the different dynamics and energies that have shaped it: Man, the sea, the rain, the wind... What impact will these energies have on the future landscape of the Bay of the Somme?



## LANDSCAPE UNITS



## TOPOGRAPHY





# 1 - The plateau of Vimeu : An Agricultural mosaïque



The Vimeux is bounded by the estuary of the Somme Bay to the North and by the Bresle Valley to the South. This plateau, with its low topography, is composed of a complex network of agricultural plots, hedgerows and villages.

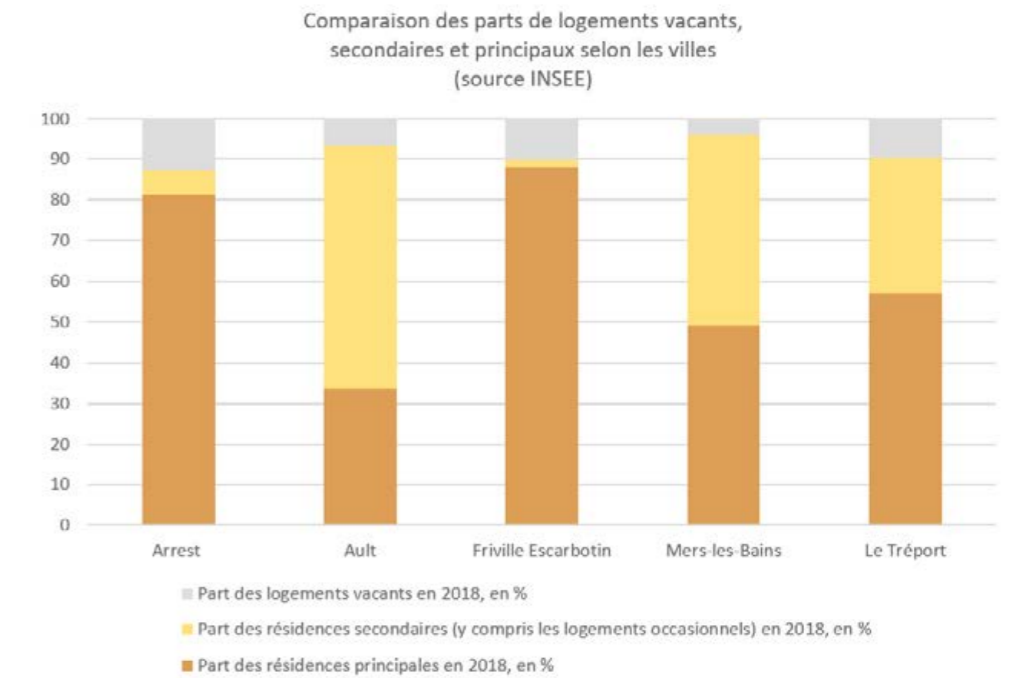
The Vimeux plateau ends with the dead cliff. 10 000 years ago, this cliff was alive and constituted the coastline. With the advance of the land on the sea and the formation of the low fields, the line of the coast changed and the cliff became dead.

The main dynamic of the territory is agriculture. The space is divided into several plots, the majority of which are used for the cultivation of cereals or beets. The fertile and humid lands of Vimeux are linked to the geological composition of the soil, which is made up of a chalk plateau covered with a layer of flint clay and silt.

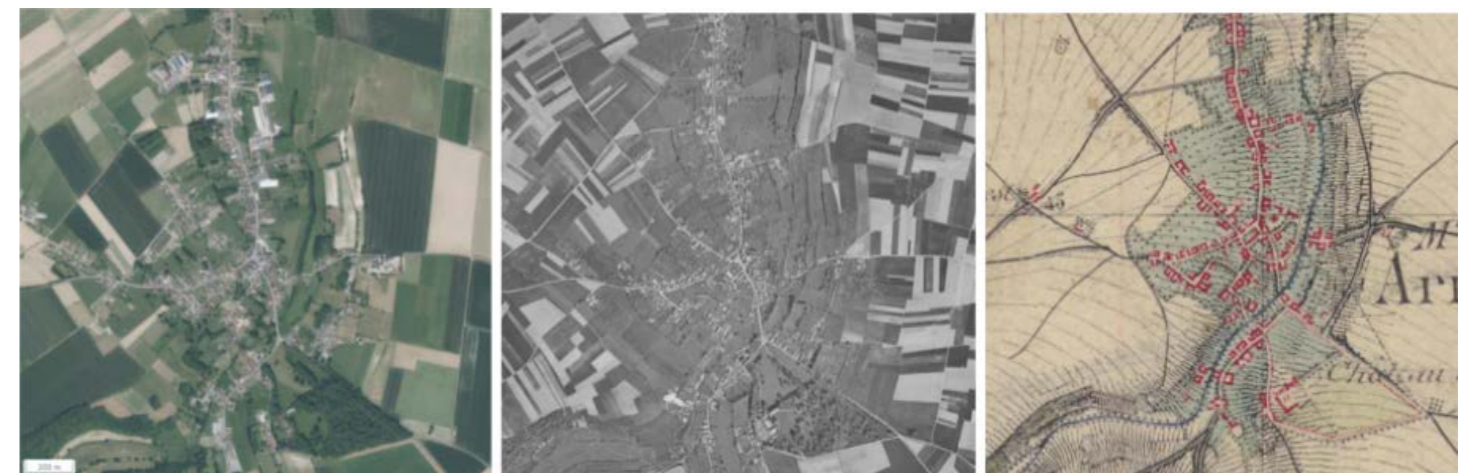
On the whole plateau, a mosaic of traditional villages draws the landscape. Recognizable from afar with the presence of their bell towers, the villages are surrounded by a belt of trees. The agricultural activity can also be seen on the outskirts of the villages with the presence of barns, grain silos and sheds used for the storage of agricultural equipment.

A historical comparison of aerial views allows us to observe the distribution of agricultural plots on the plateau. The consolidation of the late twentieth century has grouped by the mosaic of small parcels into large entities. The farms have also expanded, the landscape has been transformed into a large unified agricultural plain. From a demographic point of view, the villages on the plateau are mostly occupied by primary residences. The coastal towns are occupied by main residences but also by a significant proportion of secondary residences (see diagram below). This observation demonstrates the importance of agriculture on the plateau with a population

anchored in its territory. On the coast, the habitat is shared between locals (fishermen...) and a population looking for coastal tourist activities.



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Comparaison photographie aérienne 2021 - Photographie aérienne historique 1950-65 - Carte de l'Etat-major (1820-1866)



## 2 - The Valley of Bresle: An organization around the river



South of Ault, a new landscape unit is revealed: the Bresle valley. Its name comes from the river that flows at its feet, which begins in the Oise at an altitude of about 200m and flows into the Channel between Mers les Bains and Le Tréport.

The Bresle river is at the origin of this valley by making its way through the Senonian chalk. The topography is irregular, to the north of the valley, the steepest slope, is the end of the Vimeu plateau and the southern plateau, the gentler slope, is the Caux plateau. Even today, the economic sector of the Bresle valley is doing well. What are the contributions and impacts of human activities in this valley?

### The Bresle

From Aumale to Eu, "the Bresle is a fishy river of about 71 km in length, constituting an administrative border between Normandy and Picardy since the departmentalization of 1790." (The Environmental Discovery Association, 1992)

The Bresle is one of the three parallel rivers in the study area along with the Authie and the Somme. "The Bresle is generated by three rivers, the main one having its source in Blargies, 10 kilometers upstream from Aumale, the second in Frétincourt, 8 kilometers away, and the third in the commune of Quincampoix. Along its course, the Bresle receives mainly Picardy waters with the Liger and the Vimeuse and a small contribution from Normandy with the Méline. (Association des Amys du Vieil Eu, 1990)

Man was able to carry out dyking work during the 10th and 11th cen-

tures to make the Bresle accessible. "Previously, the river flowed through an impenetrable thicket of willows, alders and osiers, choked with brambles, rushes and reeds. The ground was only a bottomless mud and one could only cross it in Eu and Blangy where the stones were outcropping. To the south, the forest itself was impassable. (LOISEL, 1990) The Bresle was first marshy, then mastered in the 10th century, changing its face in the 20th century with the ballast pits and ponds. The clearing had no significant impact on the scale of the large territory, the action was only partial. "The declivity of the Bresle is low, only 20cm per kilometer. This slowness is one of the factors of constitution of the thick layer of peat which covers the bottom of the rivers" (LE BOUDEC, 2001).

The wooded hillsides of the valley are spread over the community of Eu. The woodlands are few on the site of the Somme and the Seine Maritime, they are concentrated in the valleys.

The forest of Eu is a vast domain of 9300ha. This territory is made up of oak, poplar, alder, willow and mainly beech trees. It is a forest which "extended since the most remote times, on 30 km, between Eu and Aumale. Dense and continuous, it was an impassable barrier which, deforested over time, was divided into three main massifs, the triage of Eu, the High Forest and the Low Forest" (Association des Amys du Vieil Eu, 1990) The coniferous trees that appeared at the beginning of the century only occupy a small area; however, these plantations represent remarkable spaces: Douglas fir, Sitka spruce, Japanese larch.

The Bresle valley site has been developed to have artificial meadows but also cultivated land where we find the "cultivation of alfalfa, kitty, clover or sainfoin, plants that are free from drought thanks to their pivotal root system" (LE BOUDEC, 2001).

In the same way, larris (open, fallow land, limestone lawns) are present in the very marked slopes of the valley. the hedgerow is present around the meadows and agricultural plots forming alternative spaces, islands for wildlife and ecological interest for crops. The hedges constitute a reserve of wood for the owners of the places.

During the XXth c, a vast marsh (Marsh of Sainte Croix) was located in great majority in Le Tréport (80%), it was partially destroyed by storing rubble and sometimes polluted fills there. From 2003 to 2013, the city of Le Tréport realized works of rehabilitation of the place by confining the polluted grounds and allowing the access of the site to the public. Today, the marsh living at the rhythm of the tides, finds little by little its natural character, the flora of origin as the wild cardera and a privileged space for the migratory palearctic birds.





## Cities of Bresle : Eu, Tréport, Mers-les-Bain



In Roman times, a military and commercial port was located towards Mers, which was the major pole of the exchanges of goods with England. A new economic dynamism was born thanks to the complementary functions of Eu and Le Tréport. Mers was then “de-throned” and reduced to a small agricultural life. “At the beginning of the 19th century, the three towns consisted of two nuclei for Mers and Le Tréport, while a more extensive center had appeared in Eu. The urban development of Mers and Le Tréport took place along the coastline. “In Mers, the northern slope of the Bresle was first subdivided on the initiative of the glass factory, then by the city itself, a 36-hectare Z.A.C. with housing and schools between the glass factory and the old urban core. Today, with the problem of rising waters, the urbanization of Mers is on a regressive dynamic where one privileges the natural spaces and the constructions are very limited, only in direction of the lands.

The administrative separations of Normandy and Picardy had consequences on the dynamism of these cities until the XIXth century, allowing Dieppe to take the monopoly of the trade. Louis-Philippe had work done to connect Eu to the sea by building a canal which essentially benefited the development of Le Tréport. Under Napoleon III, railway links were built towards Paris and Abbeville. These last years, the urban sprawl is in a progressive dynamic leading to a conurbation around these three cities. Indeed, many housing estates have been established around Eu but are limited by the sea.

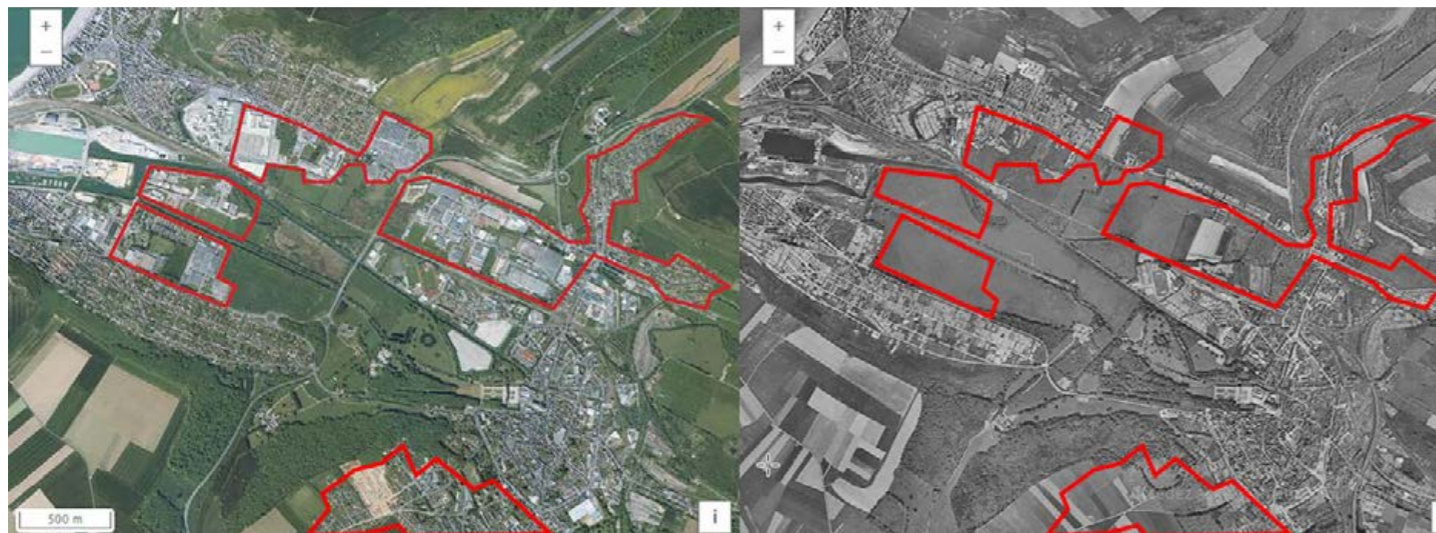
In Le Tréport, it was the city itself which, after having rebuilt the district of the beginning of the XIXth century between cliff, port and sea front, took over the housing estates of the beginning of the XXth century (Le Tréport-Moderne, then Le Tréport-Terrasse), even linking them by a third housing estate (Le Tréport-Coteau). “The abundance of wood for heating ovens and ferns whose ashes are potassium, greatly facilitated the establishment of glass factories in the forest of Eu” (Association des Amys du Vieil Eu, 1990) Around the 15th century, large glass factories were established, specializing in flat glass for glazing. The “small glass factories”, on the other hand, produced drinking glasses, carafes, flasks

and other articles of white or common glass. These articles were mouth-blown under difficult conditions, incomparably slower than modern production processes.

Bottling developed in the 19th century as the emerging railroad facilitated trade. Today, it is estimated that these companies produce between 65% and 75% of the world’s high perfume bottles. This sector is developing because there is more and more demand each year, but it is struggling to find new employees because the industrial sector is less popular with young people than the service sector. Verescence and Verreries du Courval are the first two world leaders.

Located near Bouvaincourt Sur Bresle, the Ballastières were once a ballast extraction site. These stones were used to build the railroads. Then, these stones were used to make gravel for buildings and roads. The numerous ponds that border the Bresle reveal an important past of alluvial extraction. These extraction areas have been rehabilitated, with paths, ponds, and meadows where highland cows take care of the maintenance of these spaces.

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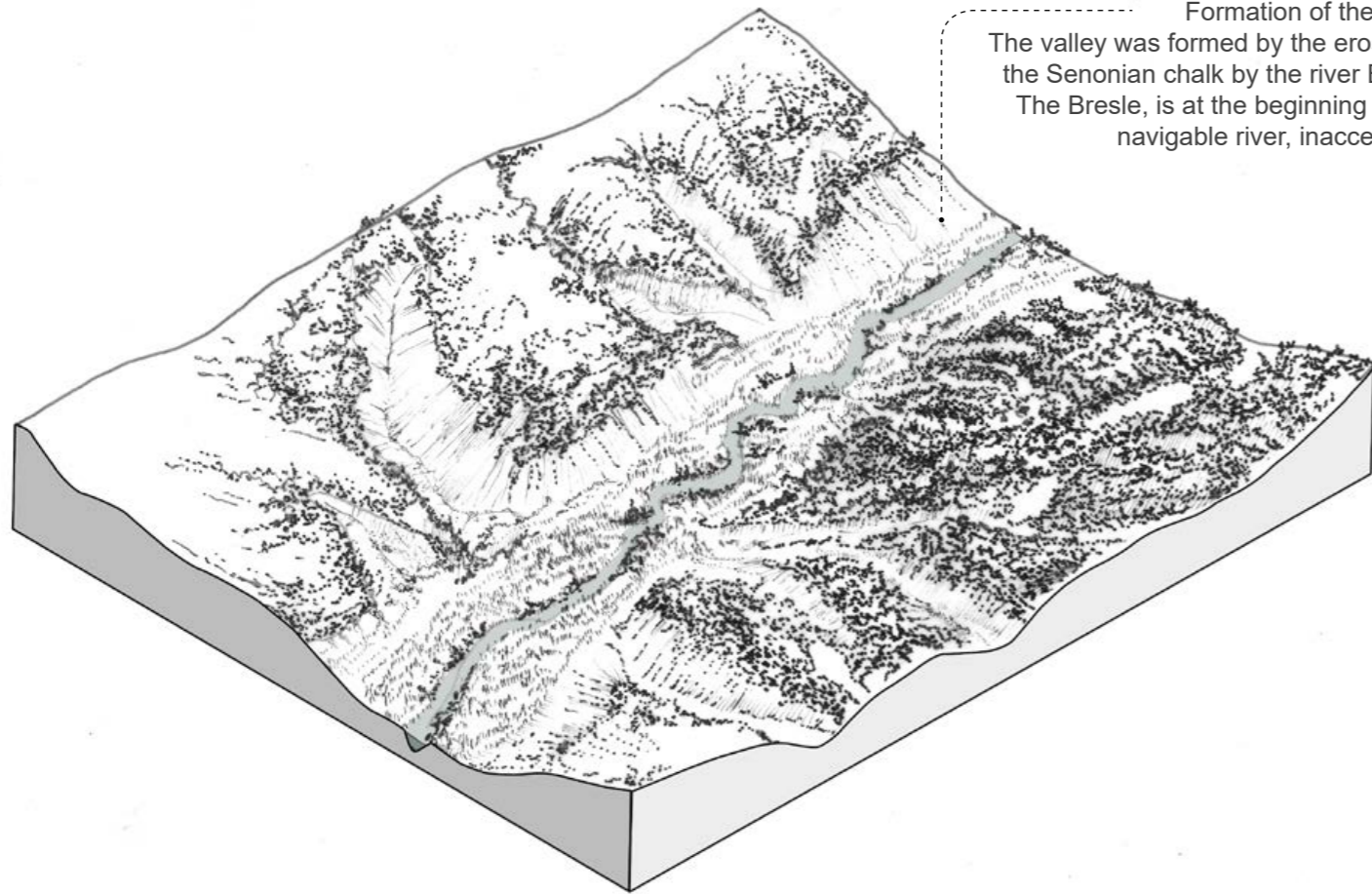


Comperative orthophoto from today and 1950 at Eu and Tréport

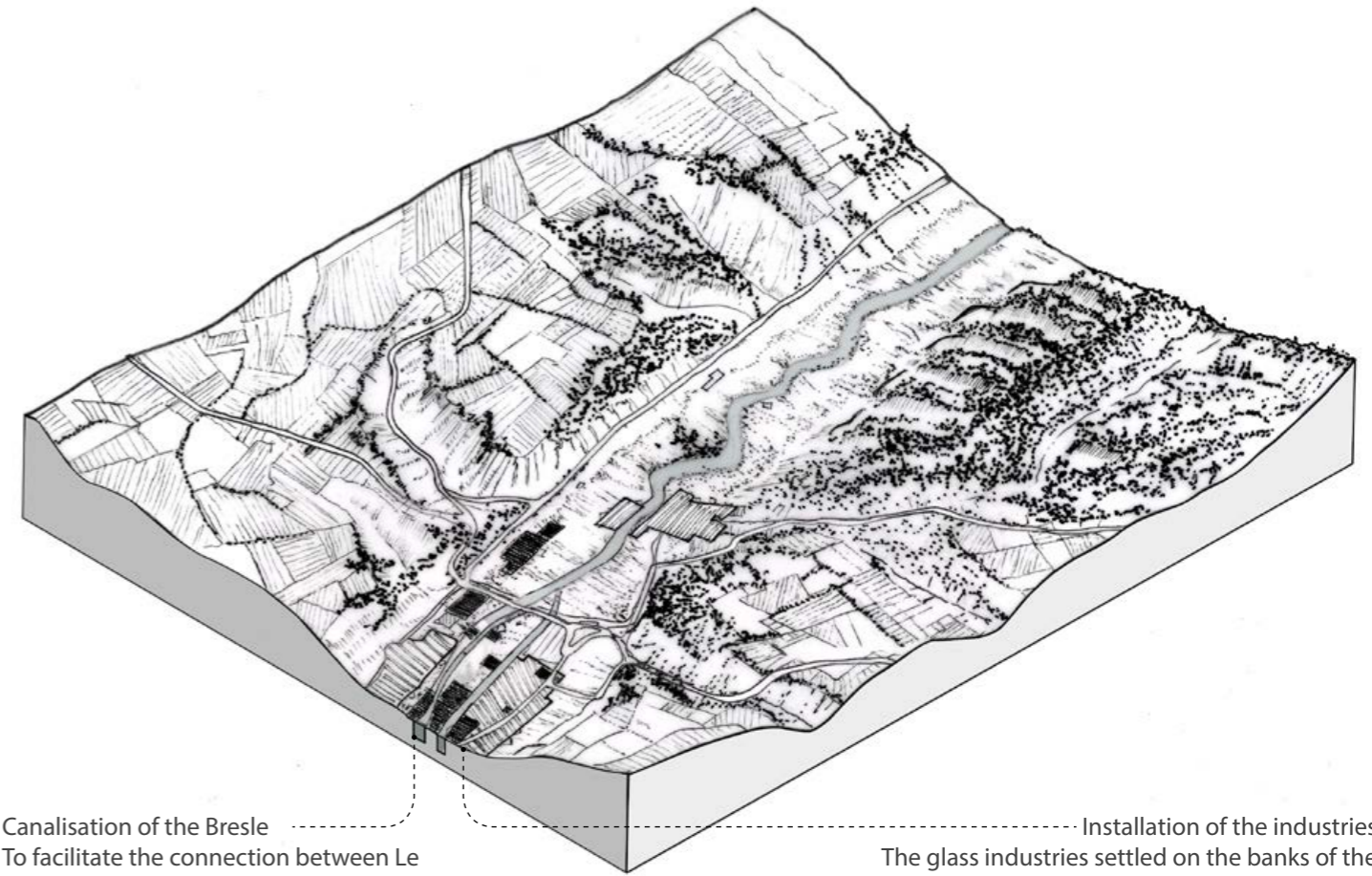


Photo from Treport



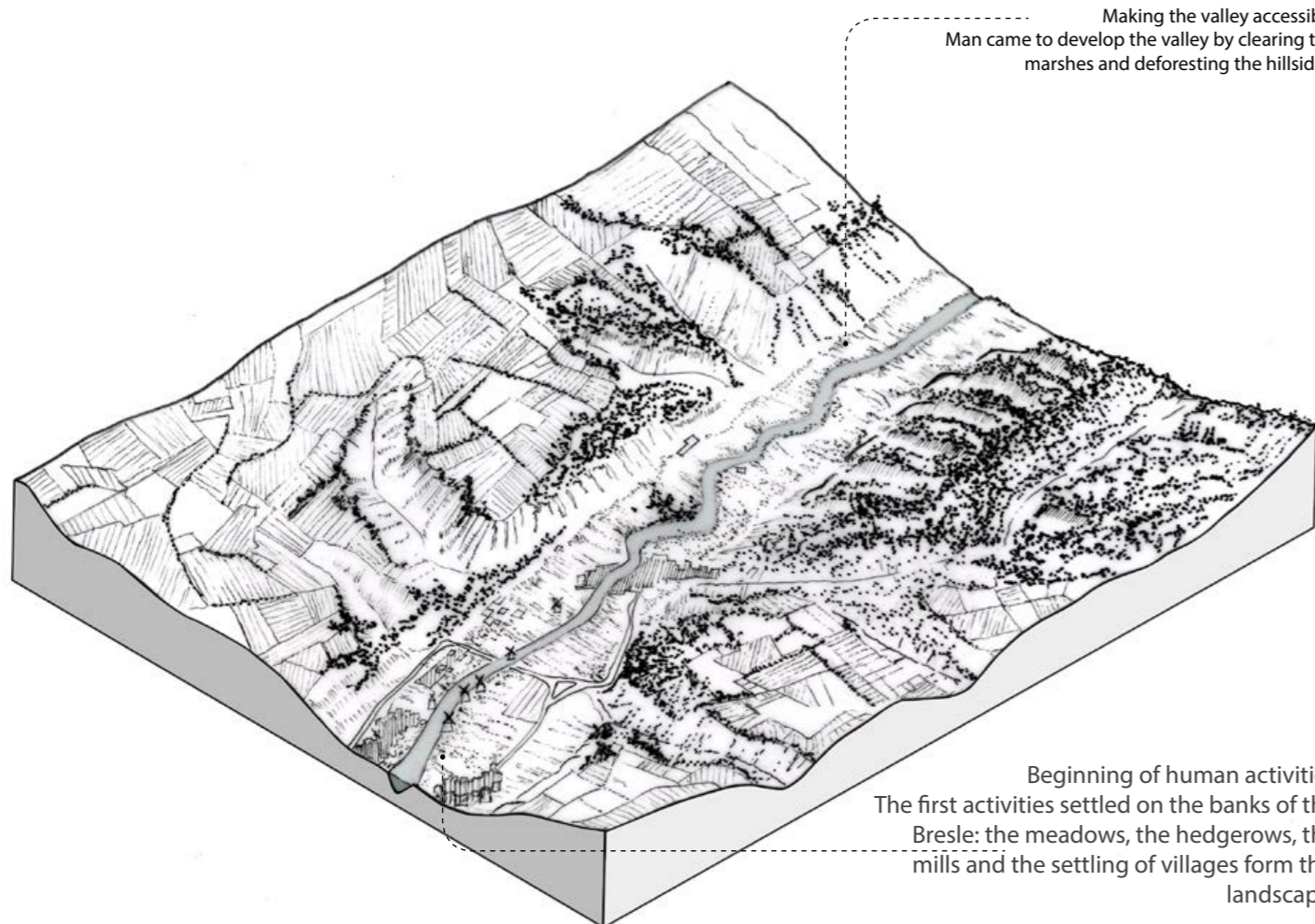


Formation of the valley  
The valley was formed by the erosion of the Senonian chalk by the river Bresle. The Bresle, is at the beginning a non-navigable river, inaccessible.



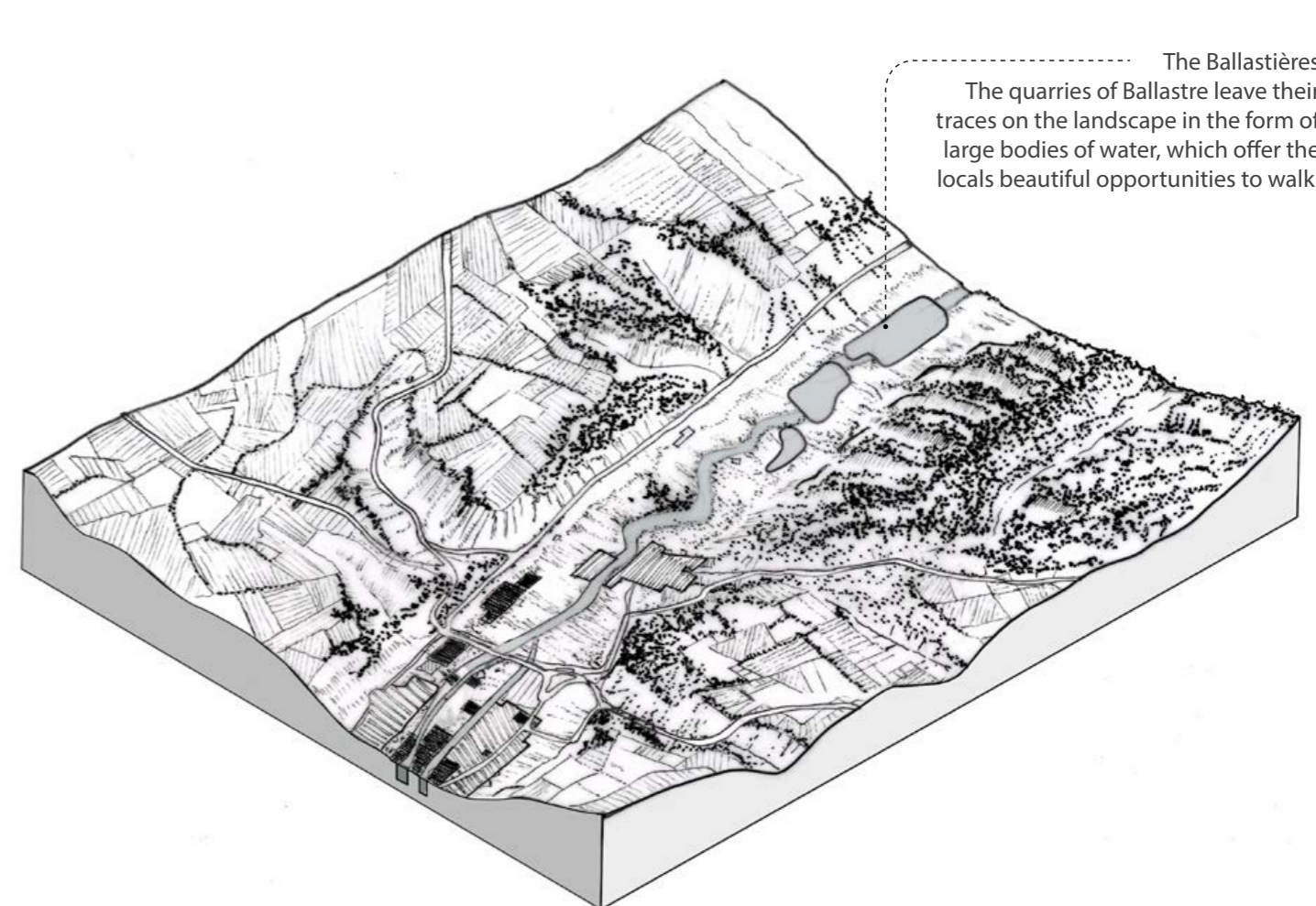
Canalisation of the Bresle  
To facilitate the connection between Le Tréport and Eu the Bresle is canalized between these two cities

Installation of the industries  
The glass industries settled on the banks of the Bresle and transformed the mouth of the river into an industrial landscape



Making the valley accessible  
Man came to develop the valley by clearing the marshes and deforesting the hillsides.

Beginning of human activities  
The first activities settled on the banks of the Bresle: the meadows, the hedgerows, the mills and the settling of villages form this landscape.



The Ballastières  
The quarries of Ballastre leave their traces on the landscape in the form of large bodies of water, which offer the locals beautiful opportunities to walk.



### 3 - The living cliffs of Picardie and Normandy : a retreating coast



Located on the coastline south of Ault, between Picardy and Normandy, this landscape unit is composed of living cliffs, the Cise Wood valley and associated coastal towns.

According to the definition of André Guilcher (1954), a coastal cliff means: "[...] a projection not covered by vegetation, with a steep slope (between about 15° and vertical or overhanging), of very variable height, in contact with the land and the sea, and which is due to the action or presence of the sea ". The designation of living cliff or sharp cliff, as opposed to dead cliff, refers to the sea that regularly strikes its wall.

Located between Ault and the Bresle estuary, the chalk cliffs of Ault extend over about 7km at a height ranging from 38 m to 80 m. At this level, the chalk base is very easy to observe, one can easily take height and overhang the sea.

This cliff is composed of clear layers, the chalk, and dark grooves, the flint. Its erosion, by the sea or by water infiltration, is at the origin of the pebbles that we find in the north. In Ault, we can observe on the beach, a diversity of pebbles in "formation", they are not yet well rounded and blue

At the level of Ault, the cliff has retreated by 45 m on some sectors since the end of the 19th century. This retreat of the cliff is a real issue for the communes such as Ault which is built on the edge of the cliff. The instability of this coastal line poses a safety problem for users as well as a danger for the preservation of material goods and heritage that may be affected.

Further south, the cliff reaches Mers-les-Bains, a popular sea side resort since the 19th century. It is possible to reach the top of the cliff

on foot from the city. At this height, the vegetation is subjected to the force of the wind and the surrounding salinity. One can observe anemomorphosis, pastures and grass of aerhaline type. A statue of Our Lady of the Cliff marks the top of the cliff and creates a landmark in the landscape. The statue, which represents the Virgin Mary and the patron saints of the three "sister cities" (Mers-les-Bains, Eu, Le Tréport), is visible from afar, even at night.

One can distinguish the dwellings qualified as "villas" in the seaside district, heritage of the city registered in a "safeguarded sector" since 1986, which marks the coastal landscape with their colors and their worked architecture. In Mers-les-Bains, various installations to fight against erosion are set up at the foot of the cliff and on the pebble beach (groins, caissons, riprap).

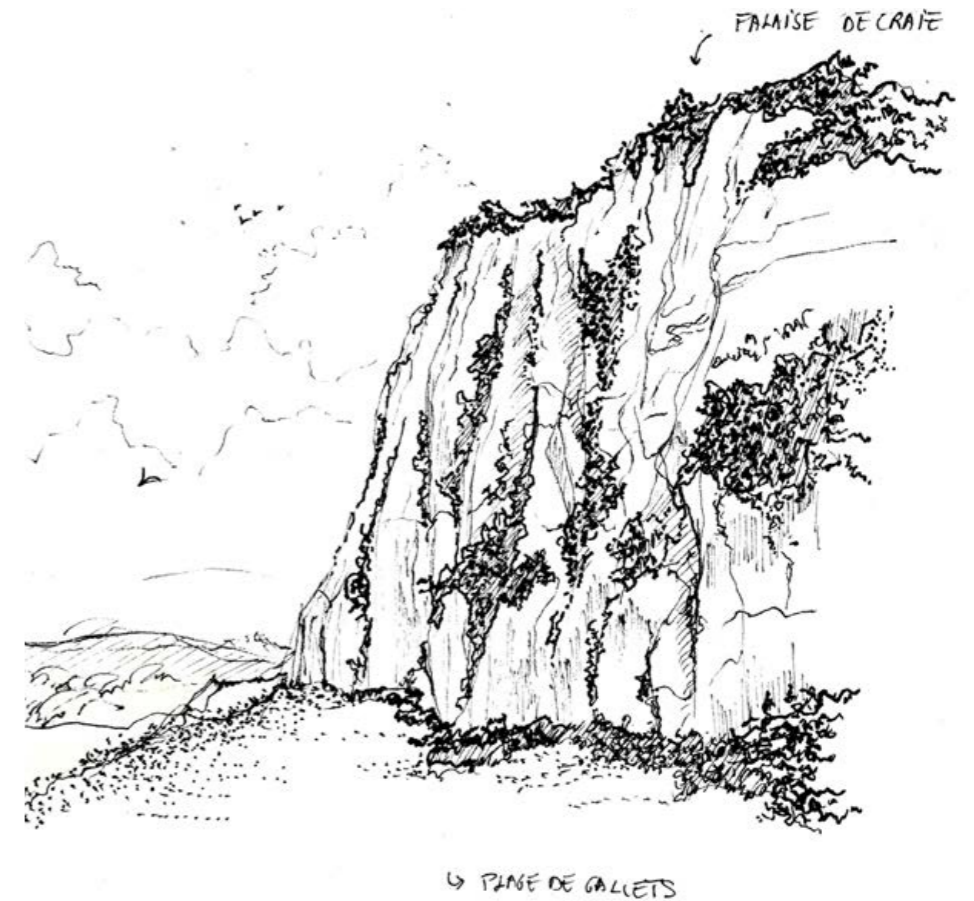


Photo par E. Desmaële: en haut de la falaise, au niveau de Mers-les-Bains, la végétation a été déformé sous la force du vent.





The Bois de Cise valley is a dry valley located about 2km south of the center of Ault. The landscape of this area is quite surprising. The access to the bottom of the valley is done by the D940. One crosses then a rather dense natural wood in which the vegetation mixes with the villas. The wood is an oak grove in which we also find beech trees, chestnut trees.

Around 1896, Jean-Baptiste Theulot, a wine merchant, bought the 50 hectares of Bois de Cise to create a seaside resort. The villas built between the end of the 19th and the beginning of the 20th century offer an architectural heritage to the site. A central square dominates the beach and a staircase leading to the sea marks the opening of this valley to the sea, wedged in the cliff.

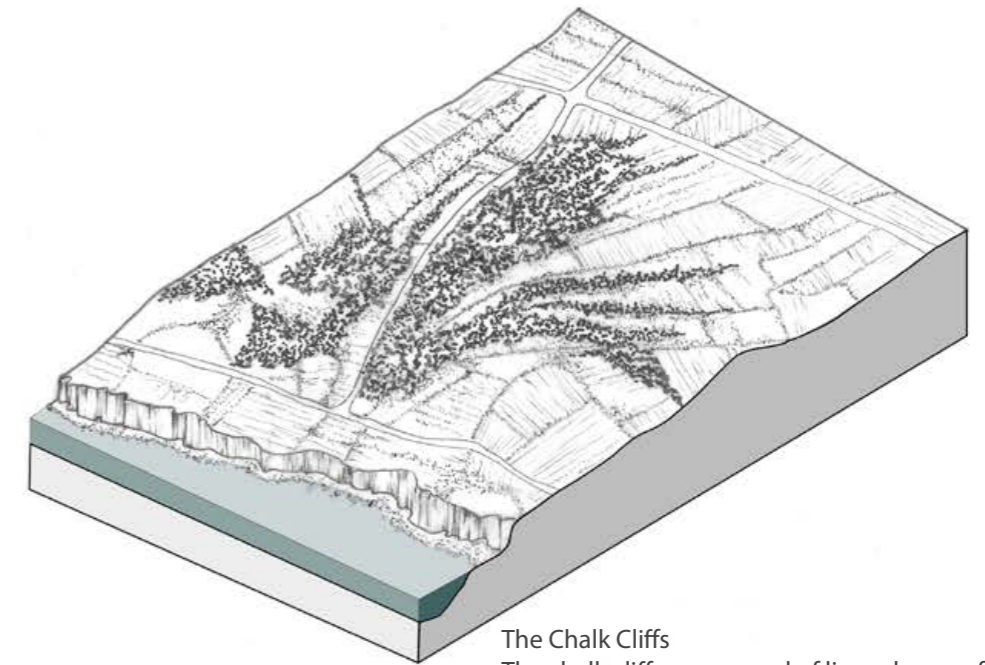
On June 22, 1959, the wood became a registered site in order to avoid its deforestation and to control new constructions.

This sector is also subject to erosion, the valley being particularly faulty. This geomorphological fragility is accentuated by the infiltration of rainwater, the valley receiving runoff from the plateau of Vimeu and the fields.

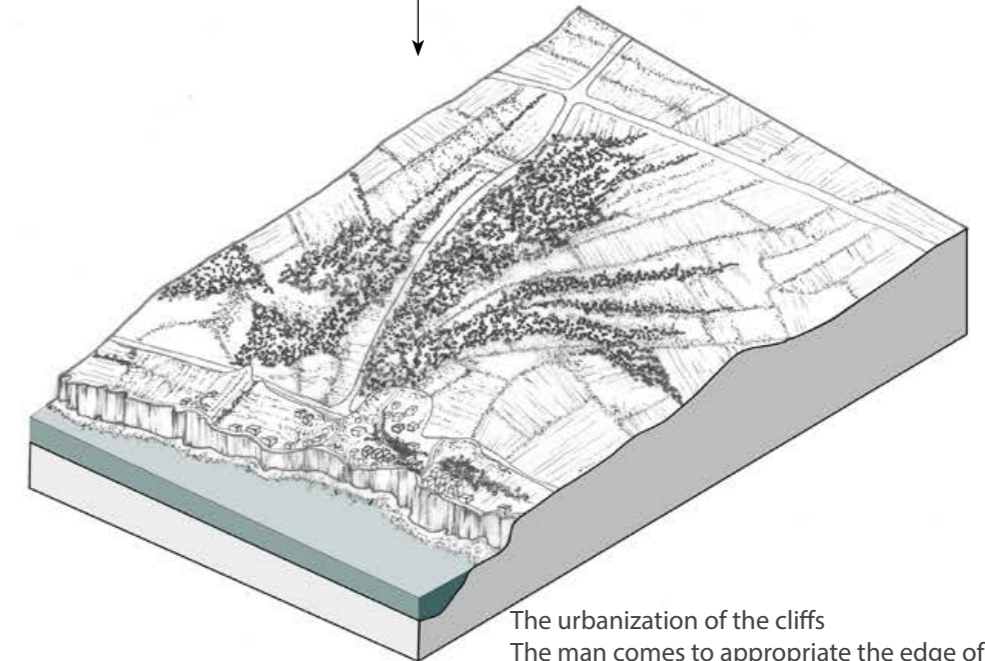
### The living cliff of Le Tréport : Normandy coast

South of Le Tréport, the Norman living cliffs extend into the Bresle valley. Also made of chalk, they rise up to 101 m high. A funicular, installed in 1908, allows to reach the pebble beach from the top of the cliffs. This arrangement allows to enjoy a superb panorama on the coast and to reach the city below quickly and for free.

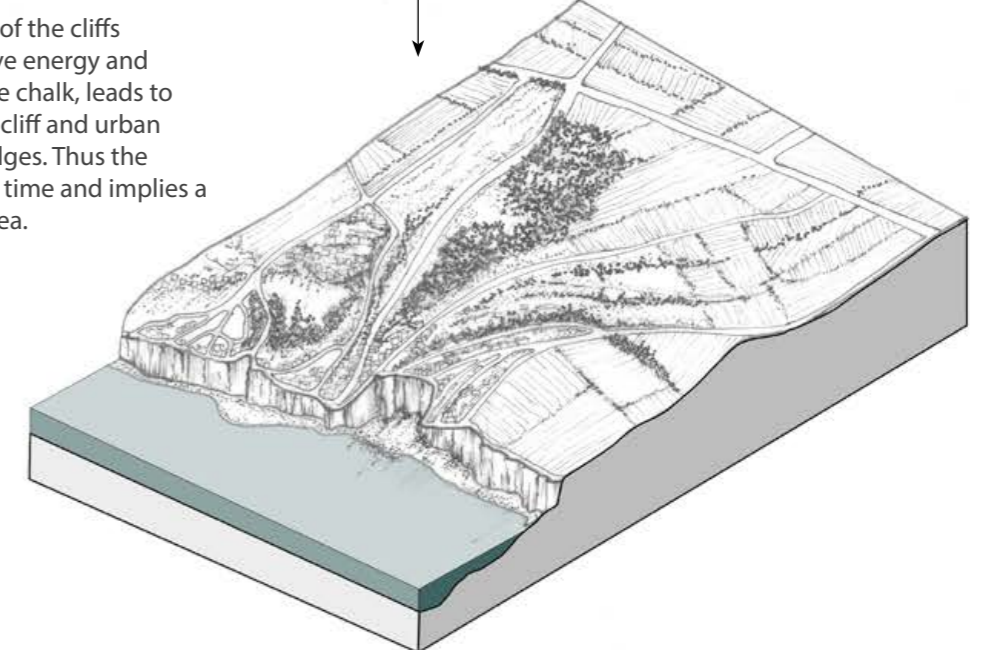
Unlike Mers-les-Bains, fishing is more developed in Le Tréport. Indeed, the port of Le Tréport participates in the economy of the region as a marina, a commercial port and a fishing port. Today, this fishing is threatened by a project of offshore wind platform led by the State and ENGIE. This project is likely to cause problems for fish and disrupt fishing. Forms of protest could be observed in Le Tréport, with slogans on banners such as "NO to the SACCAGE of our fishing zones", showing the opposition of some fishermen and/or inhabitants. Numerous wind turbines are already present on the continent, at the level of the plateau of Vimeu for example, but brings in reality few advantages to the surrounding communes. The development of this clean energy in the region raises questions from an environmental and economic point of view.



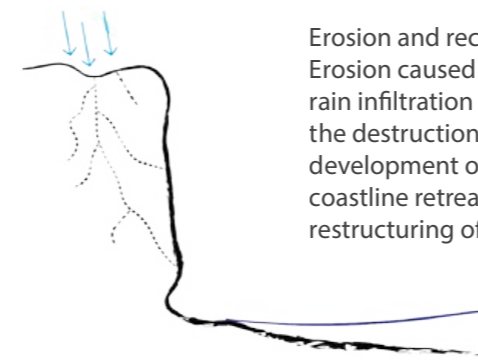
The Chalk Cliffs  
The chalk cliffs, composed of linear layers of flint and chalk, extend from Ault to Tréport.



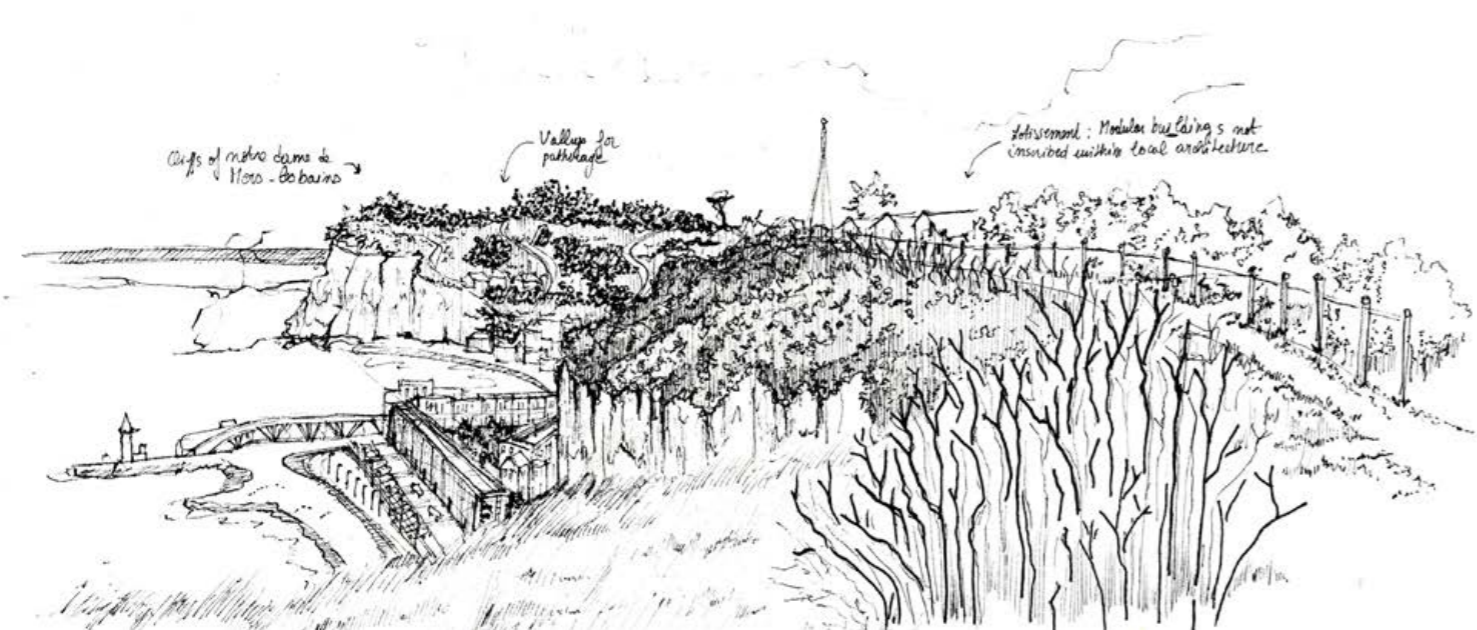
The urbanization of the cliffs  
The man comes to appropriate the edge of the cliffs, they build all along the coastline, sheltered from the sea and the marshes.



Erosion and recession of the cliffs  
Erosion caused by wave energy and rain infiltration into the chalk, leads to the destruction of the cliff and urban development on its edges. Thus the coastline retreats with time and implies a restructuring of the area.



Erosion of chalk cliffs





# 4 - The low fields Cayeux-sur-Mer : an expansion to the sea



Shaped by the hand of man over the centuries, this piece of land takes its name from the fact that it is located below sea level. At the end of the dead cliffs, the territory first takes shape with numerous agricultural plots. Near the coast, agriculture gives way to a wilderness area of sand dunes. After crossing the dunes, a wide pebble beach appears before the sea.

## The Agricultural Fields

The Bas-Champs are located in a triangle between Ault, le Hourdel and St-Valery-sur-Somme. On this territory, the agricultural plots dominate. Divided into small units, they belong to 4500 private owners. The land is cultivated with cereals and beet, as well as with meadows for breeding and fodder production.

Ponds punctuate the landscape. They have different shapes, on some of them floating plastic ducks seem to lead a peaceful life. Huts, built discreetly next to the ponds, allow hunting water game. This activity is very widespread and appreciated in the region.

Canals were built by man from the 18th century onwards and have developed over time to drain water from agricultural plots. Races, former arms of the sea, connect to the canals and structure the landscape. The water that flows in the courses and canals is fresh with a very slight salinity due to the proximity of the sea. The agricultural plots are now protected from rising water thanks to the cordon of pebbles. They represent an important local stake in the landscape, but their preservation remains uncertain in the face of rising waters.

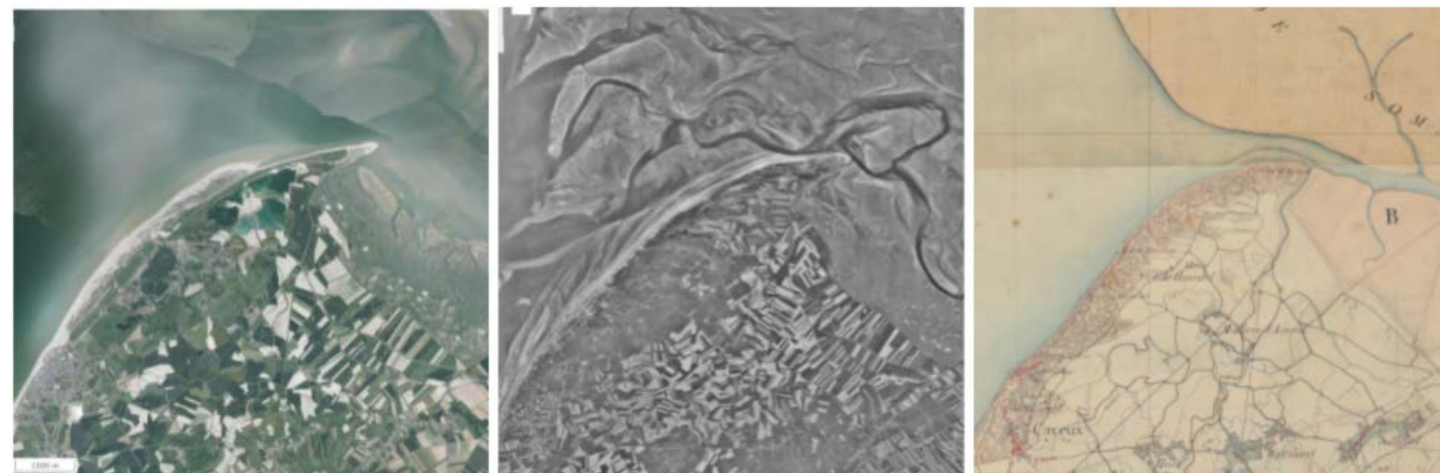
## Pebble Shore

Both in the economic field and in the landscape, the pebble is one of the main elements of this coastal region. Indeed, a large pebble beach extends from Onival to the tip of Hourdel, occupying about 13.8 km of coastline.

The cordon rests on a sandy foreshore and results from the accumulation of pebbles. These pebbles come from the erosion of the Norman living cliffs, south of Ault. The flints from these cliffs migrate from the South to the North, transported by the sea. In this way, the water makes them roll and gives them the round shape of the pebble that we know well. A pebble takes about 10 years to make this journey. At the level of Cayeux and up to the point of Hourdel, the pebbles form crochons. Some are still visible near Hourdel while others have been covered by vegetation and sand (see sand dunes). The northernmost pebbles of this belt are characterized by a blue-gray color, making them of better quality for exploitation. The high quality of these pebbles is due to their high silica content (99%) and their hardness.

North of Cayeux-sur-Mer, a zone of accumulation of pebbles is exploited on 900m by the quarries. They have the authorization to take 50 tons of pebbles per year. In return, the same quantity of pebbles (not rolled) must be brought to the south of the strip. This allows to maintain the supply of pebbles on the spit and avoids to weaken the spit further.

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Comparaison photographie aérienne 2021 - Photographie aérienne historique 1950-65 - Carte de l'Etat-major (1820-1866)



Photo by L. Samson : we can see the accumulation of the pebbles on the south side and the erosion on the north side. this is because the migration of sediment happens from south-west to north-east



The barrier represents a protection for the lowlands and the neighbouring towns. Without it, the lowlands would be submerged, leading to a complete change in the landscape. Today, this cordon is threatened by erosion. An important issue is therefore at stake for the preservation of this space.

After floods in 1990, 80 concrete groins were built south of Cayeux-sur-Mer to slow down the migration of pebbles. Today, a total of 104 groins have been built. Every year, 85,000 tons of material are put back to maintain the barrier beach. Each groin is spaced 90 m apart and is composed of a concrete bar associated with sheet piles anchored in the ground. The groins require regular renovation due to abrasion of the pebbles on their crowns. The groins blend in quite well with the landscape due to their gray color, which is close to that of the cobbles.

The dynamics of pebble migration can easily be observed on the beach at the level of these groins. Indeed, we notice that the pebbles accumulate on the south side of the groins, testifying to the force of water transport (see photo). This relationship with the sea is all the more striking on the spot, on a “stormy” day like we experienced, where the agitated sea comes to crash on the beaches and the groins.

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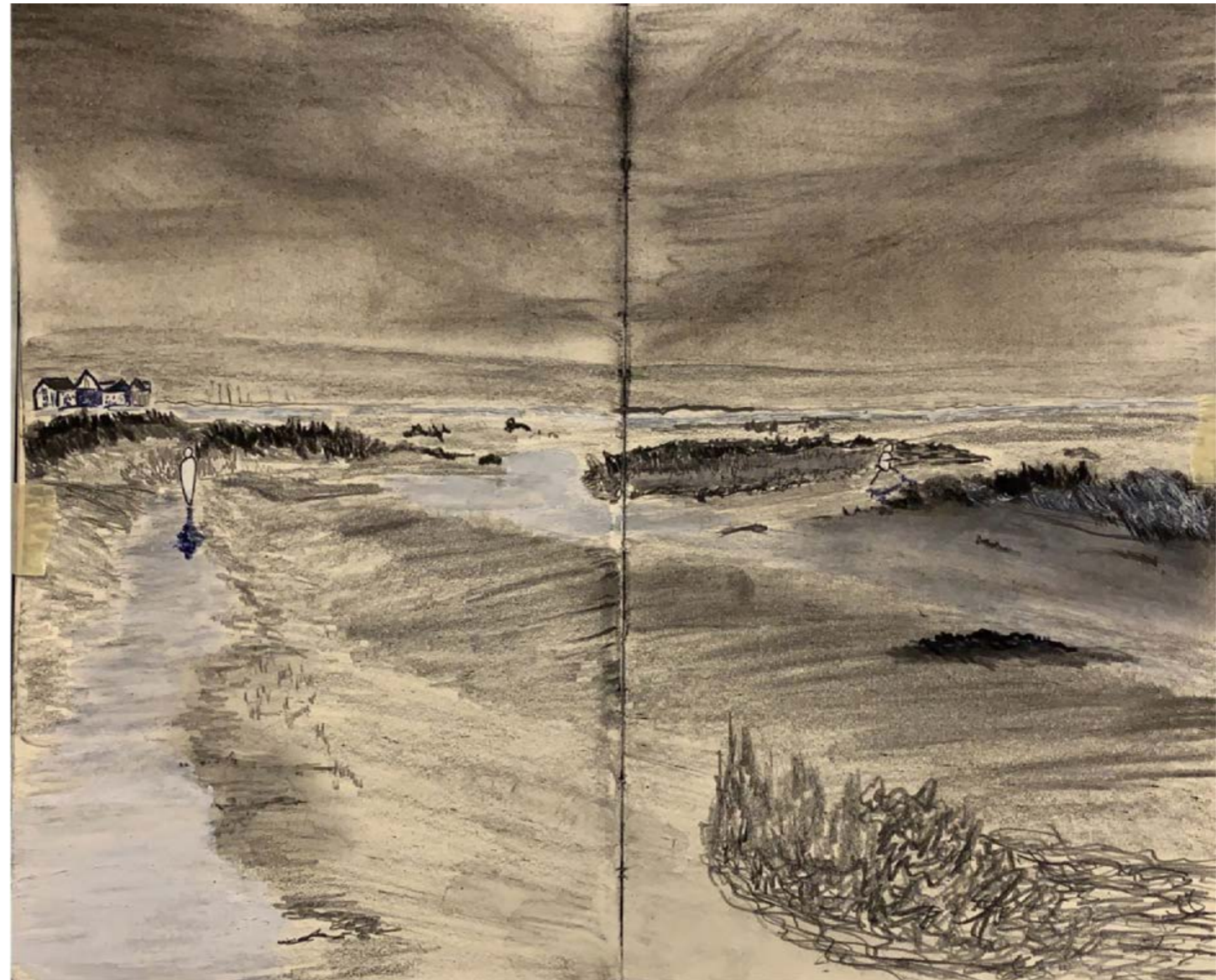
## Dunes

To continue its way on the coastline in direction of the point of Hourdel, another face of the Low Fields is revealed: that of the dunes. This so particular area marks the point where the retreat of the cordon gives place to the accumulation, what the local people call the “fulcrum”. At first glance, the landscape is dominated by a low vegetation layer that seems more subjected to bad weather than the rest of the lowlands but also under the influence of visitors forming bare areas related to the more or less visible trampling.

However, the large stands of sand amnophiles, obiones, sea cabbages and *Batis maritima* present on the top of the dunes demonstrate the opposite by being well anchored on the site. The vegetation allows a protection against the wind. It becomes more and more woody towards the land, such as privet and sea buckthorn.

The local actors specify that the *Arroche du littoralis* (*Atriplex littoralis*) is one of the typical species of Cayeux as well as the association of these 3 species: the *Criste marine* (*Critum maritimum* L.), the *Armérie maritime* (*Armeria maritima*) and the *Pavot Cornu* (*Glaucium flavum*)

Heading towards Le Hourdel, another landscape appears. This time, the proximity of the channel of the Somme has a rather consequent influence on the dunes which evolve at the rhythm of the tides and the seasons. The landscape dynamics are well felt on this portion of the lowlands because the accumulations of pebbles in the form of successive hooks show this conquest of the land over the sea. Plants such as glasswort settle temporarily behind these dikes forming mollières (or schorres).





**BEFORE THE 18<sup>th</sup> CENTURY**

Estuary of Somme  
The Somme river flowing in the English Channel

Zone of sedimentation  
The Somme River deposits its sediments all along the bay creating environments of ecological interest such as the sandy slikke

The Vimeu Plateau  
Territory formed of fertile silty soil which is ideal for agriculture --> becomes very coveted agricultural land

Living cliffs of Vimeu  
Limestone cliff of the Vimeu which raises and protects the agricultural lands from the sea

The English Channel  
Sea of the Normandy coast which separates the north of France from the United Kingdom

**AT THE 18<sup>th</sup> CENTURY**

Dead cliffs of Vimeu  
Following the advance of the land, the old cliffs have no more contact with the water, they are now qualified as dead cliffs

The Lower Fields  
In the 17th century, men started to dig races and canals in order to drain the sea and to gain new agricultural lands. Initially, these new lands were not very suitable for agriculture. They were historically allocated to the most modest peasants

**19-20<sup>th</sup> CENTURY**

Carrières de galets  
L'accumulation de galets a permis le développement d'une économie locale centrée sur l'extraction de galets

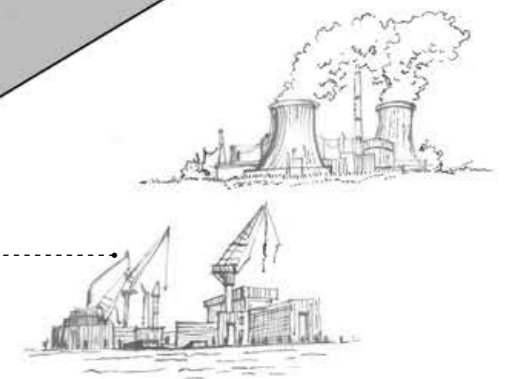
Sand dunes  
Dune landscapes formed by the pebble spikes covered with sand and vegetation adapted to the salinity.

Development of the pebble belt  
The flint blocks from the erosion of the chalk cliffs to the south of the lowlands are transported by the sea currents along the coast. Transformed into pebbles, they accumulate to form this barrier that protects the lowlands.

**TODAY**

Concrete groins  
Installation of groins perpendicular to the shoreline in order to slow down the migration of pebbles and protect the barrier beach from erosion

Threat to the pebble beach  
The construction of port infrastructures and the nuclear power plant further south of the coast have impacted the migration of pebbles, weakening the barrier beach and threatening to submerge the lowlands with rising water.





# 5 - The estuary of Somme: in the rythm of the tides



This territory traces a thousand years of human history. Initially formed by an archipelago of small islands, it was populated by Celtic tribes of fishermen. The activities of the bay were adapted according to the tides. Until the 13th century, navigation by boat was possible in the bay. The tides have shaped the landscape, depositing layers of sediment and forming pools of sea water called Bâches.

Over the centuries, man sought to expand the agricultural plots to produce more food resources. Gradually, land was reclaimed from the sea with the successive construction of dikes and other infrastructure. The flow of sediment gradually decreased to form the Somme estuary of today.

There are several ways to categorize the bay and its estuary according to topography, sea level, the site can also be observed at different scales. The large scale highlights the tidal action and the presence of a marine marsh. The small scale details the anthropic activities practiced on the territory. According to the elevation, from the highest to the lowest, the sub-units are composed of the schorre, the slikke and the channel of the Somme.

### The Schorre - Salt Marshes

Located on the highest part of the estuary, the schorre is also called molière in the region. It is defined by an area of maritime marsh, with strong floristic and faunistic interests. The place is colonized by a halophilic vegetation with the presence of *Plantagini maritimae* and *Limonietum vulgaris*, it is also a station of ornithological observation. The salt meadows cover part of the territory, they occupy an important place in the local agriculture with the sheep breeding. On the schorre, many ponds dug by man punctuate the

landscape. They are used for hunting waterfowl, a very common practice on this site. These two activities have an economic and social role but they also present a risk for the preservation of local biodiversity. One of the issues related to this territory is the regulation of the activities carried out on the site in order to preserve the species present and their habitats.

### The Slikke - Mudflat

Located at the level below the schorre, this part of the estuary consists mainly of mudflats, areas where sand, mud and other sediments are deposited by ocean currents. It is also the habitat of seals in some areas. On this territory, activities are centered around fishing. Several types of fishing are practiced: fishing on foot, mussel farming as well as the harvesting of sea vegetation (saltwort and maritime aster). This particular place regulates the fishing actions naturally with the movement of the tides. One of the main challenges of the territory is to protect and safeguard the ecosystems and to maintain the open environments to avoid silting up by sediments.

### Somme Channel

The river is located at the lowest level of the estuary. Upstream, in the valley, the low gradient of the river has shaped numerous meanders creating a complex network of streams. In the seaward direction, the stream flows in a controlled manner through a concrete channel, which results in the absence of sediment towards the sea and a faster flow of water. In the bay, the direction of the Somme is managed by constructed dikes. This territory presents a flooding problem because the Somme river is gradually deepening in the face of the sediment barrier brought by the sea at the mouth of the estuary.

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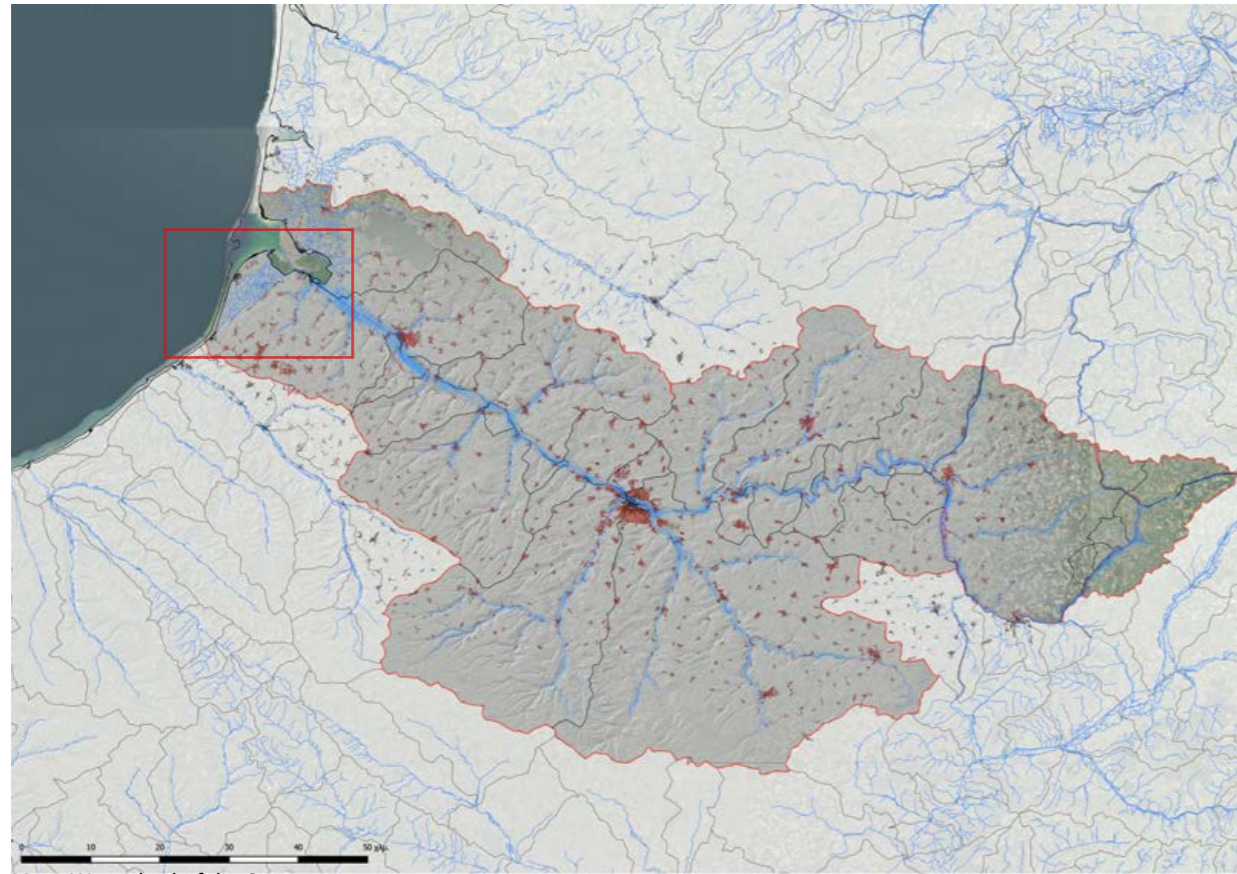


Photo by M. Gastebois : smudflat at the level of Hourdel in low tide (june 2021).

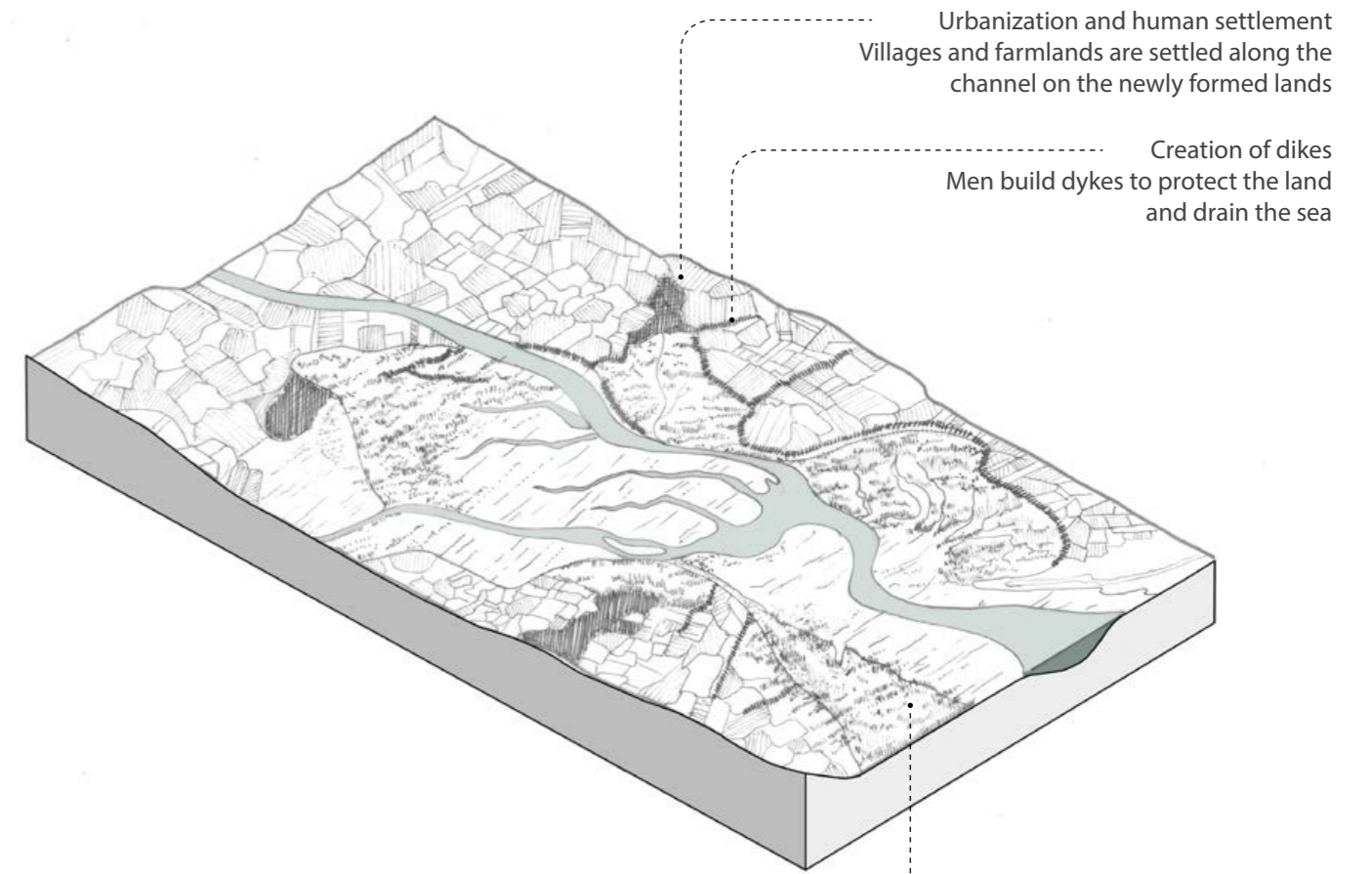


Photo par M. Gastebois : slikke and molière at Hourdel in low tide (june 2021).





Map : Watershed of the Somme.

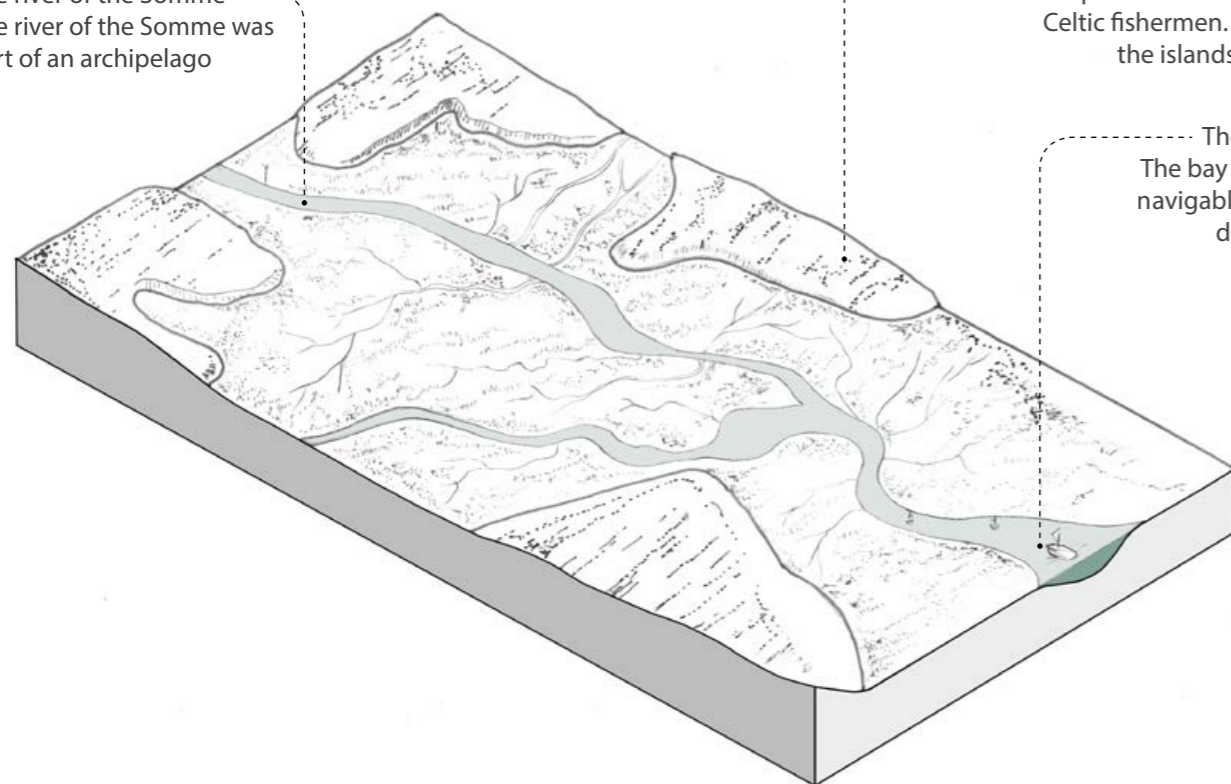


Urbanization and human settlement  
Villages and farmlands are settled along the channel on the newly formed lands

Creation of dikes  
Men build dykes to protect the land and drain the sea

Appearance of the molières  
The sediments deposited by the sum create the slikke and the schorre located further from the water

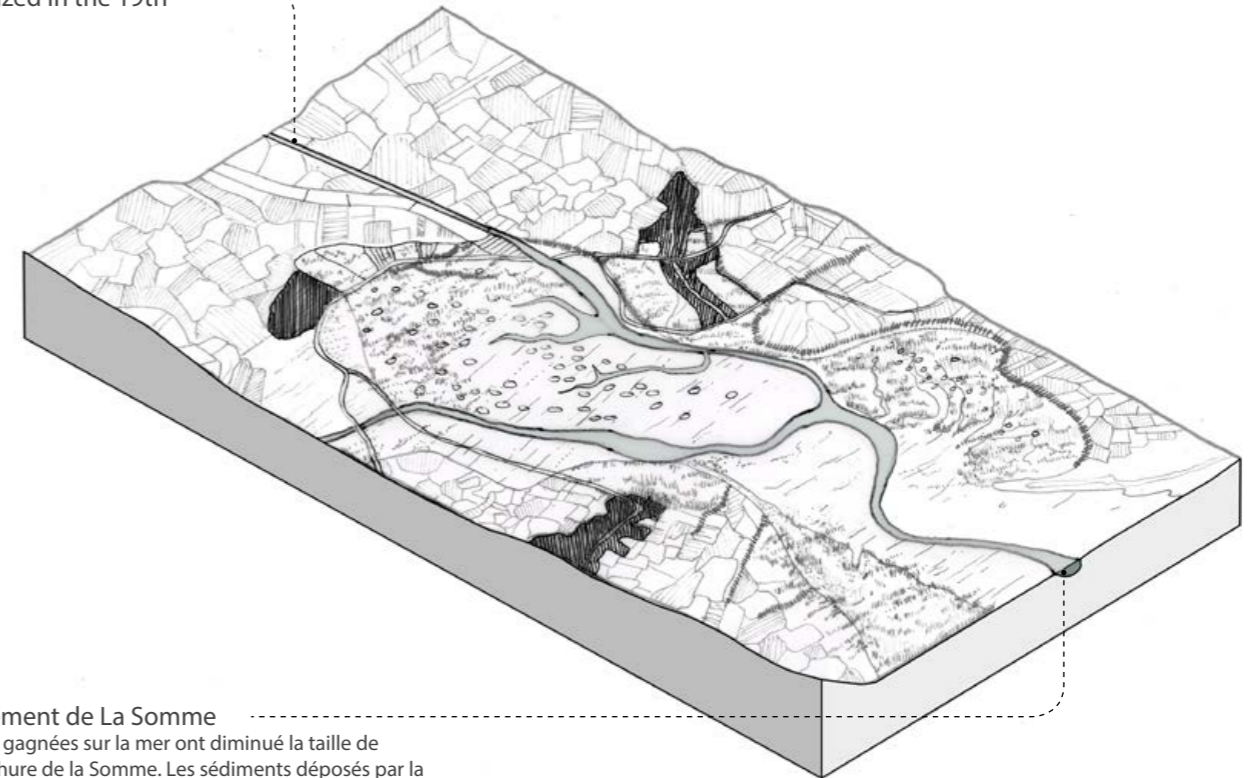
The river of the Somme  
The river of the Somme was part of an archipelago



The almost-islands of the fishermen  
The peninsulas were inhabited by Celtic fishermen. During low tide the islands are connected.

The Navigable Bay  
The bay was completely navigable and floodable during high tides

Canalization of the Somme  
The outlet of the Somme is canalized in the 19th century



Ensamblage de La Somme  
Les terres gagnées sur la mer ont diminué la taille de l'embouchure de la Somme. Les sédiments déposés par la Somme et la mer s'accablent sur une surface plus petite, causant l'ensablement progressif de l'estuaire. Cela créera des problèmes d'inondation en amont dans le future.



The Estuary of Somme

The Low Fields Cayeux-sur-Mer

The Plateau of Vimeu

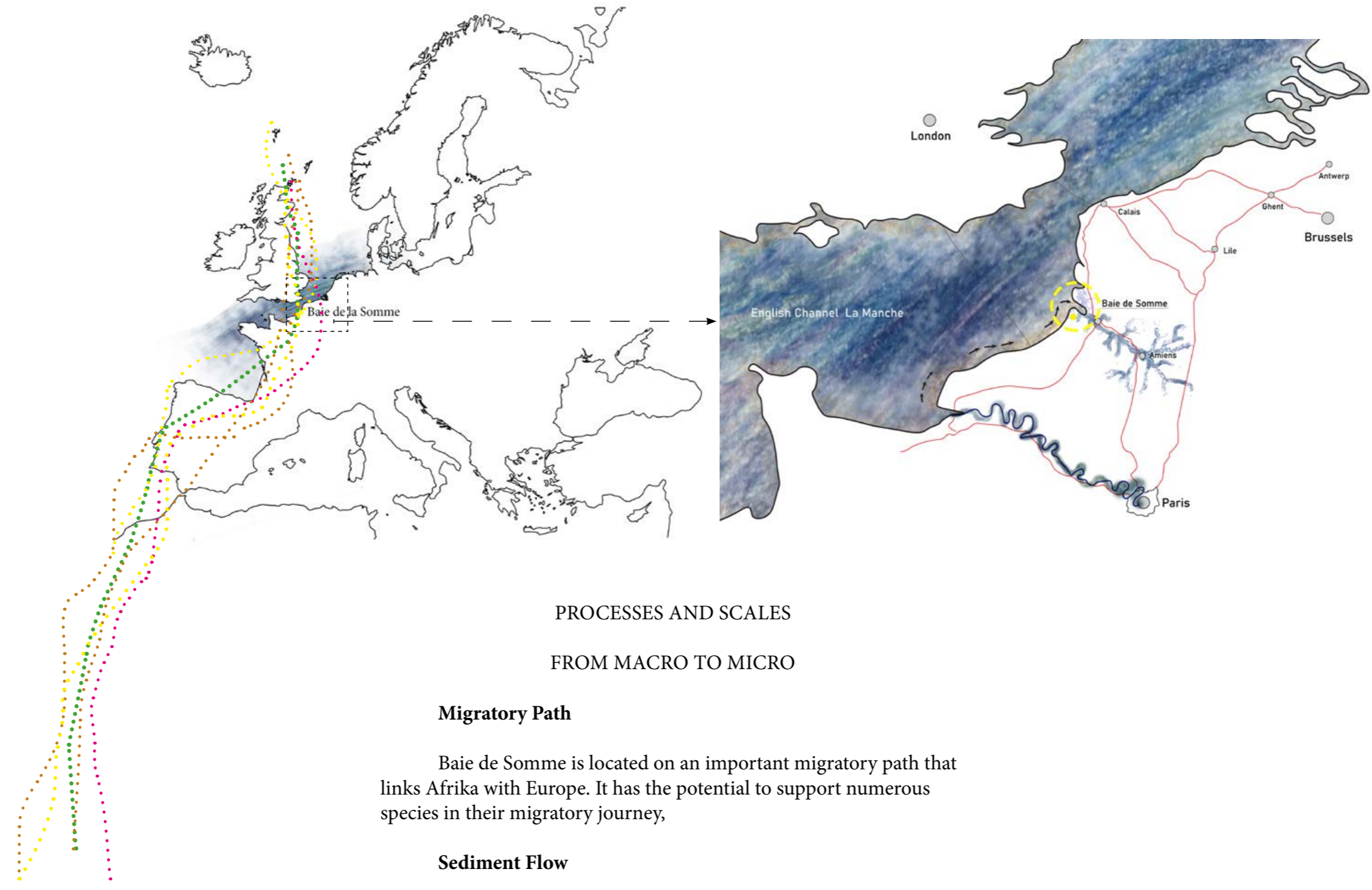
The Valley of Bresle





# **03 ANALYSE AND UNDERSTAND**





PROCESSES AND SCALES  
FROM MACRO TO MICRO

**Migratory Path**

Baie de Somme is located on an important migratory path that links Afrika with Europe. It has the potential to support numerous species in their migratory journey,

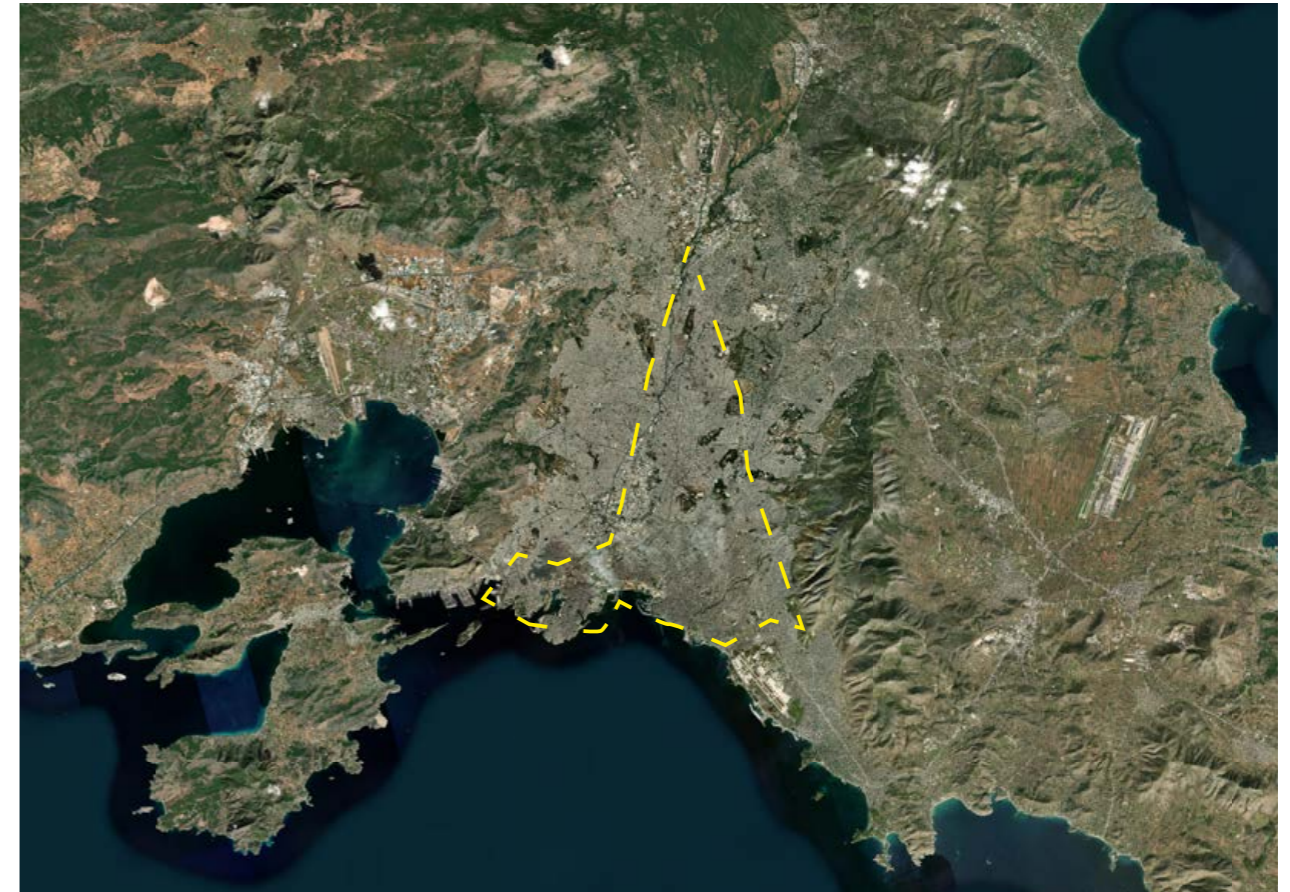
**Sediment Flow**

An important flow of sediment happens from south-West to north-East. The sediments from the Seine River and the material of the eroded coast cliffs flow to the estuary. Constructions on the coast are affecting this flow that normally stabilised the area.





Baie de Somme, France



Athens, Greece



Barcelona, Spain

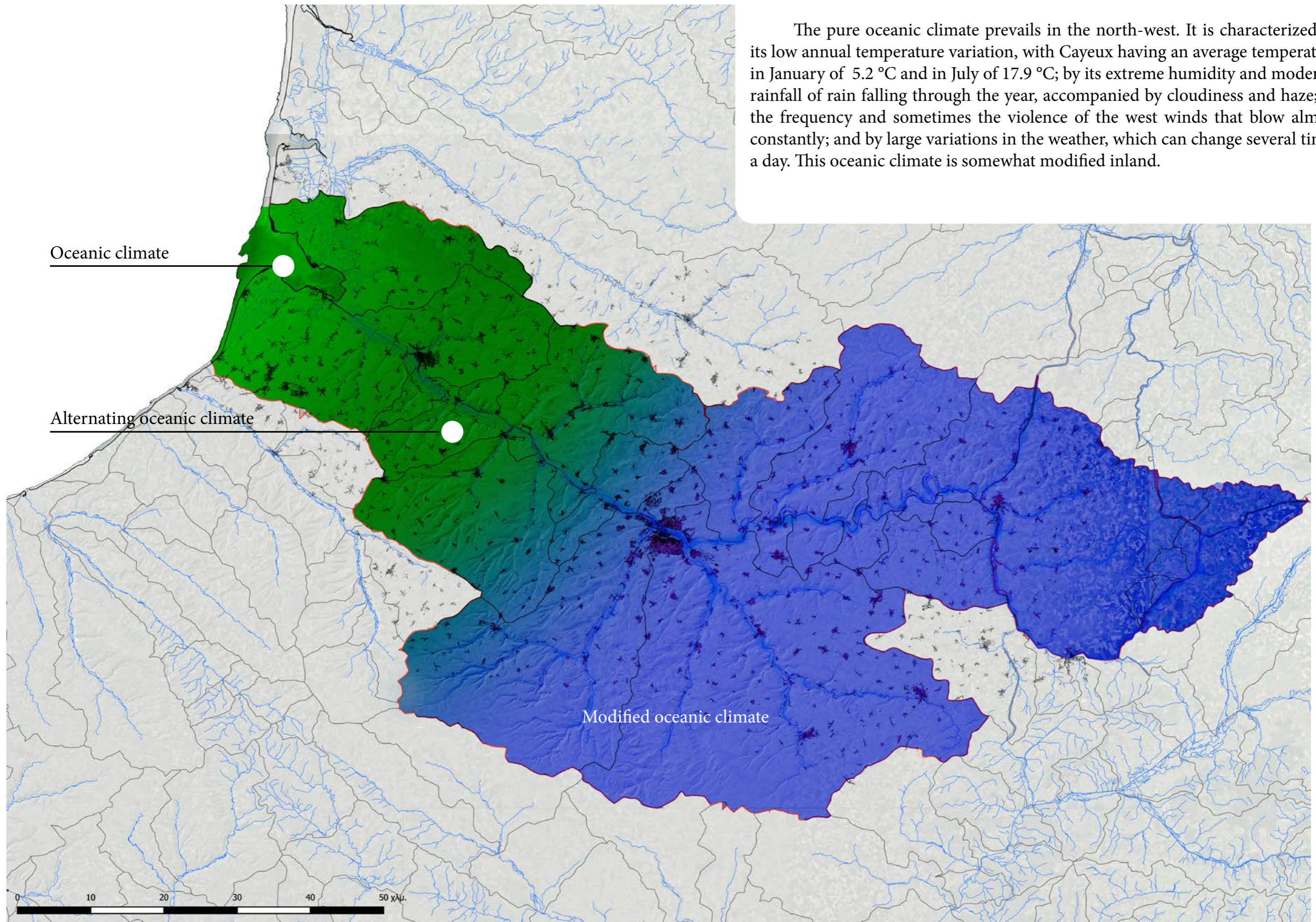
#### SCALE COMPARISON

In order for me to understand the scale of the territory I compare it with the places I know well in the same scale. The Area of Bas Champs is 42,6 km<sup>2</sup> and the area of Baie de Somme is 42.1 km<sup>2</sup> combined they have an area of 84,7 km<sup>2</sup>.



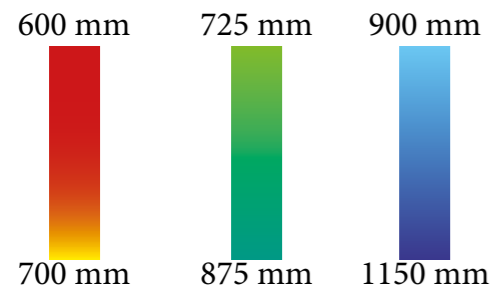
## CLIMATE TYPES

The pure oceanic climate prevails in the north-west. It is characterized by its low annual temperature variation, with Cayeux having an average temperature in January of 5.2 °C and in July of 17.9 °C; by its extreme humidity and moderate rainfall of rain falling through the year, accompanied by cloudiness and haze; by the frequency and sometimes the violence of the west winds that blow almost constantly; and by large variations in the weather, which can change several times a day. This oceanic climate is somewhat modified inland.





### ANNUAL PRECIPITATION

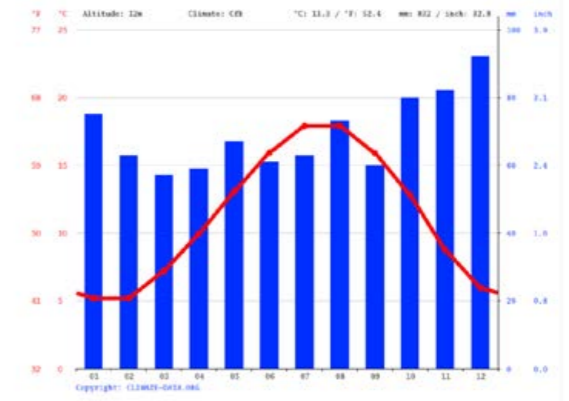


### ANNUAL ENVIRONMENTAL DATA

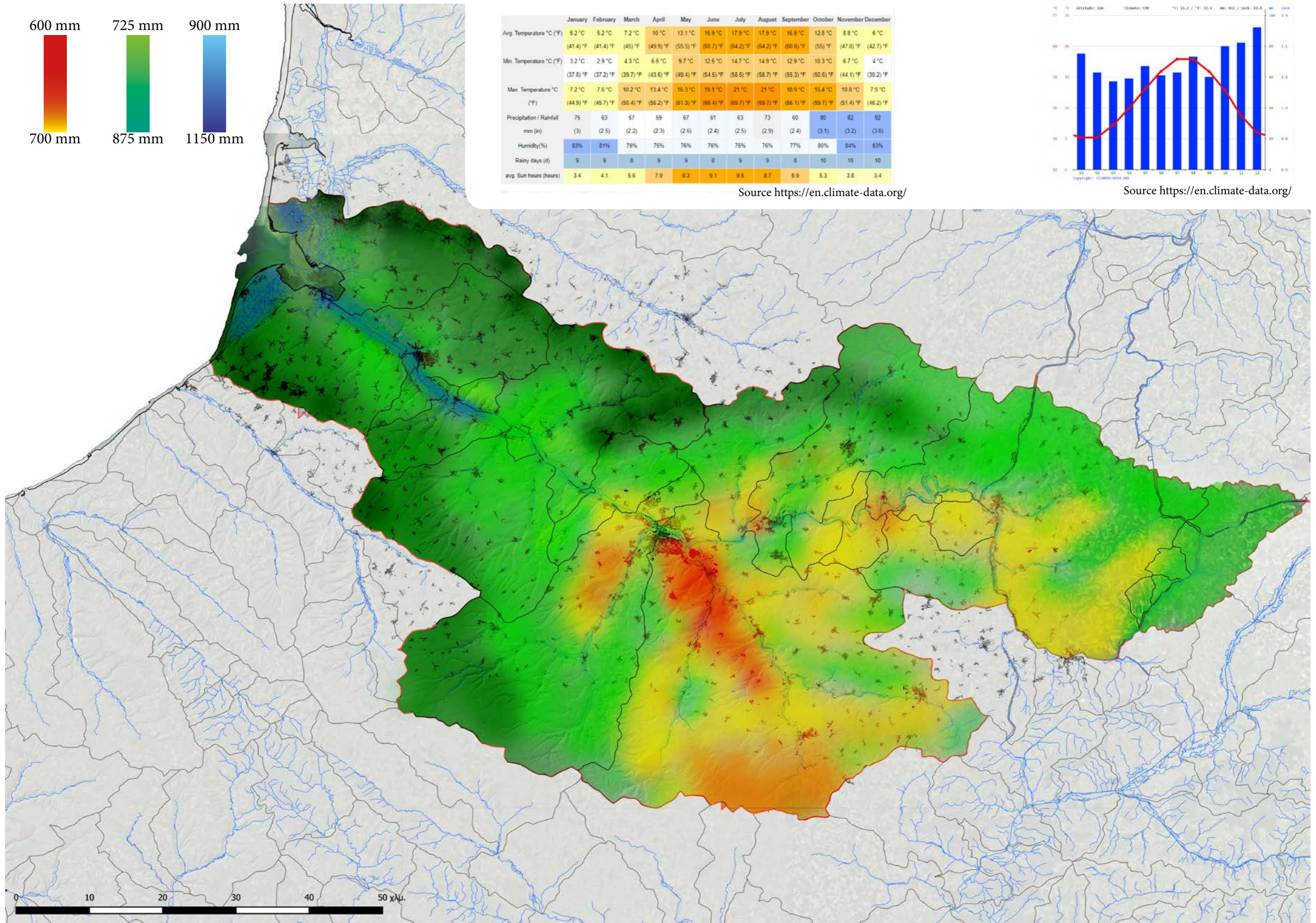
	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature °C (°F)	5.2 °C (41.4) °F	5.2 °C (41.4) °F	7.2 °C (45) °F	10 °C (49.9) °F	13.1 °C (55.5) °F	15.9 °C (60.7) °F	17.9 °C (64.2) °F	17.9 °C (64.2) °F	15.9 °C (60.6) °F	12.8 °C (55) °F	8.8 °C (47.8) °F	6 °C (42.7) °F
Min. Temperature °C (°F)	3.2 °C (37.8) °F	2.9 °C (37.2) °F	4.3 °C (39.7) °F	6.5 °C (43.6) °F	9.7 °C (49.4) °F	12.5 °C (54.5) °F	14.7 °C (58.5) °F	14.9 °C (58.7) °F	12.9 °C (55.3) °F	10.3 °C (50.6) °F	6.7 °C (44.1) °F	4 °C (39.2) °F
Max. Temperature °C (°F)	7.2 °C (44.9) °F	7.6 °C (45.7) °F	10.2 °C (50.4) °F	13.4 °C (56.2) °F	16.3 °C (61.3) °F	19.1 °C (66.4) °F	21 °C (69.7) °F	21 °C (69.7) °F	18.9 °C (66.1) °F	15.4 °C (59.7) °F	10.8 °C (51.4) °F	7.9 °C (46.2) °F
Precipitation / Rainfall mm (in)	75 (3)	63 (2.5)	57 (2.2)	59 (2.3)	67 (2.6)	61 (2.4)	63 (2.5)	73 (2.9)	60 (2.4)	80 (3.1)	82 (3.2)	92 (3.6)
Humidity (%)	83%	81%	79%	75%	76%	76%	75%	76%	77%	80%	84%	83%
Rainy days (d)	9	9	8	9	9	8	9	9	8	10	10	10
avg Sun hours (hours)	3.4	4.1	5.6	7.9	8.3	9.1	9.5	8.7	6.9	5.3	3.8	3.4

Source <https://en.climate-data.org/>

### CLIMATE GRAPH BY MONTH



Source <https://en.climate-data.org/>



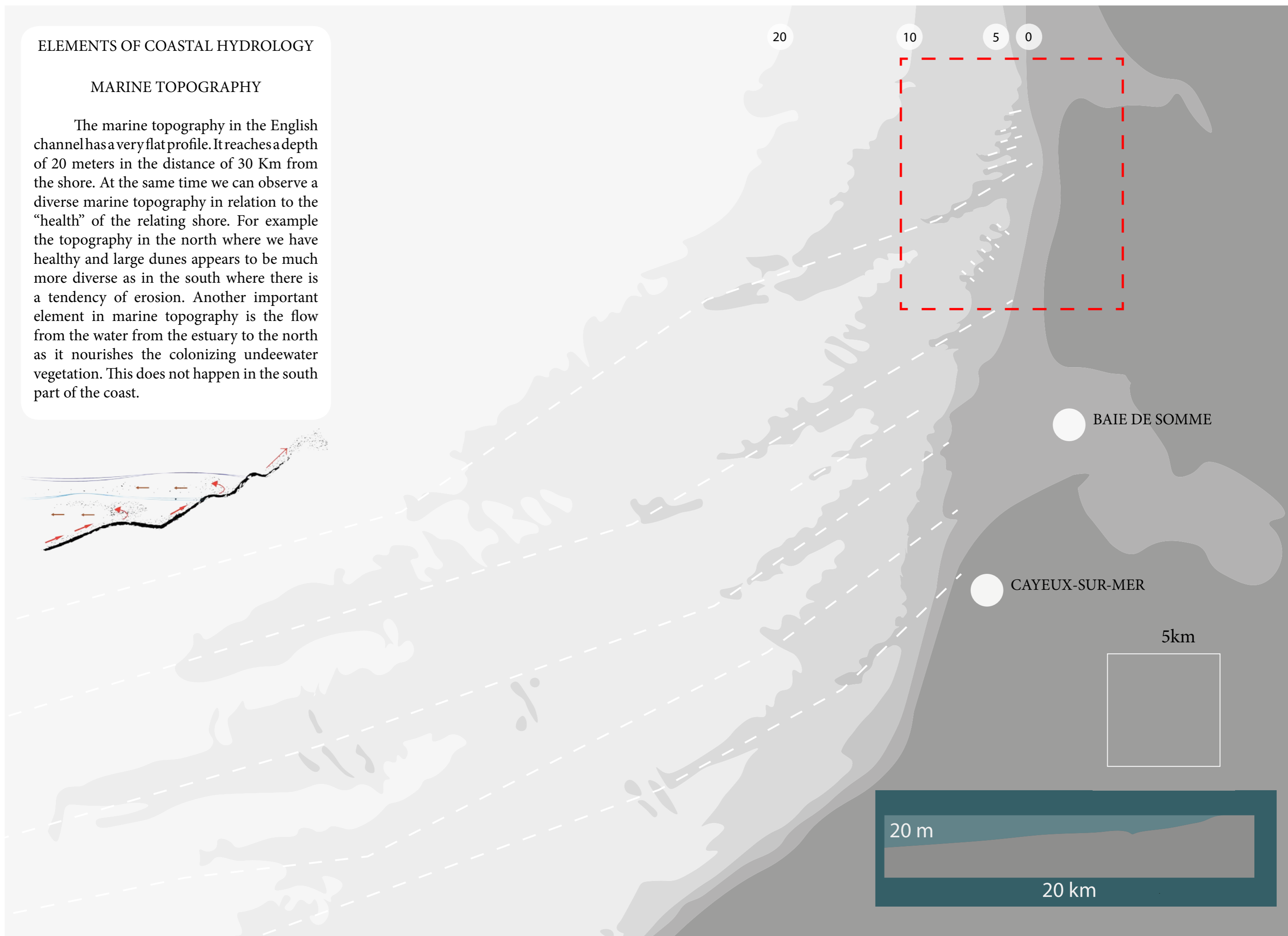
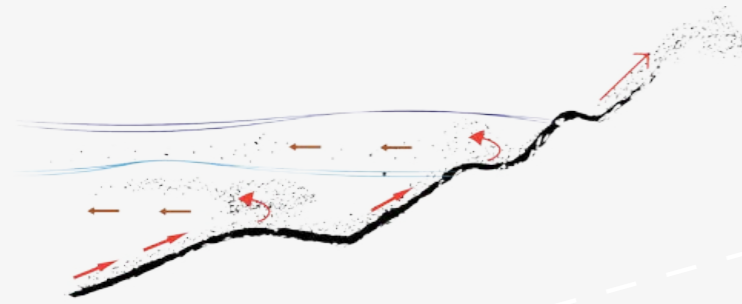


## ELEMENTS OF COASTAL HYDROLOGY

### MARINE TOPOGRAPHY

The marine topography in the English channel has a very flat profile. It reaches a depth of 20 meters in the distance of 30 Km from the shore. At the same time we can observe a diverse marine topography in relation to the "health" of the relating shore. For example the topography in the north where we have healthy and large dunes appears to be much more diverse as in the south where there is a tendency of erosion. Another important element in marine topography is the flow from the water from the estuary to the north as it nourishes the colonizing undeewater vegetation. This does not happen in the south part of the coast.

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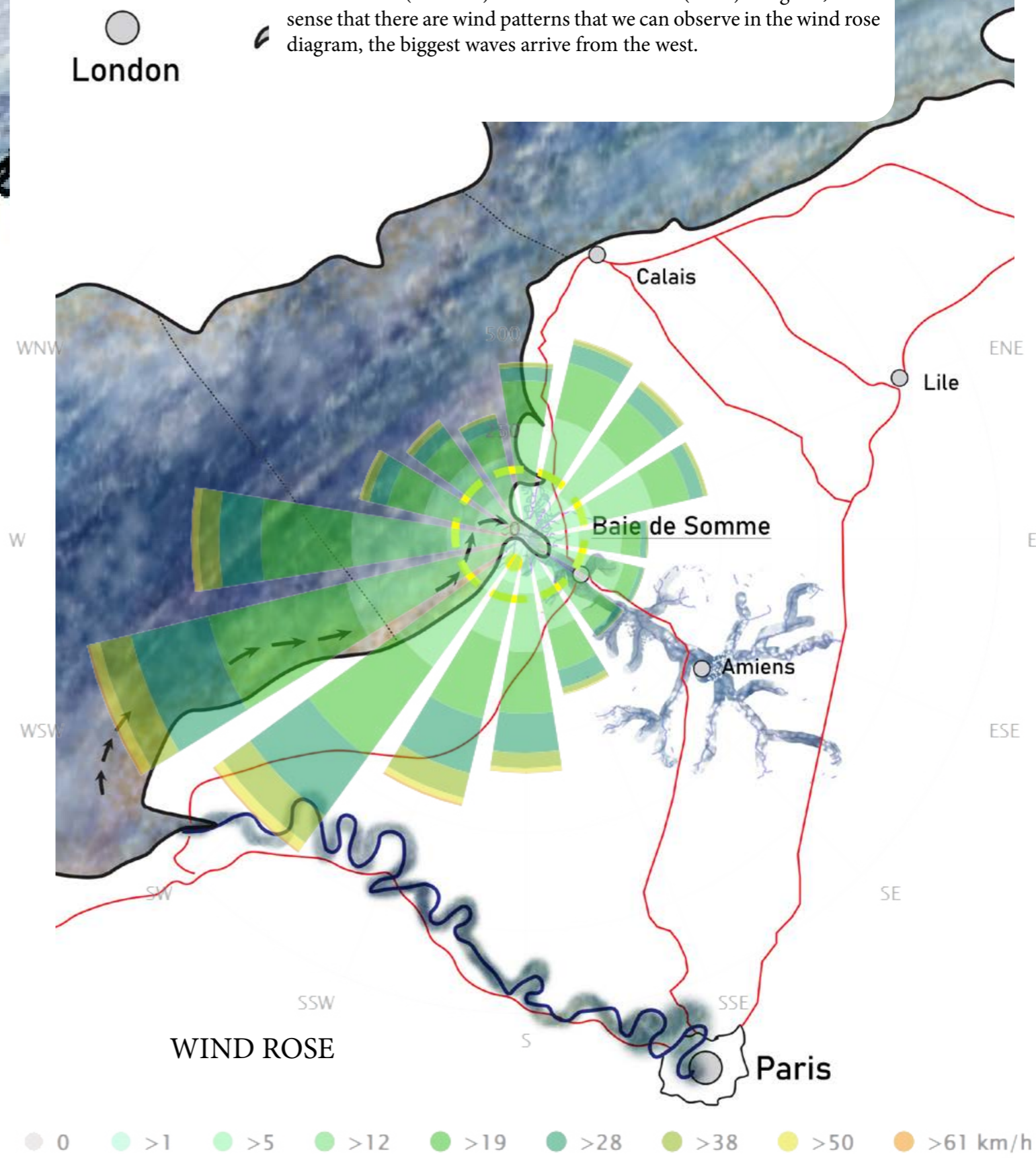


COAST DISTANCES AND WAVE PROPAGATION

ELEMENTS OF COASTAL HYDROLOGY

WAVE PROPAGATION  
DISTANCE AND WIND

Waves normally accumulate energy through two conditions : distance from shore, and wind parameters such as direction, strength and frequency. Because these two condition work together and because the one (distance) is stable and the other (wind) is regular, in the sense that there are wind patterns that we can observe in the wind rose diagram, the biggest waves arrive from the west.



WIND ROSE



## ELEMENTS OF HYDROLOGY

### ANCIENT HYDROLIC IDENTITY

This territory traces a thousand years of human history. Initially formed by an archipelago of small islands, it was populated by Celtic tribes of fishermen. The activities of the bay were adapted according to the tides. Until the 13th century, navigation by boat was possible in the bay. The tides have shaped the landscape, depositing layers of sediment and forming pools of sea water called Bâches.

Over the centuries, man sought to expand the agricultural plots to produce more food resources. Gradually, land was reclaimed from the sea with the successive construction of dikes and other infrastructure. The flow of sediment gradually decreased to form the Somme estuary of today.

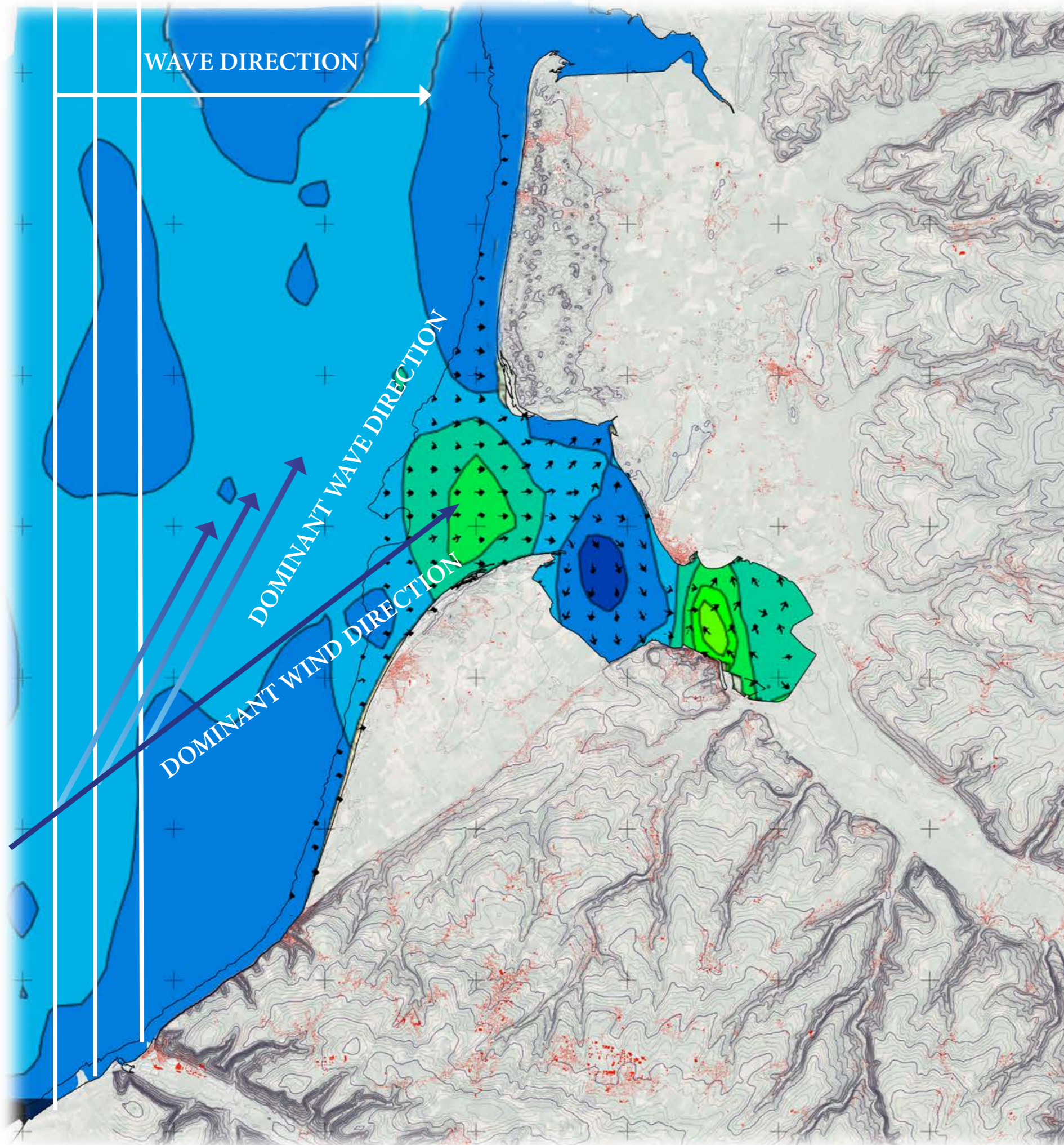




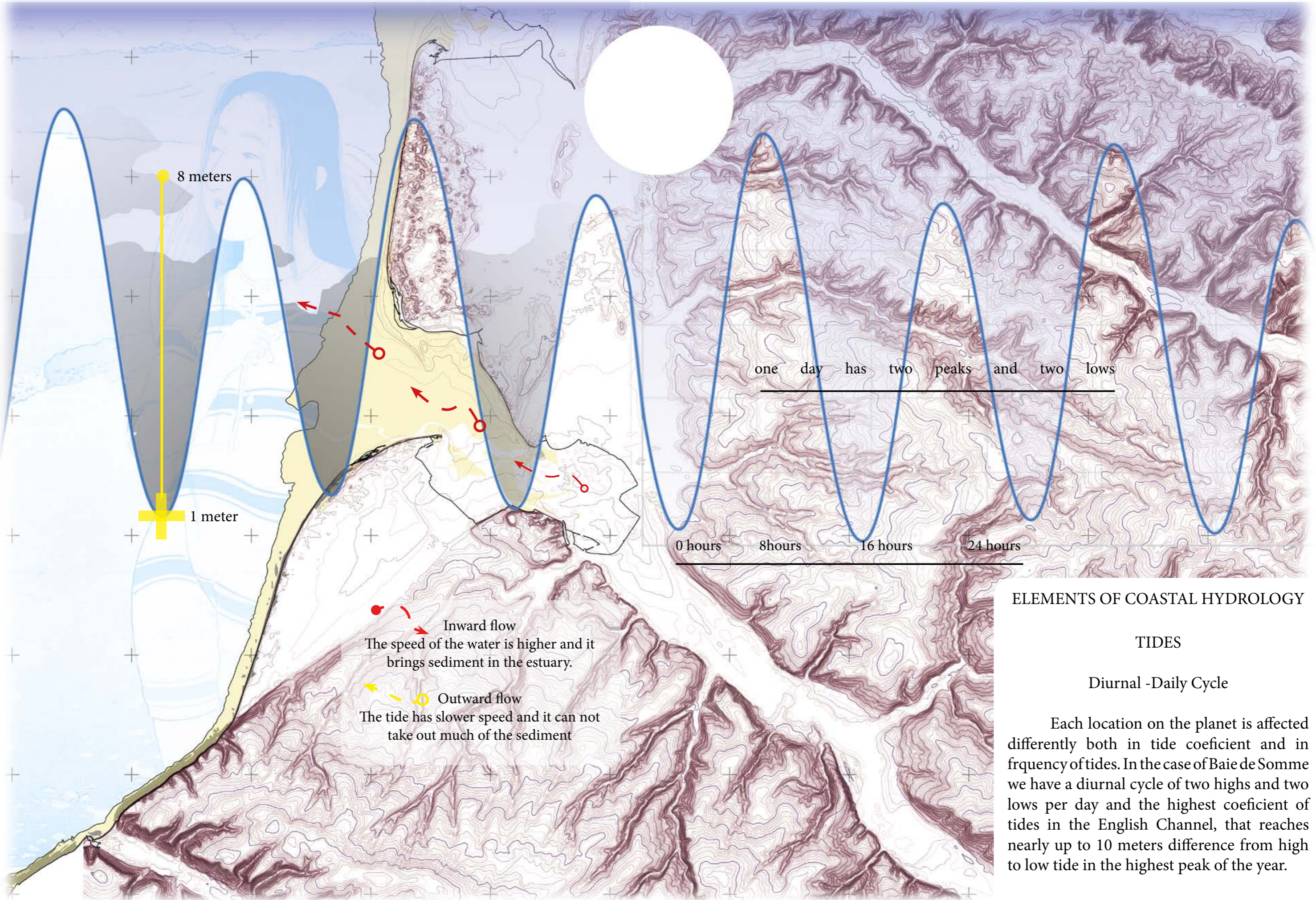
## ELEMENTS OF COASTAL HYDROLOGY

### WAVE DIRECTION

Waves normally accumulate energy through two conditions distance from shore, and wind parameters such as direction, strength and frequency. Because these two conditions work together and because the one (distance) is stable and the other (wind) is regular, in the sense that there are wind patterns that we can see in the wind rose diagram, the biggest waves arrive from the west.







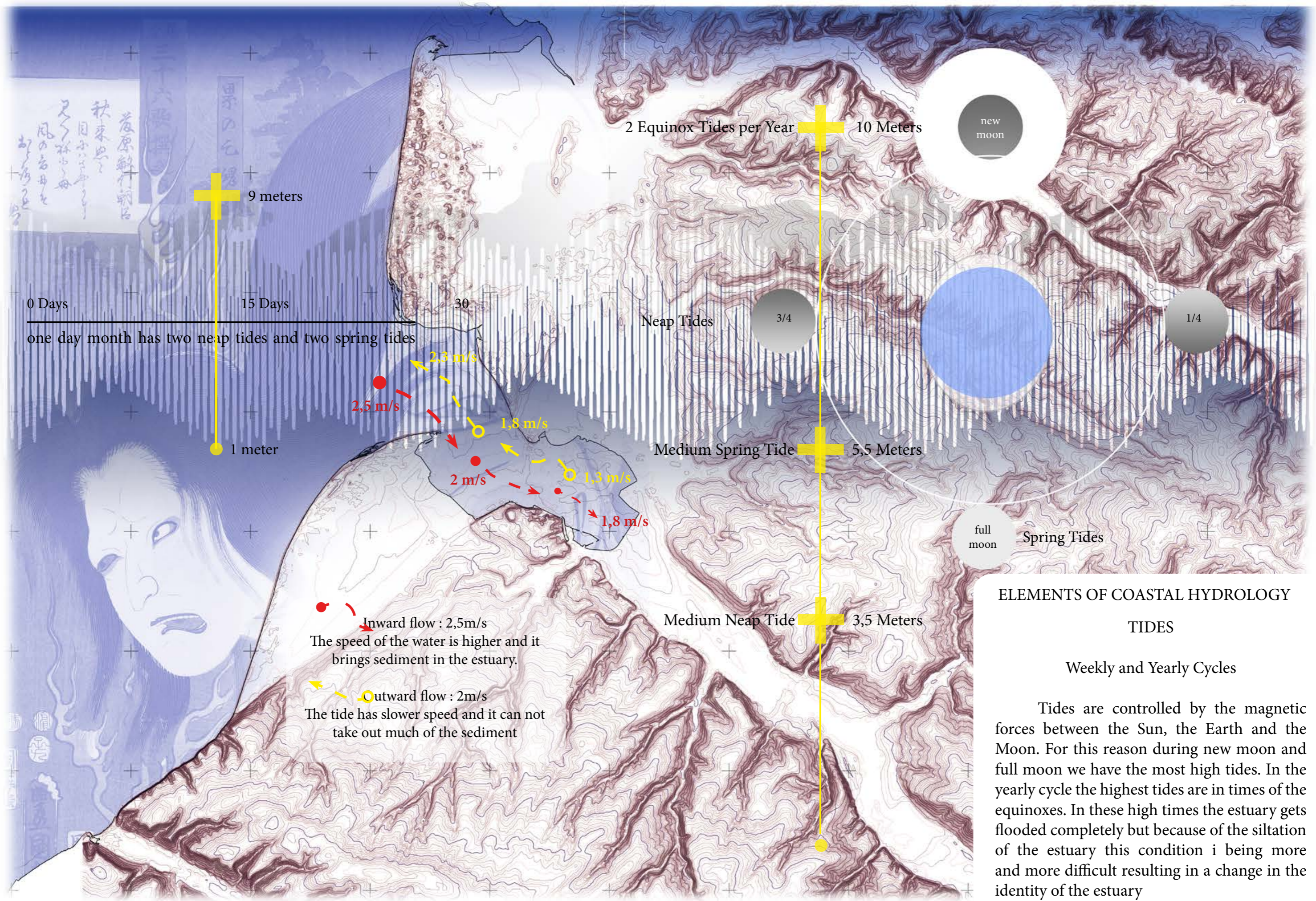
ELEMENTS OF COASTAL HYDROLOGY

TIDES

Diurnal -Daily Cycle

Each location on the planet is affected differently both in tide coefficient and in frequency of tides. In the case of Baie de Somme we have a diurnal cycle of two highs and two lows per day and the highest coefficient of tides in the English Channel, that reaches nearly up to 10 meters difference from high to low tide in the highest peak of the year.



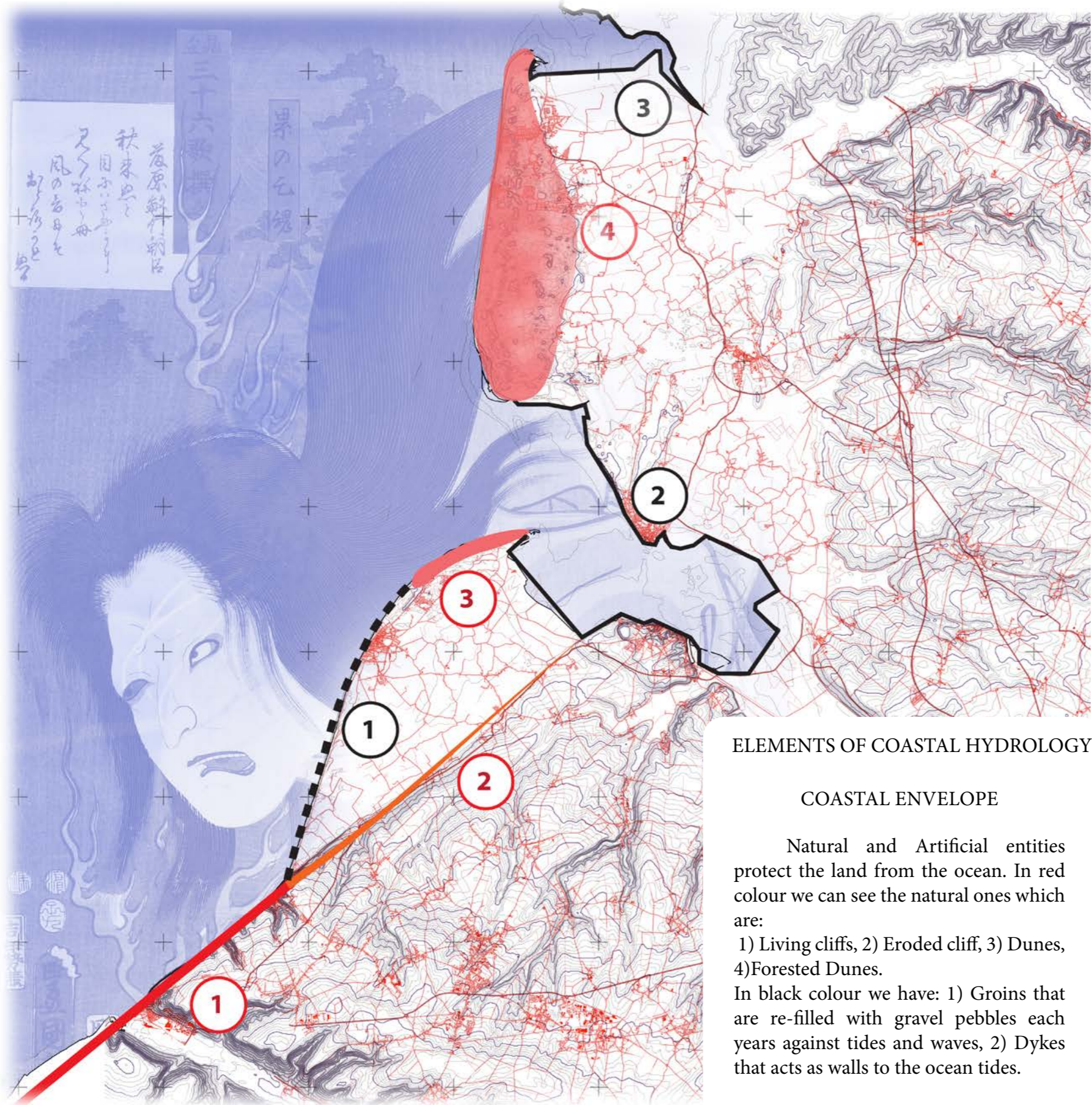


ELEMENTS OF COASTAL HYDROLOGY  
TIDES

Weekly and Yearly Cycles

Tides are controlled by the magnetic forces between the Sun, the Earth and the Moon. For this reason during new moon and full moon we have the most high tides. In the yearly cycle the highest tides are in times of the equinoxes. In these high times the estuary gets flooded completely but because of the siltation of the estuary this condition is being more and more difficult resulting in a change in the identity of the estuary





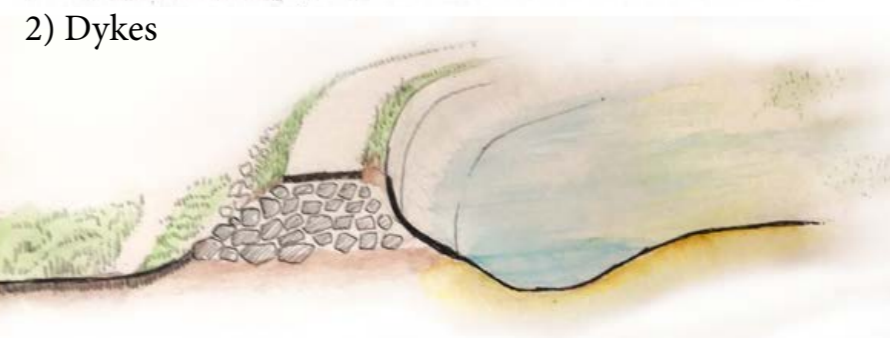
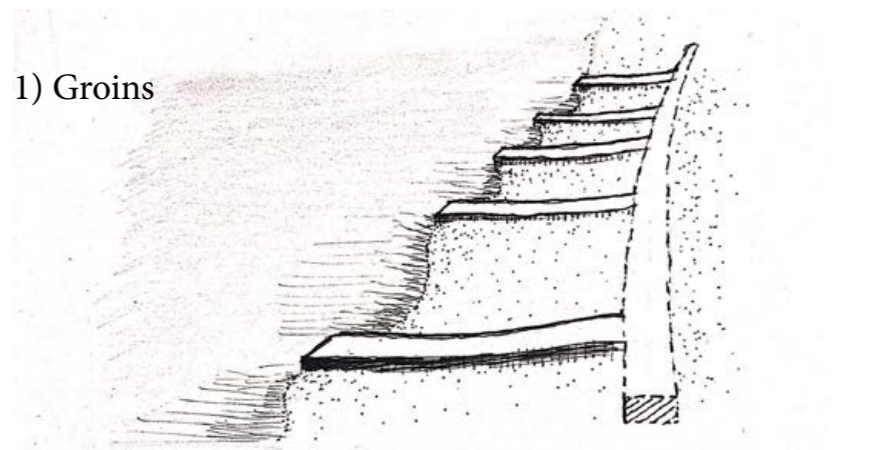
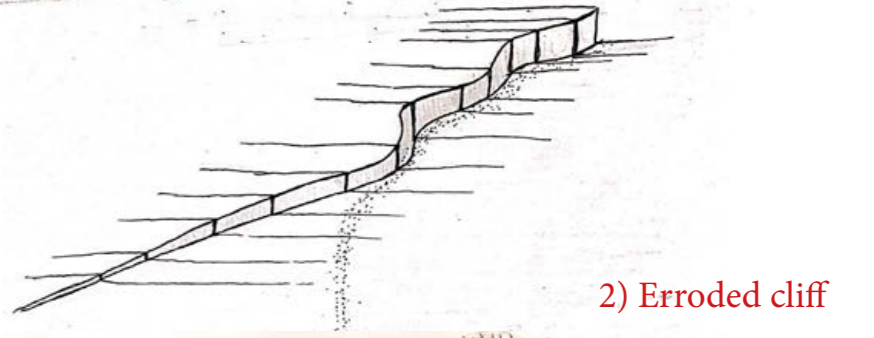
ELEMENTS OF COASTAL HYDROLOGY

COASTAL ENVELOPE

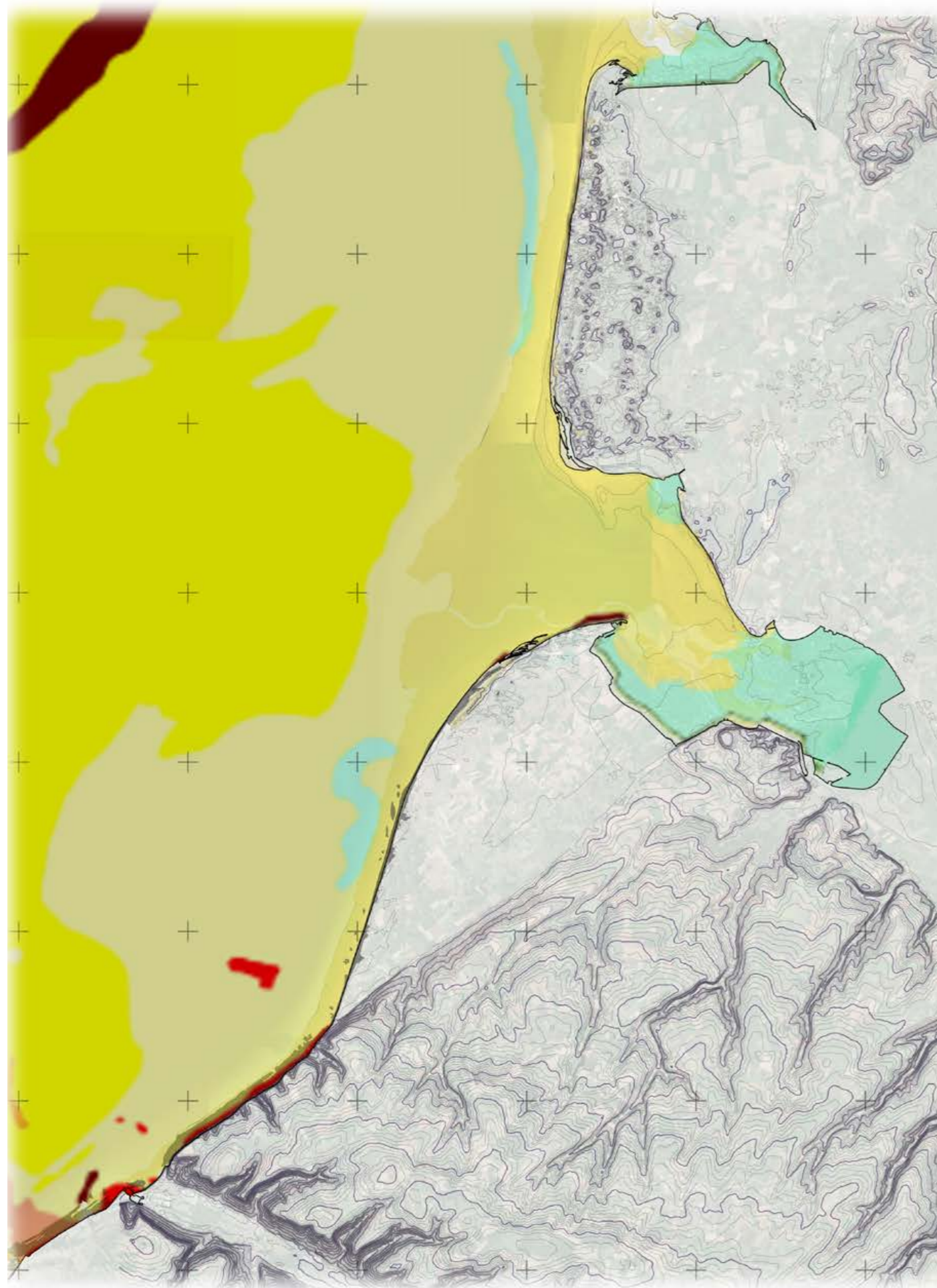
Natural and Artificial entities protect the land from the ocean. In red colour we can see the natural ones which are:

1) Living cliffs, 2) Eroded cliff, 3) Dunes, 4) Forested Dunes.

In black colour we have: 1) Groins that are re-filled with gravel pebbles each years against tides and waves, 2) Dykes that acts as walls to the ocean tides.

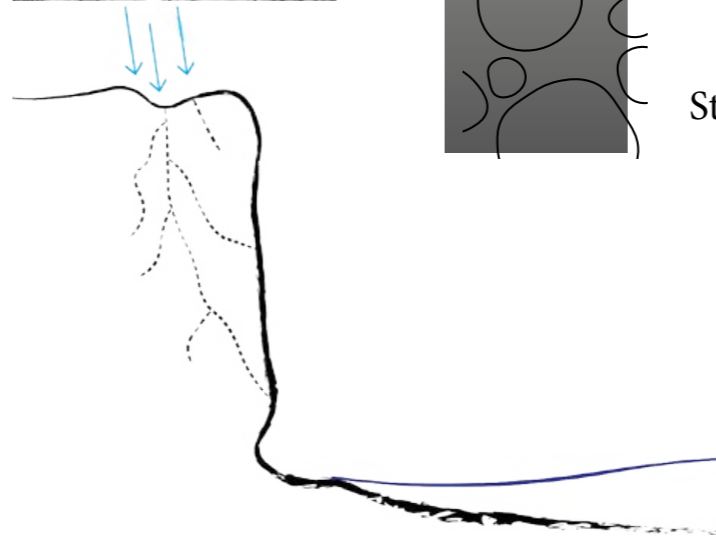






LEGEND

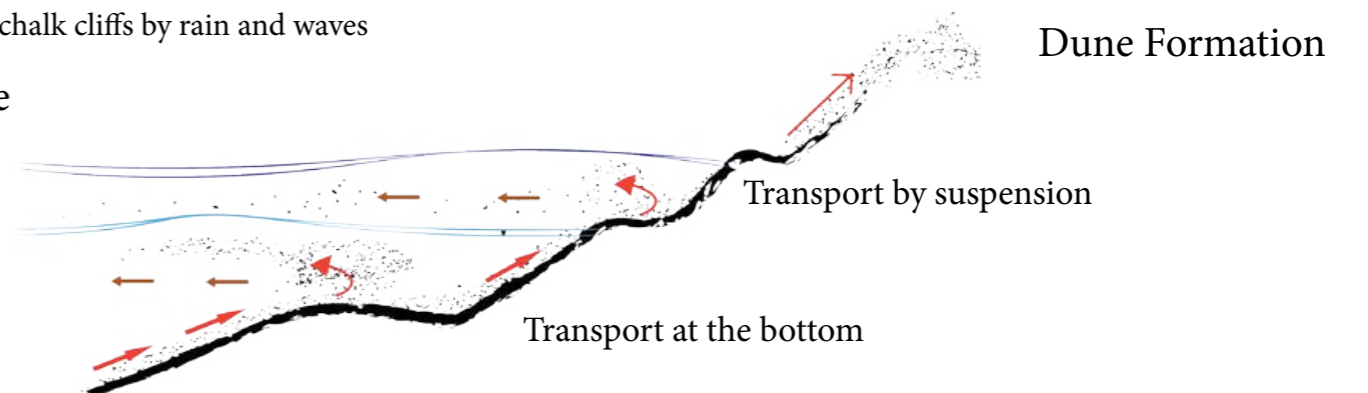
- Rock
- Pebble
- Gravelly pebble
- Sandy pebble
- Muddy pebble
- Gravel
- Pebbly gravel
- Sandy gravel
- Muddy gravel
- Sand
- Pebbly sand
- Gravelly sand
- Muddy sand
- Muddy gravelly sand
- Fine sand
- Gravelly fine sand
- Muddy fine sand
- Very fine sand
- Mud
- Gravelly mud
- Sandy mud
- Mud w/ h fine sand



Errision of chalk cliffs by rain and waves

High tide

Low tide



Clay

Fine Sand

Medium Sand

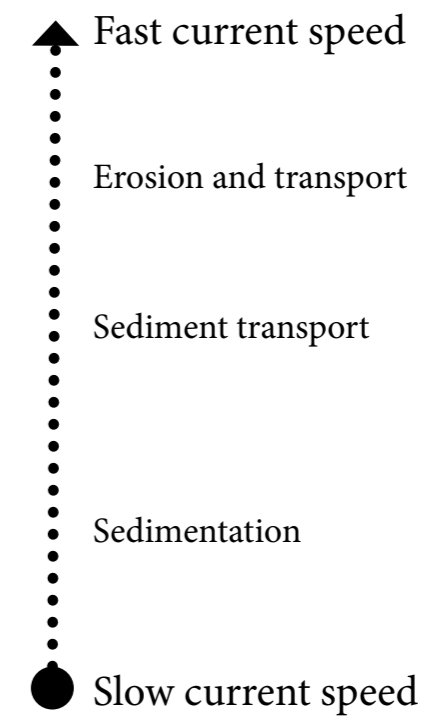
Coarse Sand

Gravel

Stones

SEDIMENT TRANSPORT

Sediment transport is affected by speed of currents and weight of said sediment. There are two types of currents, the vertical movements tides and the diagonal movements of waves front west to north. Slow currents allow sedimentation and high speeds allow sediment transport and erosion. Because fine sediment flows by suspension the it travels more far away than heavier sediments. This is the reason that the estuary is filled with fine sediment

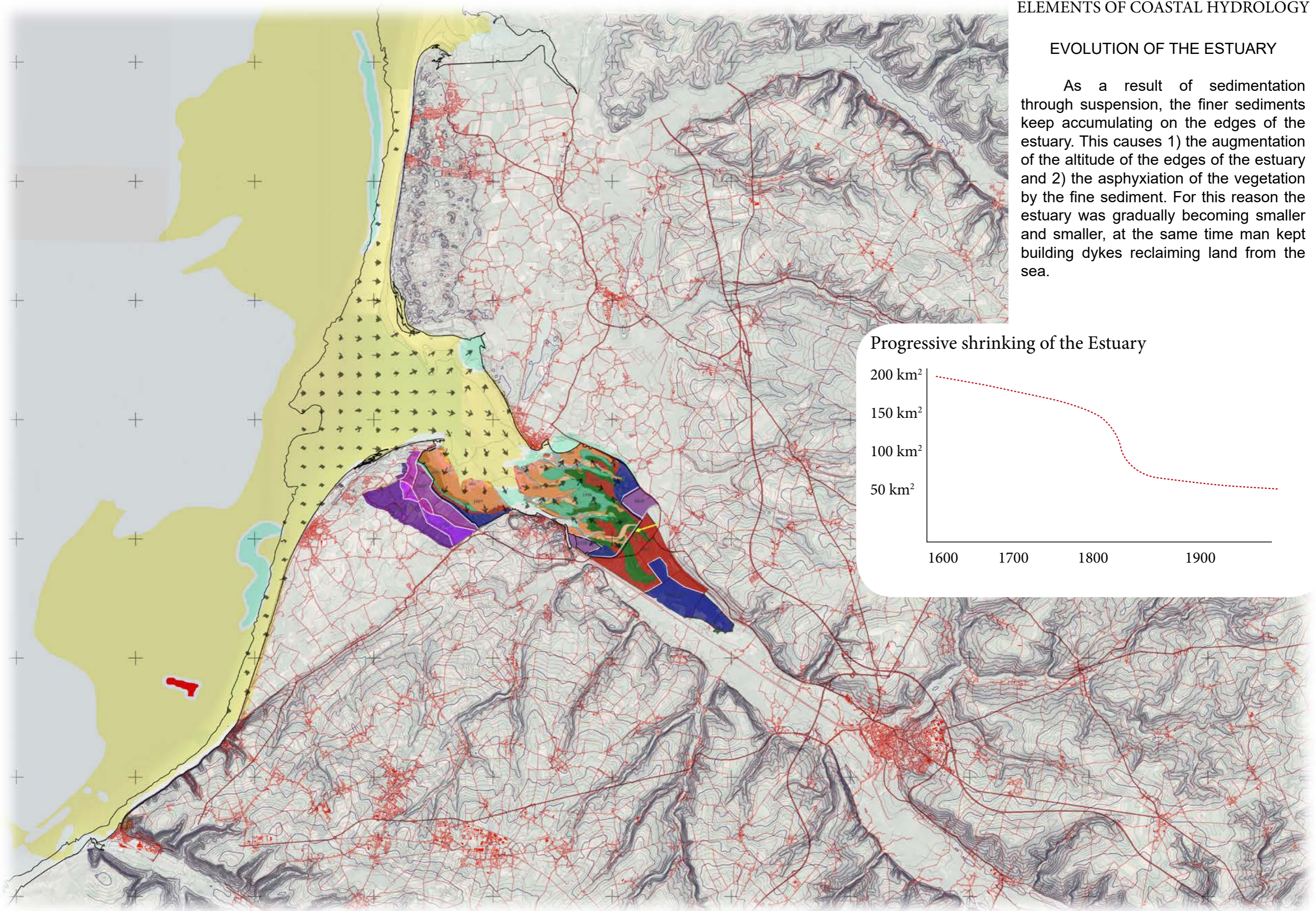
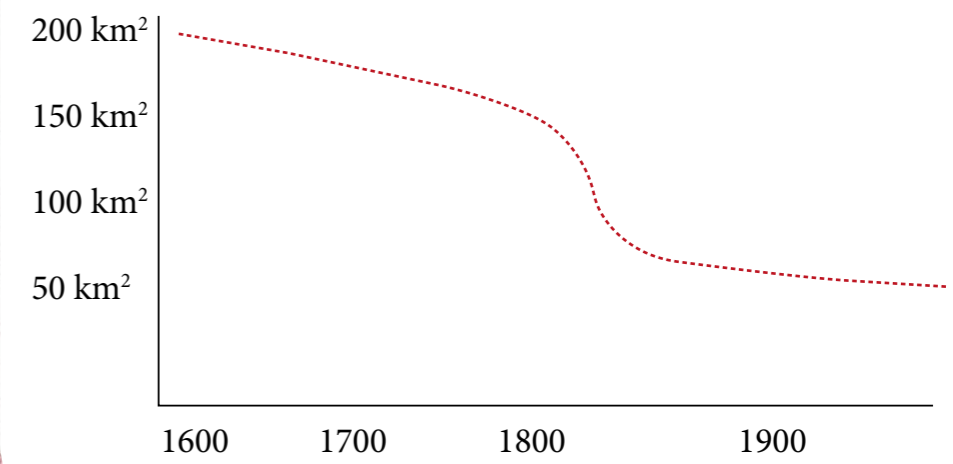




EVOLUTION OF THE ESTUARY

As a result of sedimentation through suspension, the finer sediments keep accumulating on the edges of the estuary. This causes 1) the augmentation of the altitude of the edges of the estuary and 2) the asphyxiation of the vegetation by the fine sediment. For this reason the estuary was gradually becoming smaller and smaller, at the same time man kept building dykes reclaiming land from the sea.

Progressive shrinking of the Estuary



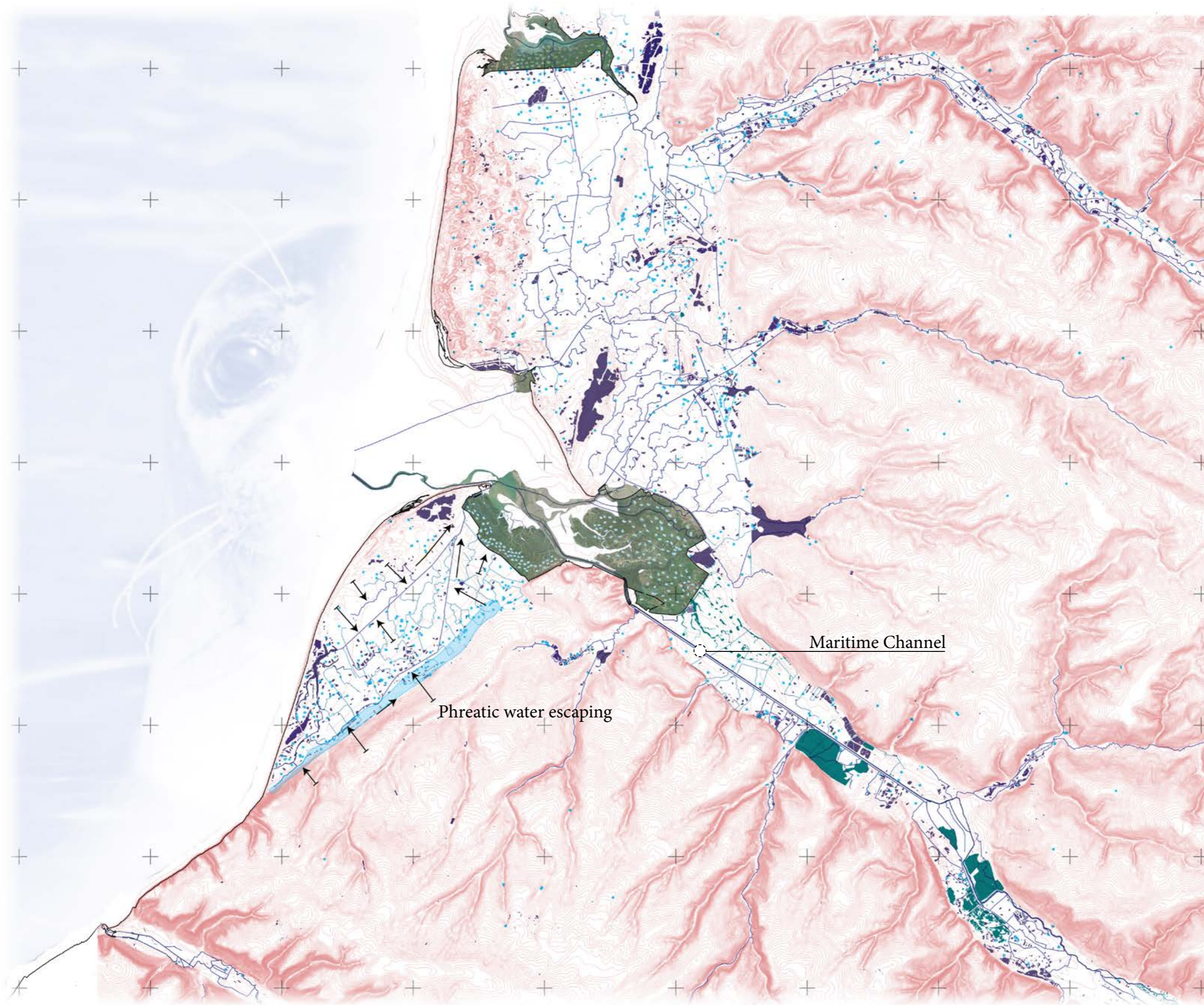


# ELEMENTS OF HYDROLOGY

## SURFACE WATER

The ancient estuary that is now a productive landscape has a very complex constructed hydrological system. The acquisition of land from the sea happened slowly and gradually over the course of many decades and this is marked in the way that man slowly drained small parts of the estuary. The Elements of Hydrology are consisted by channels and ponds. One important element is the underground water that can in specific areas reach the surface and flow outwards.

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## LEGEND

-  Canal
-  Ecoulement canalisé
-  Ecoulement naturel
-  Estuaire
-  Marais
-  Mare
-  Plan d'eau de gravière
-  Réservoir-bassin
-  Retenue

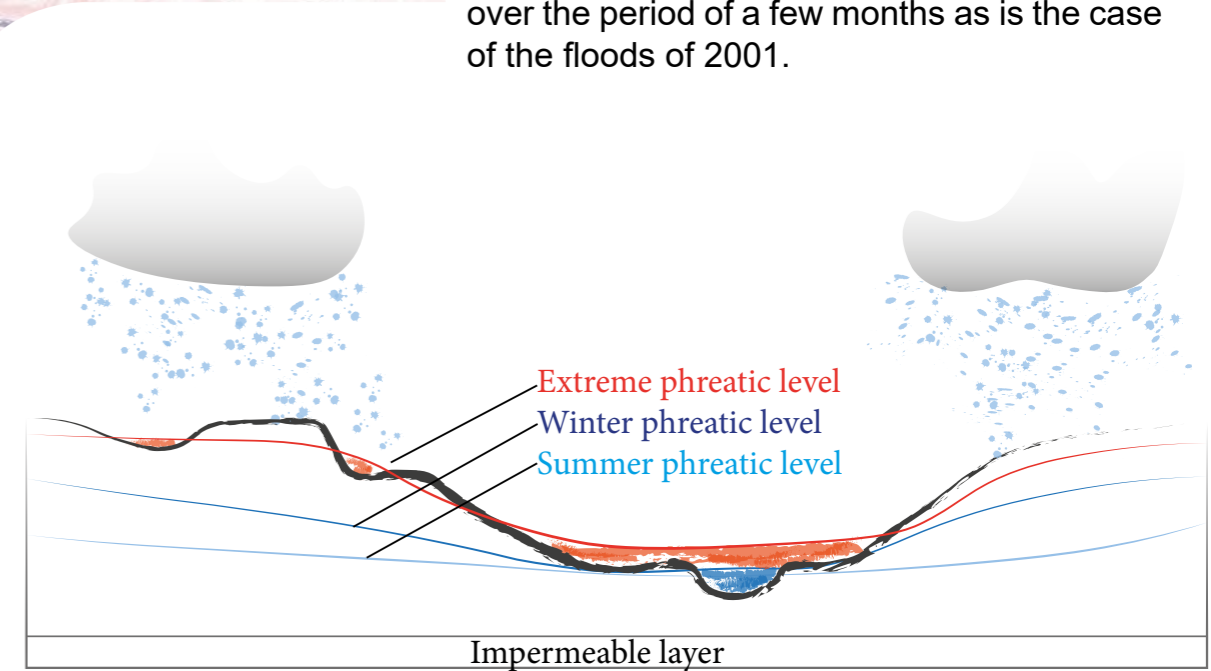


## ELEMENTS OF HYDROLOGY





### PHREATIC WATER

An important water element comes from the underground. Its level is changing all the time in relation to precipitation and atmospheric pressure. When constant rainfalls occur for a period of a few months the underground water rises from the ground with slow speeds.

Coupled with high pressure and high tides the territory has the possibility to flood over the period of a few months as is the case of the floods of 2001.



### LEGEND

-  Low Sensitivity of Phreatic Water
-  Medium Sensitivity of Phreatic Water
-  High Sensitivity of Phreatic Water
-  Surge of Phreatic Water

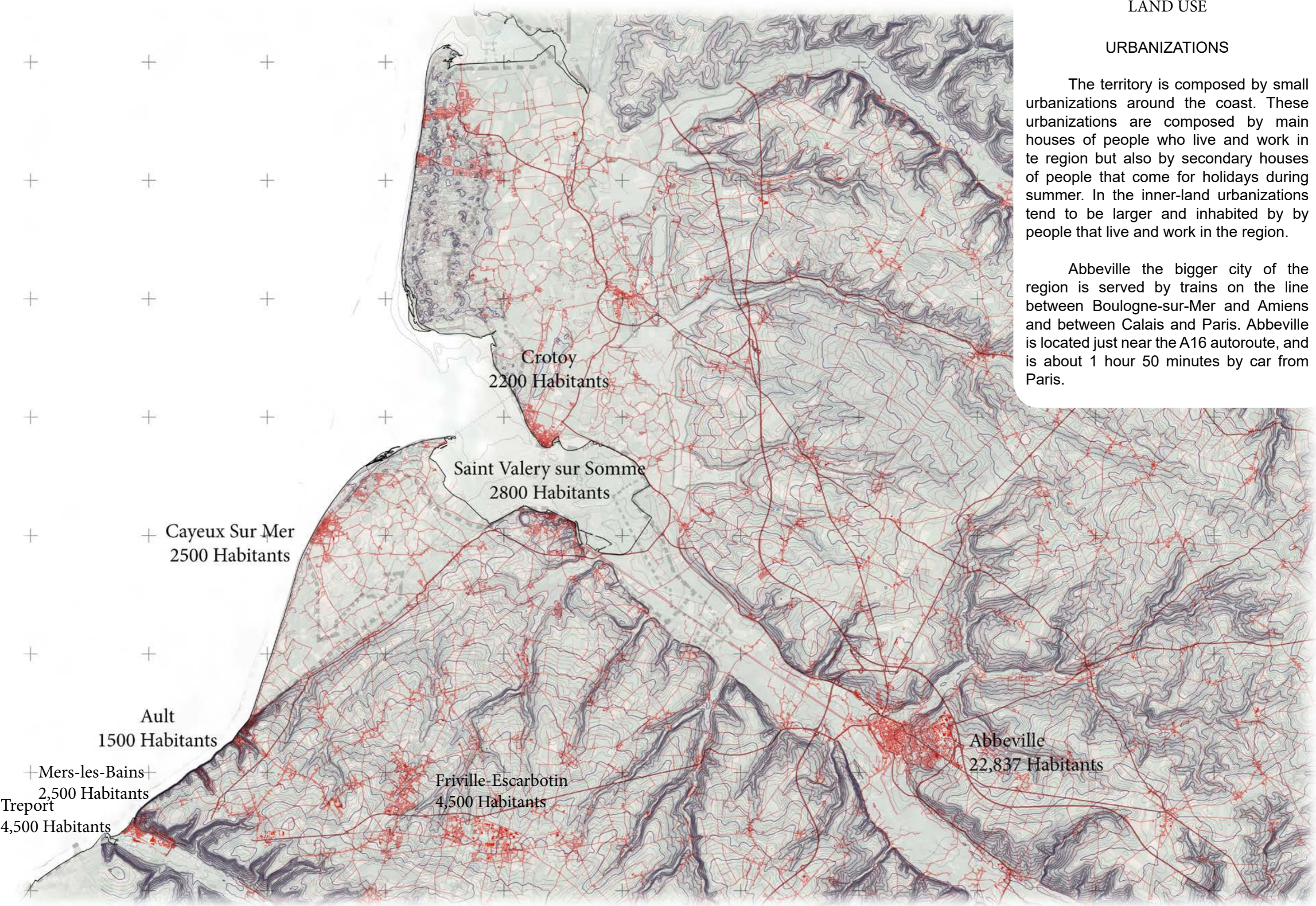


## LAND USE

### URBANIZATIONS

The territory is composed by small urbanizations around the coast. These urbanizations are composed by main houses of people who live and work in the region but also by secondary houses of people that come for holidays during summer. In the inner-land urbanizations tend to be larger and inhabited by people that live and work in the region.

Abbeville the bigger city of the region is served by trains on the line between Boulogne-sur-Mer and Amiens and between Calais and Paris. Abbeville is located just near the A16 autoroute, and is about 1 hour 50 minutes by car from Paris.













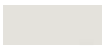






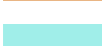
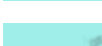



# LAND USE

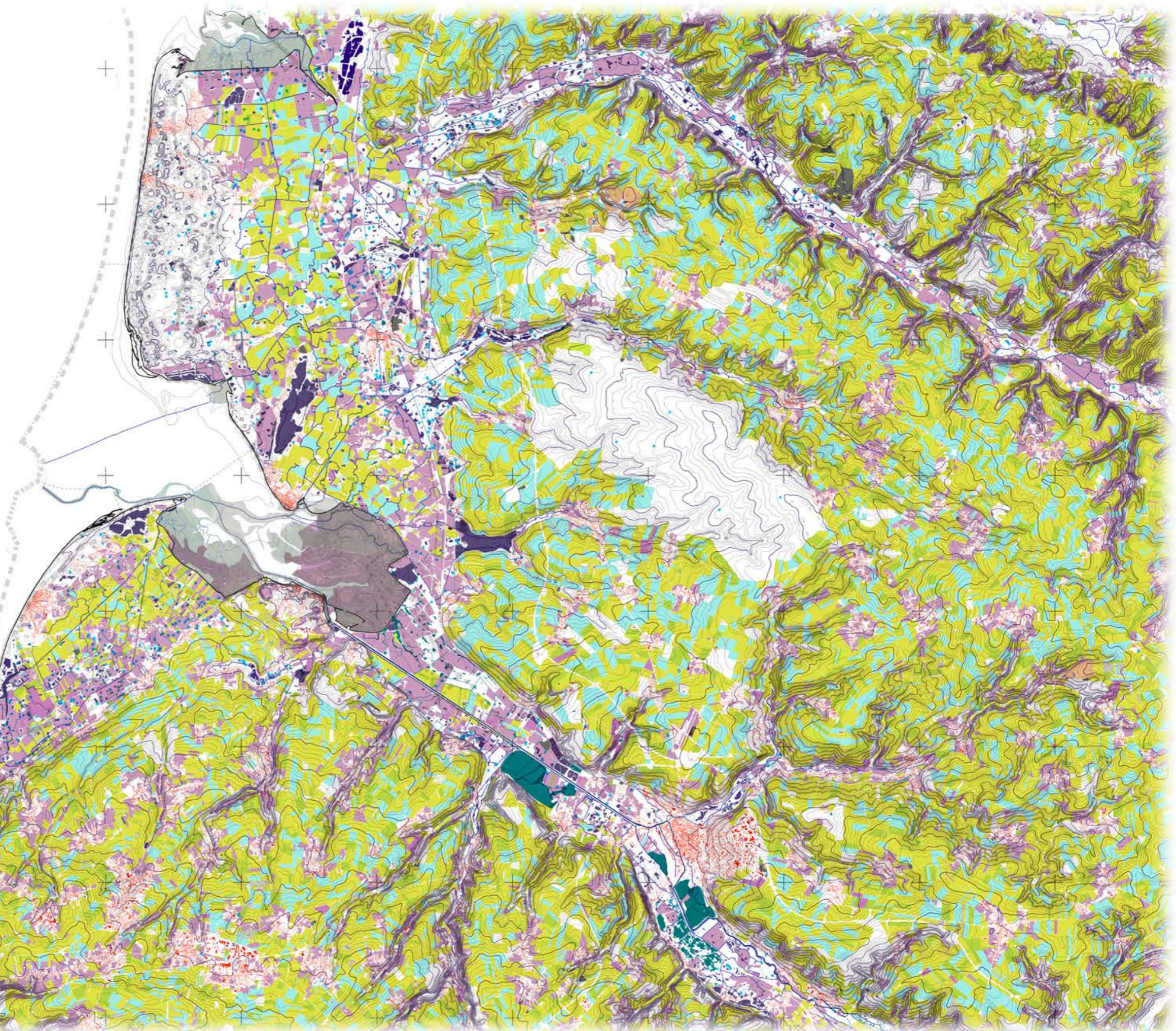
## AGRICULTURE

The productive landscape dominates the territory. By dividing the study into 5 categories we can more easily understand the territory. The categories are Grains in hues of green, Pasture in hues of purple, arboriculture in orange hues, vegetables in blue hues and other in grey. When looking the above categories in relation to topography and hydrology we can see that productive areas for pasture are located in formerly inundated lands or in lands where the phreatic level rises easily.

### LEGEND

-  CEREALS
-  CEREALS
-  CEREALS
-  CEREALS
-  OILSEEDS
-  OILSEEDS
-  OILSEEDS
-  PROTEINOUS
-  FLAX AND HEMP
-  GRAIN
-  FORAGE
-  GRASS SURFACE PASTURE
-  GRASS SURFACE PASTURE
-  GRASS SURFACE PASTURE
-  ARBORICULTURE
-  FRUIT TREES
-  ARBORICULTURE
-  VEGETABLES
-  VEGETABLES
-  OTHER

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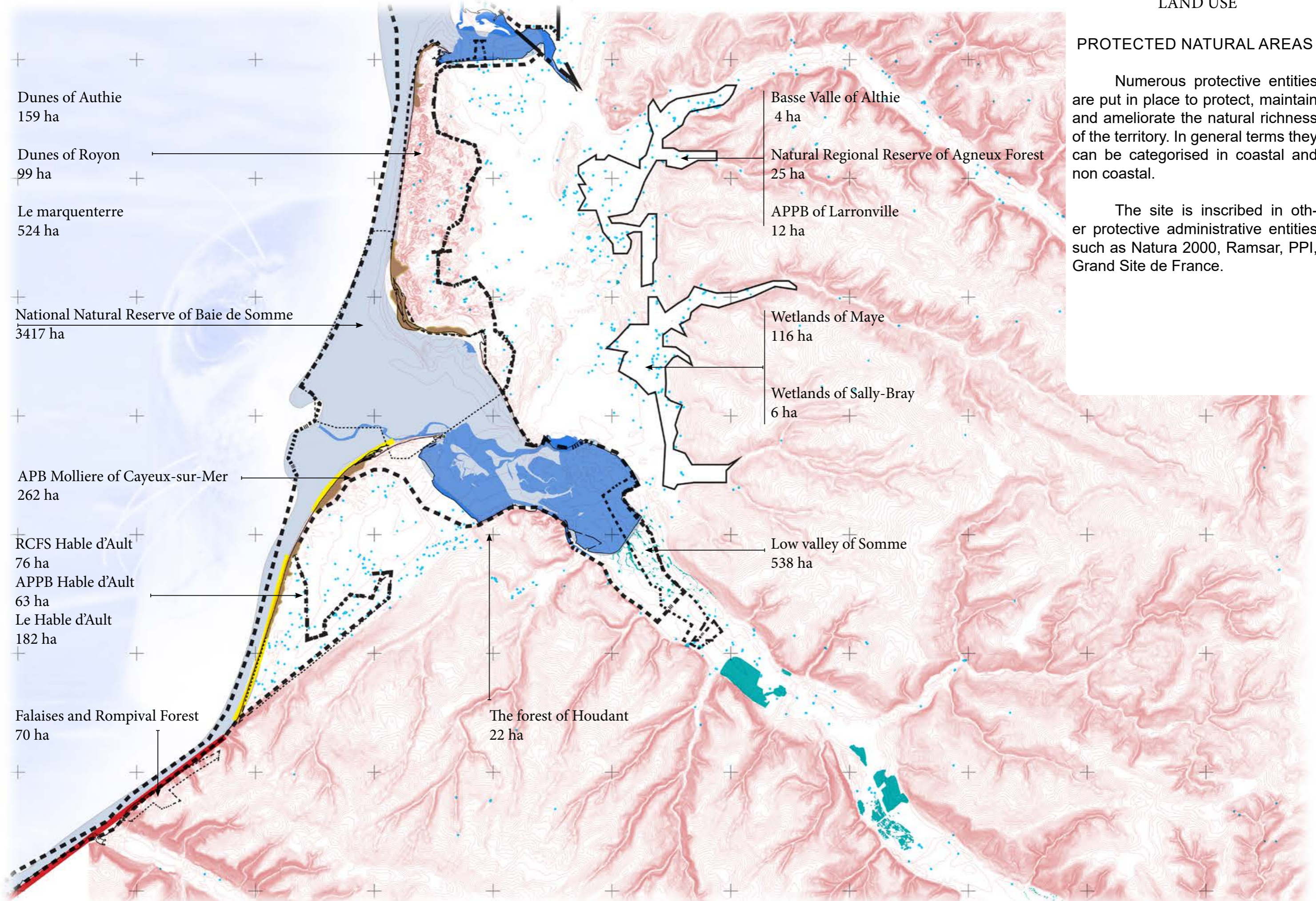


LAND USE

PROTECTED NATURAL AREAS

Numerous protective entities are put in place to protect, maintain and ameliorate the natural richness of the territory. In general terms they can be categorised in coastal and non coastal.

The site is inscribed in other protective administrative entities such as Natura 2000, Ramsar, PPI, Grand Site de France.









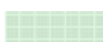




## LAND USE

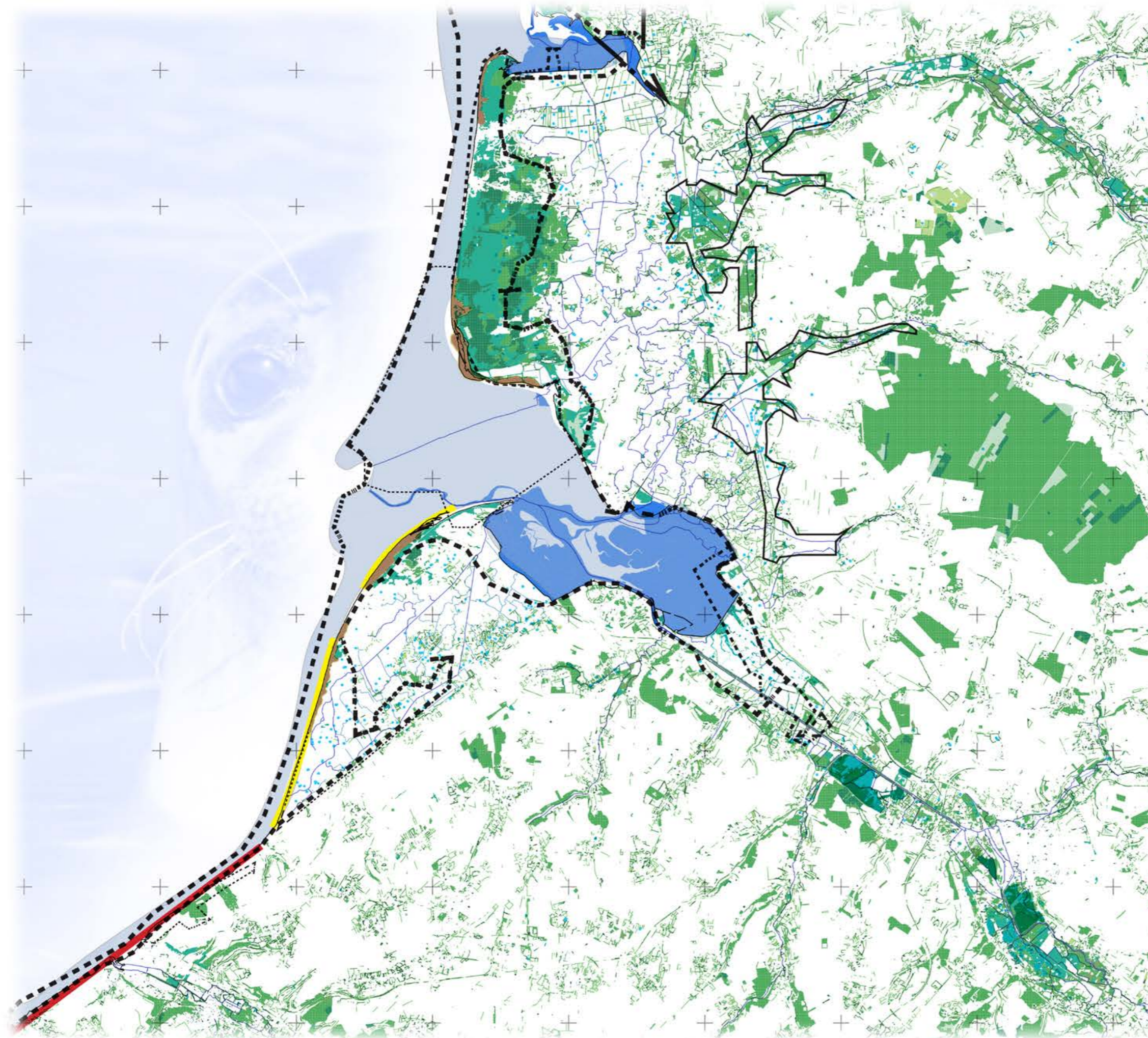
### HABITATS - BIODIVERSITY

In relation to the sites differentiated conditions of humidity, salinity, substrate and soil acidity we can find many different habitats.

Some of the habitats that we have already see are the Falaise, Cordons de galets, Dunes, Estuary, Wetland, Low wetlands, Humid prairies, Acidic habitats

### LEGEND

-  Forest below 100H
-  Conifer Forest above 100H
-  Deciduous Forest above 100H
-  Mixed Forest above 100H
-  Open Forest above 100H
-  Linear plantation
-  Woody Heath
-  Poplar Plantation
-  Orchard





*Ammophila arenaria*



*Armeria maritima*



*Brassica oleracea*



*Glaucium favum*



*Silene uniflora*



*Spartina maritima*



*Salicornia europaea*



*Halimione portulacoides*



*Leymus arenarius*



*Eryngium maritimum*



*Calystegia soldanella*



*Liparis loeselii*



*Anagallis tenella*



*Ophiglossum vulgatum*



*Epipactis palustris*



*Parnassia palustris*



*Carex trinervis*



*Pedicularis palustris*



**WILD FLORA**



Bruant lapon



Souchet



Chipeau



Sarcelle d'été



Mudflat



Salth Marshes



Low Dune Marshes



Wetland



Falco\_peregrinus



Grand gravelot



Marouette ponctuée



Black tailed Godwit



Panure a moustache



Traquet moiteux



Butor étoile



Phoque



**WILD FAUNA**

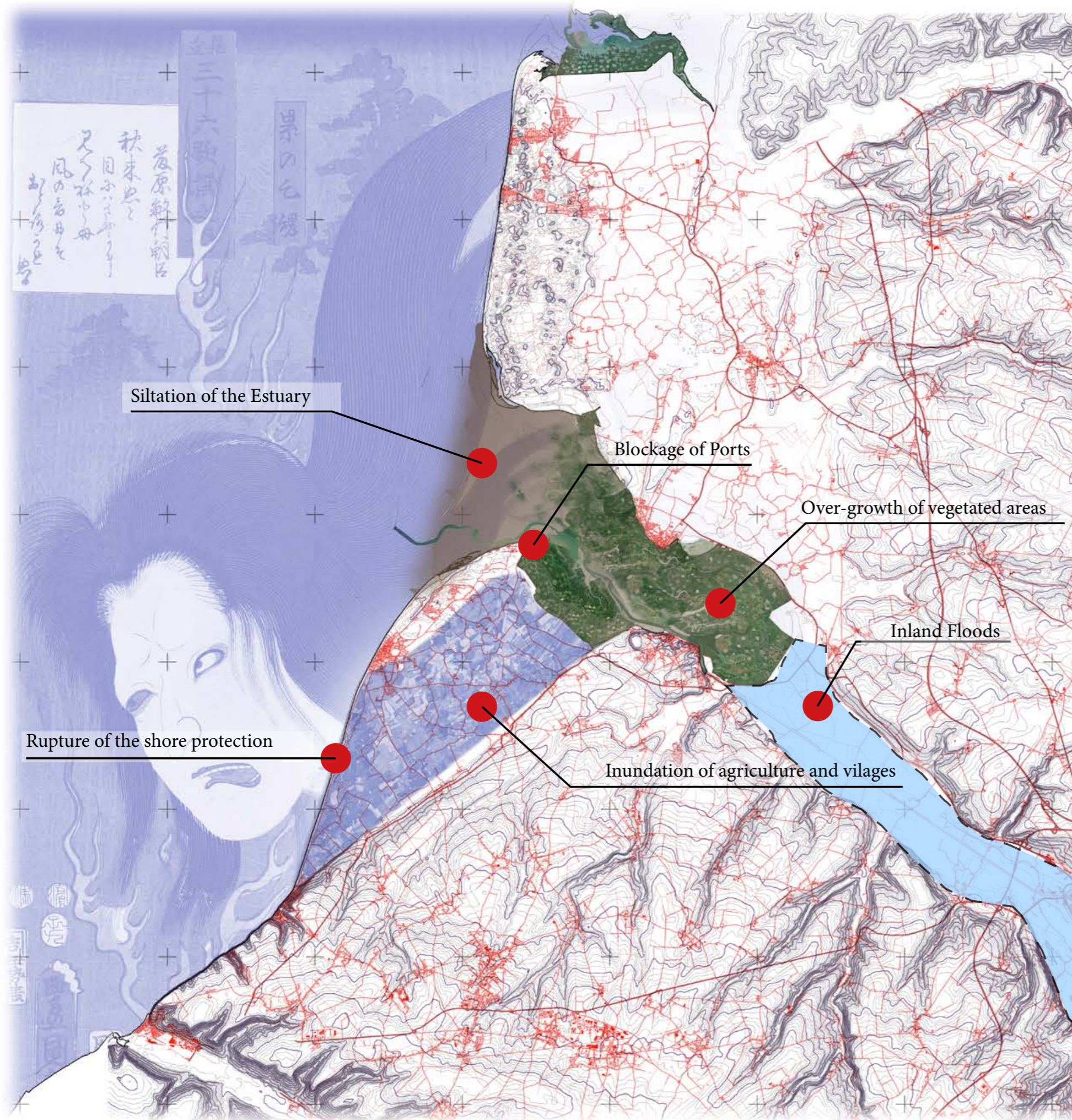
**ENVIRONMENTS**



RISK

A TERRITORY UNDER MULTIPLE RISKS

The territory is facing a complex system of problems of hydroic identity. The rupture of the shore due to erosion in big storms causes inundations during the winter months. In periods of high tides the water can not exit to the ocean normally so phenomenons of flood by rainwater, phreatic water and storms become even greatly felt. At the same time the siltation of the estuary is blocking the access of the boats to the ports making it harder for fishing activities to occur. Thus any solution should take into consideration the multiple challenges.



Flood by Phreatic Water in Abbeville



Eroding Coast of Hable d'Ault in a Storm

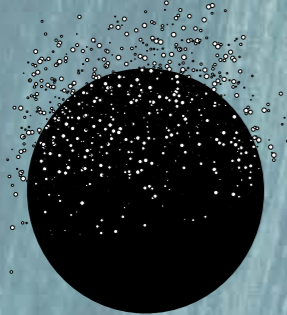


Flood of 1990 in Cayeux Sur Mer

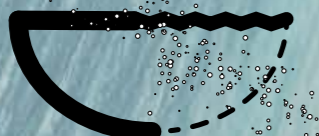




DIAGNOSIS TERRITORIAL



CAYEUX-SUR MER  
SEA LEVEL RISE / STORM FLOODING

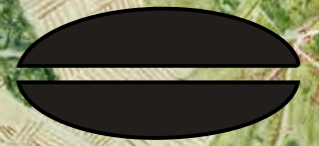


HABLE D'AULT  
BREACH OF THE SHORE IN STORMS / ERROSION

BAIE DE SOMME  
SILTATION OF THE ESTUARY  
BLOCKAGE OF PORTS



LOW FIELDS  
REGULAR FLOODING

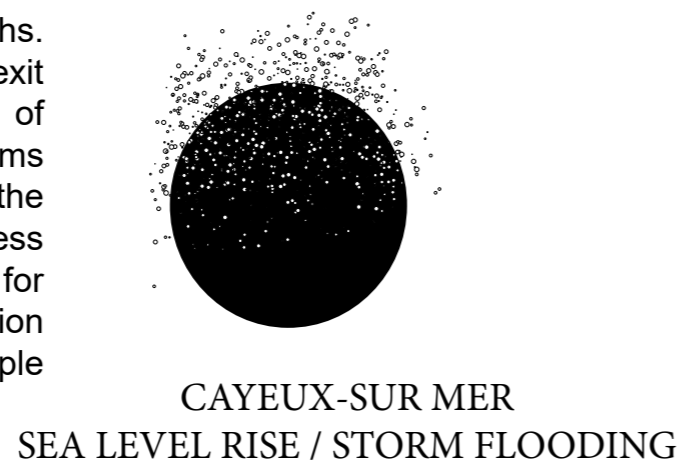




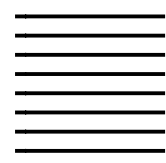
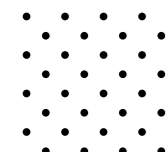
# RISK

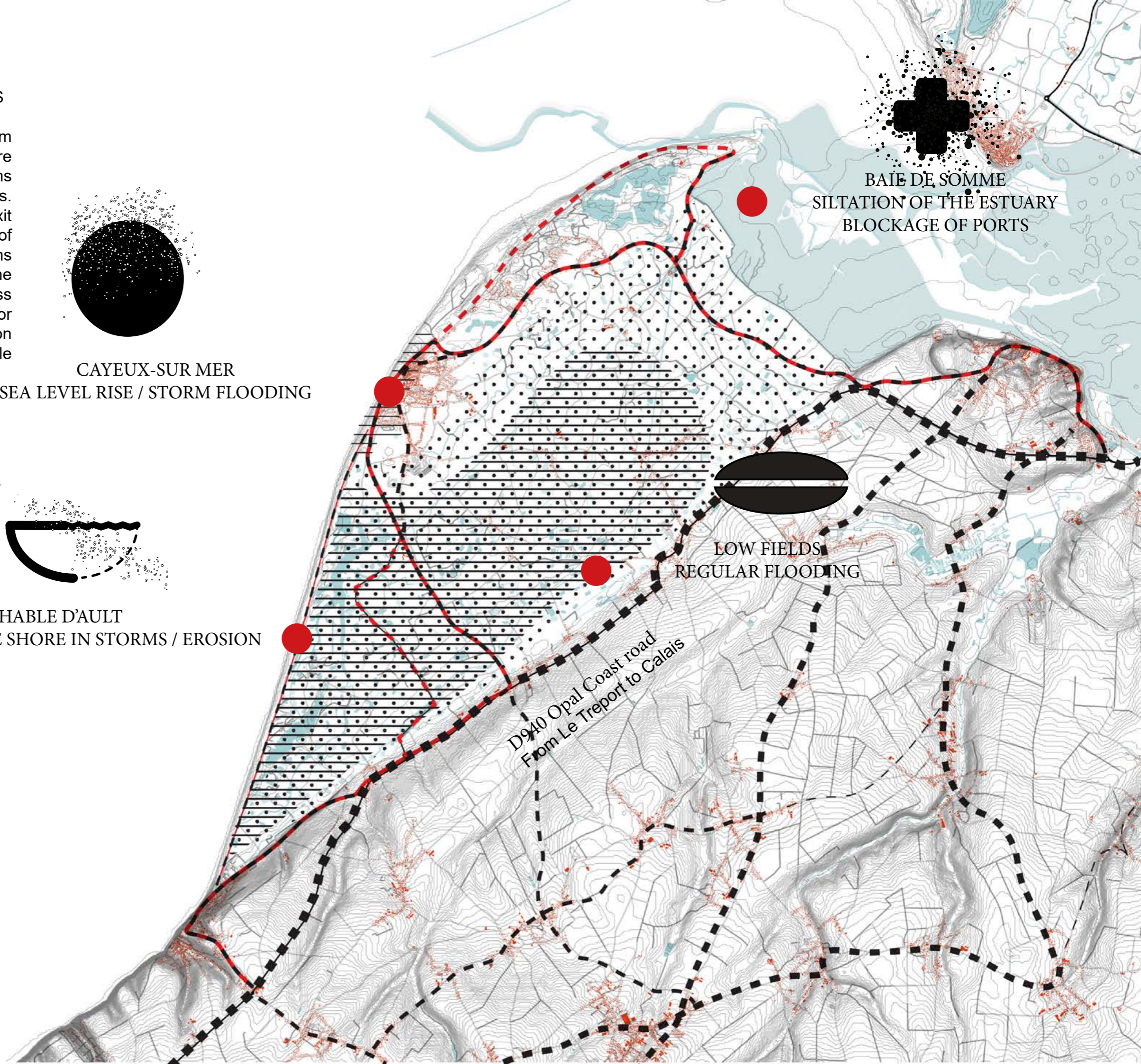
## A TERRITORY UNDER MULTIPLE RISKS

The territory is facing a complex system of problems of hydrolic identity. The rupture of the shore due to erosion in big storms causes inundations during the winter months. In periods of high tides the water can not exit to the ocean normally so phenomenons of flood by rainwater, phreatic water and storms become even greatly felt. At the same time the siltation of the estuary is blocking the access of the boats to the ports making it harder for fishing activities to occur. Thus any solution should take into consideration the multiple challenges.



### LEGEND FLOODING TYPES AND REGIMES

-  Flooding Storm
-  Flooding by Rainwater and Underground Water





## Chapter 03

### Links of Images

1) [http://www.picardie-nature.org/IMG/pdf/diaporama\\_fete1b.pdf](http://www.picardie-nature.org/IMG/pdf/diaporama_fete1b.pdf)

2) [www.u-picardie.fr/beauchamp/littoral/GRENOBLE-2.html](http://www.u-picardie.fr/beauchamp/littoral/GRENOBLE-2.html)

3) <https://www.lassuranceenmouvement.com/2021/04/19/memoiredurisque%E2%80%8B-inondations-de-la-somme-en-2001/>

4) <https://www.baiedesomme.org/actu/7107-avis-de-tempe-te-en-baie-de-somme>

5) <http://l.brenet.free.fr/baschamps.htm>

6) <http://l.brenet.free.fr/baschamps.htm>





# 04 IMAGINE & PROPOSE



# PROJECTIONS OF CLIMATE CHANGE

## SSP SCENARIOS

Shared Socioeconomic Pathways (SSPs) are scenarios of projected socioeconomic global changes up to 2100.

They are used to derive greenhouse gas emissions scenarios with different climate policies. They have been used to help produce the IPCC Sixth Assessment Report on climate change, published on 9 August 2021.

The SSPs provide narratives describing alternative socio-economic developments. These storylines are a qualitative description of logic relating elements of the narratives to each other. [en.wikipedia.org/wiki/Shared\\_Socioeconomic\\_Pathways](https://en.wikipedia.org/wiki/Shared_Socioeconomic_Pathways)

## CLIMATE CHANGE AND SEA LEVEL RISE

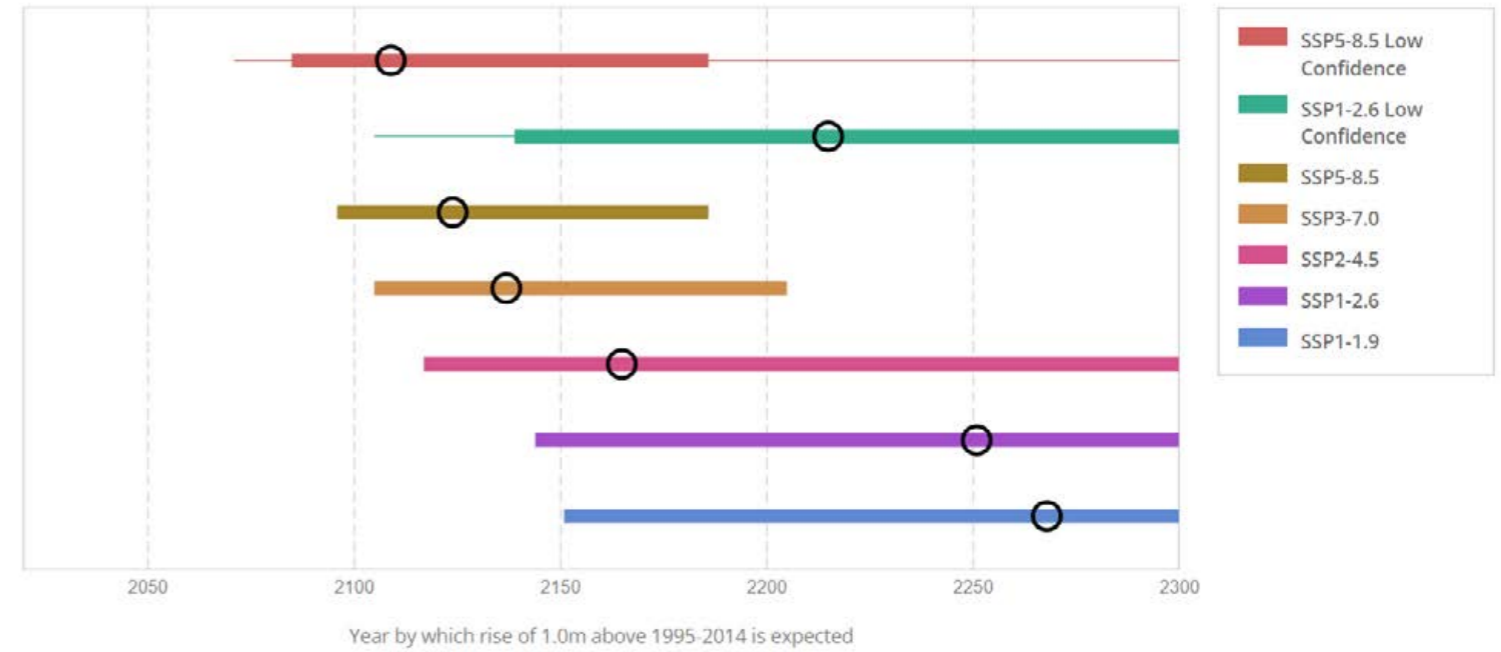
A consequence of human activities is global warming and as a consequence is the rise of the sea level due to the expansion of the water molecules and the melting of the ice. In our effort to anticipate the future, scientists have created a set of scenarios examining the projected timing of sea-level rise. These scenarios are ranked from the most optimistic/utopian, to the less optimistic.

In the diagram on the right we can see the projected time it will take for the sea-level to rise 1m in relation to said scenarios. Pessimistic scenarios calculate 1m sea-level rise will occur between 2100 and 2150 whereas optimistic scenarios project this to happen after 2150. Unfortunately optimistic scenarios already appear to be too optimistic since certain key factors have already been broken.

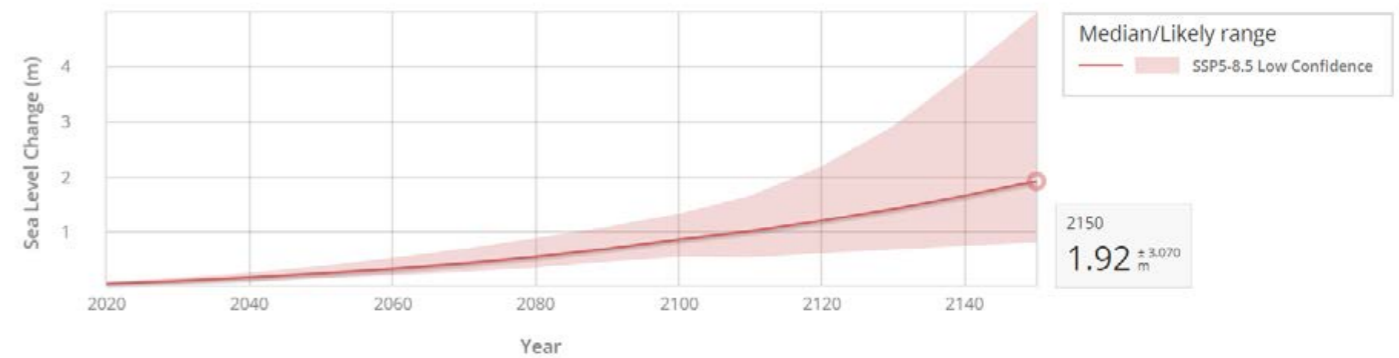
According to scenario SSP5-8,5 of Low Confidence, which is the most pessimistic but quite probable the expected sea-level rise in the year 2150 will be 1.92m. An other scenario of SSP3-7.0 predicts that the expected sea-level rise of the year 2150 will be 1.12m.

## Projected Timing of Sea-Level Rise Milestones

Timing of exceedance of different thresholds (increments of 0.1 m) under different SSPs. Thick bars show 17th-83rd percentile ranges, and black circles show median value. Thin bars also show 5th-95th percentile ranges for SSP1-2.6 Low Confidence and SSP5-8.5 Low Confidence scenarios.

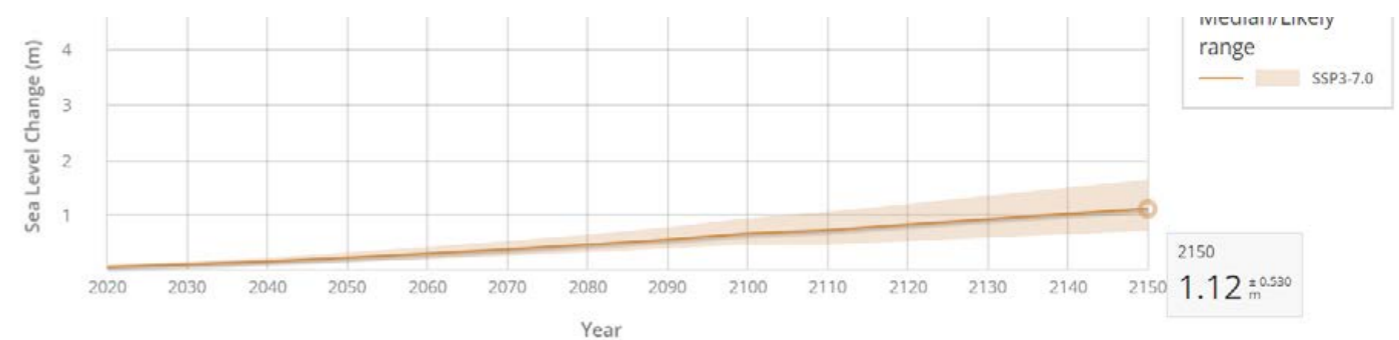


Sea-level change for SSP scenarios resulting from processes in whose projection there is *medium confidence*. Two *low-confidence* scenarios, indicating the potential effect of low-likelihood, high-impact ice sheet processes that cannot be ruled out, are also provided. Shaded ranges show the 17th-83rd percentile ranges. Projections are relative to a 1995-2014 baseline. The plot below shows the projection and uncertainties for 'Total Sea Level Change'. Data for the individual contributions can be downloaded under 'Get Data'.



### SCENARIO ⓘ

SSP1-1.9   SSP1-2.6   SSP2-4.5   SSP3-7.0   SSP5-8.5   SSP1-2.6 Low Confidence   **SSP5-8.5 Low Confidence**   GET DATA ▾



### SCENARIO ⓘ

SSP1-1.9   SSP1-2.6   SSP2-4.5   **SSP3-7.0**   SSP5-8.5   SSP1-2.6 Low Confidence   SSP5-8.5 Low Confidence   GET DATA ▾



# PROJECTIONS OF CLIMATE CHANGE

## RCP SCENARIOS

A Representative Concentration Pathway (RCP) is a greenhouse gas concentration (not emissions) trajectory adopted by the IPCC. Four pathways were used for climate modeling and research for the IPCC fifth Assessment Report (AR5) in 2014. The pathways describe different climate futures, all of which are considered possible depending on the volume of greenhouse gases (GHG) emitted in the years to come. The RCPs – originally RCP2.6, RCP4.5, RCP6, and RCP8.5 – are labelled after a possible range of radiative forcing values in the year 2100 [en.wikipedia.org/wiki/Representative\\_Concentration\\_Pathway](http://en.wikipedia.org/wiki/Representative_Concentration_Pathway)

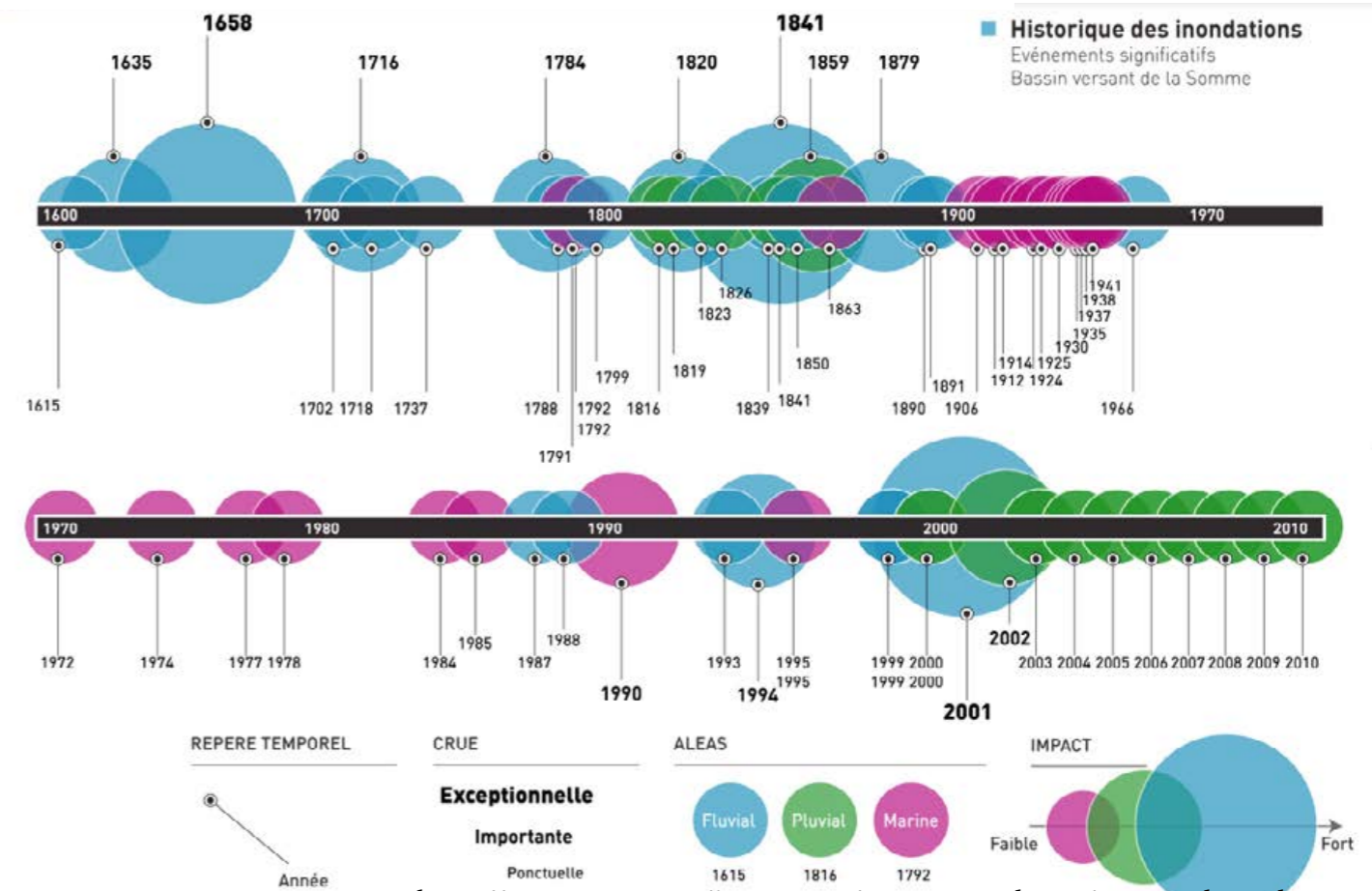
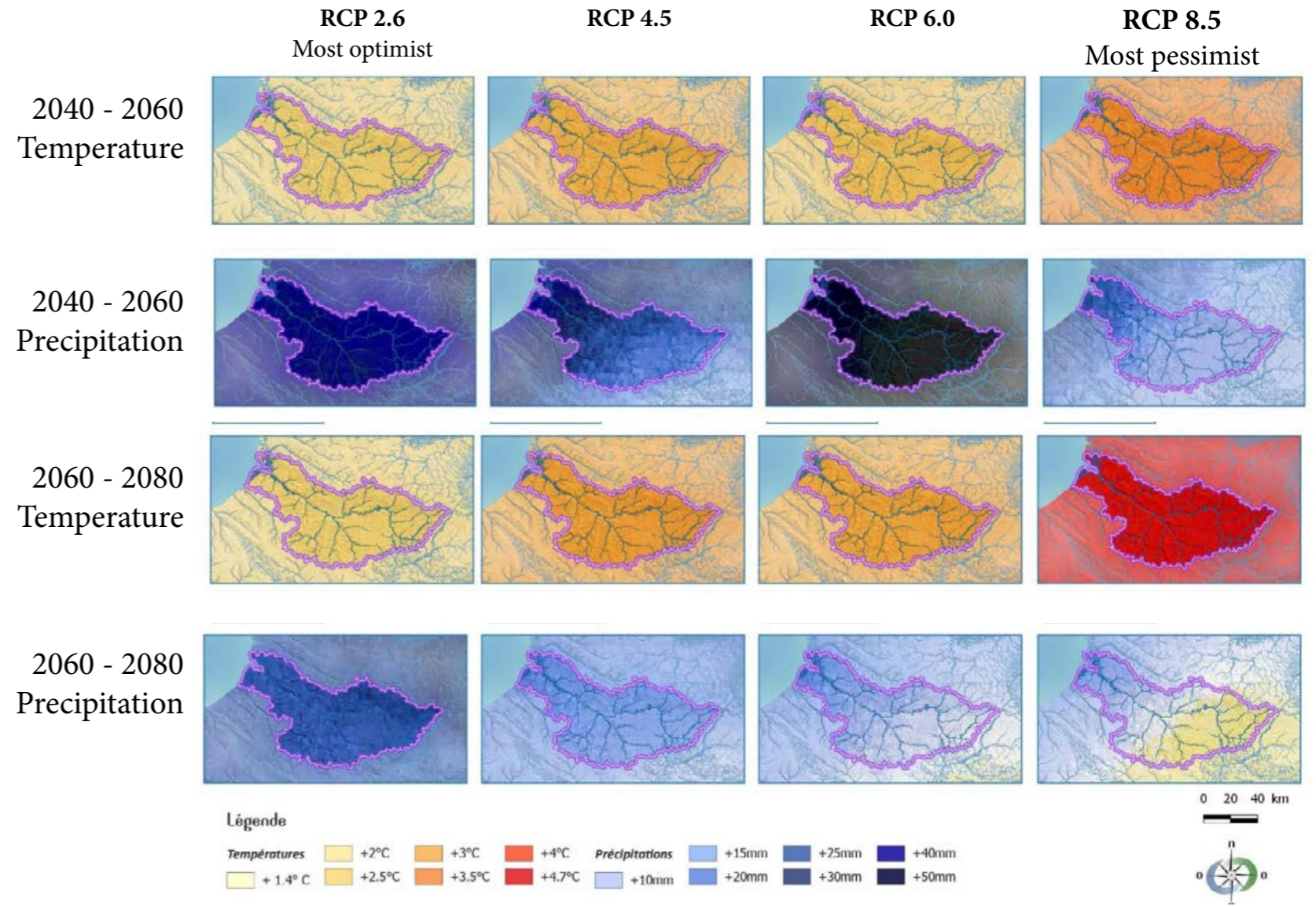
## CLIMATE CHANGE / TEMPERATURE AND PRECIPITATION

Another element that climate change will affect is the element of precipitation in parameters such as frequency, duration, intensity and location. In the following scenarios in the periods of 2040-2060 projected Augmentation in temperature is 1,4C - 3,5C and Augmentation in precipitation is +10mm - +50mm. In the years between 2060 - 2080 the projected Augmentation in temperature is 2,3C - 4,7C and change in precipitation between -4mm - +44mm.

As we can see on the diagrams of precipitation on the right, with marked territory the floodplain of Somme river there are scenarios where precipitation is augmented homogeneously and others where the coastal part is more affected. This is an important element of information which is linked to uncertainty. Because the sensitivity of the aquifer below the territory exhibits a rise if frequent and homogeneous distribution over the territory there is a possibility of frequent general flooding of the territory with duration of months due to phreatic water rising.

## PAST FLOODINGS and THE FUTURE?

In the time-line on the right we can see the types of floods that have affected the floodplaine of Baie de Somme. Floods by rainwater in blue, by the sea in purple and by the river/phreatic in green. Through this time-line we can see that the territory is already under great risk of natural disasters but what is to happen in the future? Should we abandon the territory and move to higher/drier conditions? I would like to imagine this as a possibility to find new scenarios of living close to the water even if it means living with risk and uncertainty.





# TIME and CHANGE

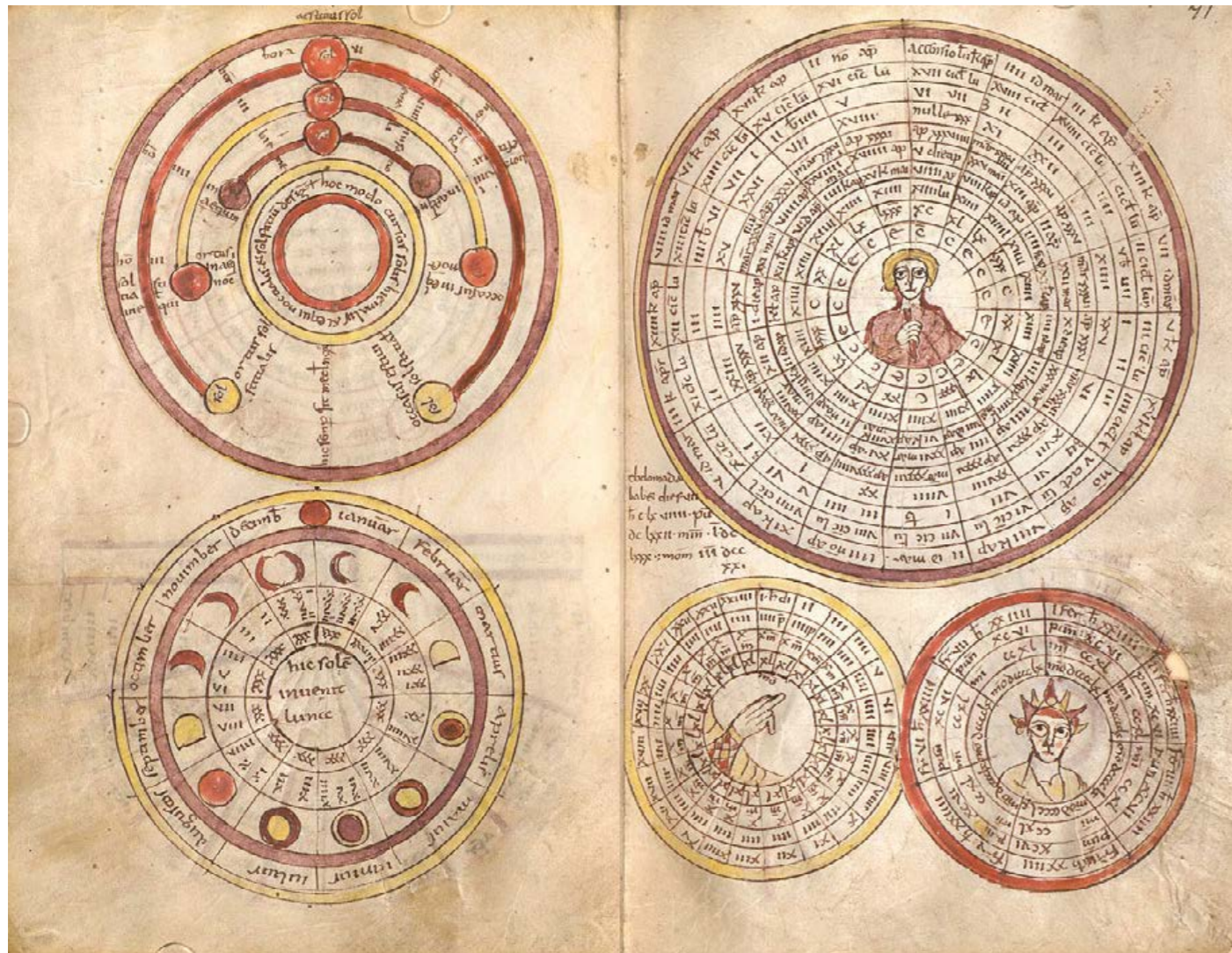
## MAKING TIME SENSED THROUGH THE TIDES

Metonic cycle or enneadecaeteris (from Ancient Greek: ἐννεακαιδεκαετηρίς, from ἐννεακαίδεκα, “nineteen”) is a period of almost exactly 19 years after which the lunar phases recur at the same time of the year. [en.wikipedia.org/wiki/Metonic\\_cycle](https://en.wikipedia.org/wiki/Metonic_cycle)

As it has been stated before by Jacques Ranciere, about the distribution of the sensible. Things can be understood only when they can be made sensed and time is another thing to be sensed through the senses. Measuring time is an attribute that we have divided into equal between one rotation around the sun but this rotation is neither exact nor does it inform us something more about it than that.

In previous times and in other cultures, humans understood that other celestial bodies play a vital role in the organization of time in cycles. Sun and Moon cycles have been observed to reset in a period of almost 19 years. But why would sun and moon cycles interest us in the landscape? As we already know sun and moon are the principal celestial bodies that control the movements of tides and their alignment produces the high tides. In an area where low and high tide have a difference of 9m this is a very important information to have, even as a sensation. For this reason introducing a tide-sensitive landscape is also a form of education about the time and the landscape through the senses through qualities of wetness, smell, vegetation, flooding.

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[en.wikipedia.org/wiki/Metonic\\_cycle](https://en.wikipedia.org/wiki/Metonic_cycle)

### CLIMATE

Winter storms are strong events that can produce phenomena of increased risk in relation to floodings and damages.

Period of phenomenon: September to March

Risk period: January to March

(1) Winter Storms (7) Hiking

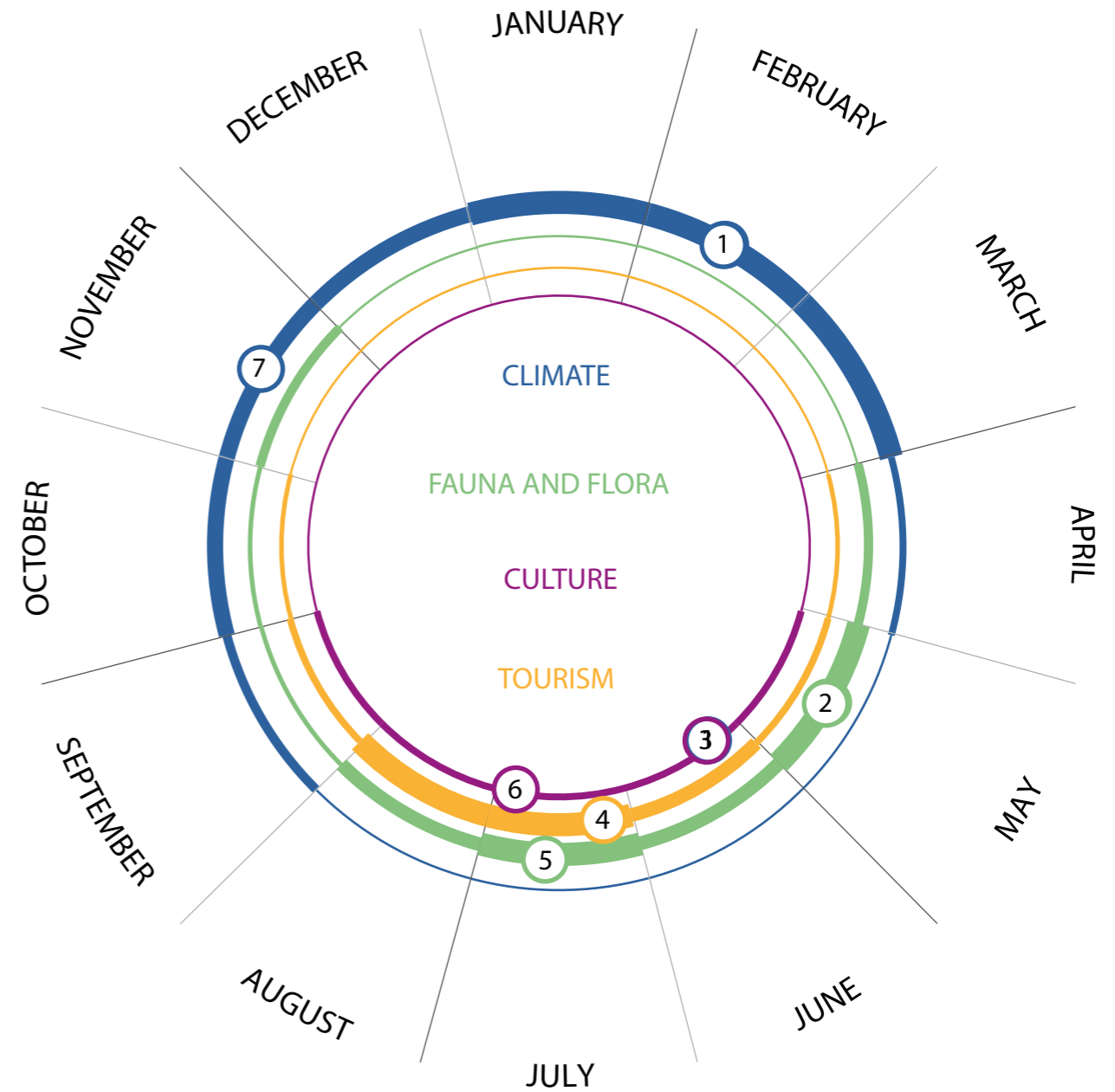
### FAUNA AND FLORA

Spring is an important period for the reproduction of animals that find refuge in the Baie de Somme.

Period of phenomenon: August to May

Intense period: July and May

(2) Bird nesting (5) Seal watching



### TOURISM

In the Summer the tourists and local enjoy the pebble beach. Thanks to the groin structure this beach has the longest beach path way in Europe

Period of phenomenon: September to May

Peak Season: August - July

(4) High touristic Season

### CULTURE

Summer period is an opportunity for open air-festivities for locals and tourists. The sea, the wind and the flowers become topics of celebration

Period of phenomenon: September to May

(3) Kite festival (6) Sea festival



## Thinking About Design of Landscape

I argue that because climate change is not only a transformation of the physical conditions of the earth but also of the human psyche we need to design in ways that not only change the physical space but also transform the human perception and behaviour.

To change the perception of the user first we must be able to change the perception of the Landscape Designer. For this reason we need a new term to define a new discipline that in its centre it has the transformation of civilization through the realization of the deep embodied connection of body and nature in the common space. That's why I would prefer instead of the term Landscape Architecture, Land Art, Landscape Design to use the term Landscape Practice which unifies every action that has human/nature discourse in its centre. We already know that human behaviour is the only one that can rapidly affect the Landscape and Climate Change.

In the text "The medium is the message" We see how every medium has its own way of transmitting information, the book to the eye, music to the ear, the film to the eye and the ear. but the living body is always in a different realm. Through every medium we understand differently A storm in a text is experienced differently than a storm in a painting, than a storm in a song, than a storm than a storm on the body. So we see that landscape is also a medium that transfers information to humans and non humans. So the question that comes up is how do we share the important information about climate change/disaster through Landscape Practises?

But how does the modern man comes in contact with scenarios of distraction? Science-fiction novels and films usually have topics of disaster in the big scale, this is the material we learn about global problems. In this

medium we explore disaster through a technological view that is disembodied and that usually arrives at the end from a laboratory and a scientist that is detached from the world. In both cases of mythical and cultural education the scenario of adaptation is not present. Thus the question arose, how can we move from rejecting fear of change through the scientific buffer to accepting change through the embodied experience ?

Landscape architecture is the discipline that deals with the design of natural spaces, its the discipline that manages natural phenomena and bodies, creates relationships and opportunities. Landscape architecture is what exists between man and the terror that exists out there. But could this way of thinking be actually dangerous? Could it be that by being a polite designer we are missing out the opportunity of whole range of emotions to be experiences between humans and nature?

In this sense Jacques Rancière talks about the distribution of the sensible. Things can be understood only when they can be made sensed. So in a way sometimes, hiding the problem between scientific solutions may be causing more harm in the long-term. Maybe real solutions need to be found much deeper in the human psyche. This is the realm that artists get permission to access and exhibit in the gallery space but the gallery space is institutional, it happens once and it doesn't become part of the lived life of humans. On the other hand land-art explores multiple aesthetic concepts of nature but its always positioned so far away and it hardly accessible to enter into the human experience in a large scale.

So maybe what we need is not only technological answers but flexible human beings that develop diverse solutions through the own interaction with nature. Philosophical flexibility - trial and error and again trial leading to Biodiversity of species / diversity of humans.











# TERRITORIAL MASTER PLAN DESIGNING FLOOD

## System of Solutions for Coast Resilience

Based on the complexity and seriousness of the challenges of territory the only way to respond is through a system of projects that each is the basis of the other. If the territory is not properly drained then construction is not possible. The over silted estuary provides material for construction. The new tidal estuary provides the biological conditions for the safety of the coast and finally we come to Cayeux-sur-mer where we allow habitants to experience safely equally the forces of the territory.

### LEGEND FLOODING TYPES AND REGIMES

-  Flooding by Tides
-  Extreme Tides
-  Flooding by Tides Year
-  Flooding by Tides Month
-  Flooding by Tides Week
-  Flooding by Tides Day
-  Flooding by Tides Controlled
-  Flooding by Rainwater and Underground Water

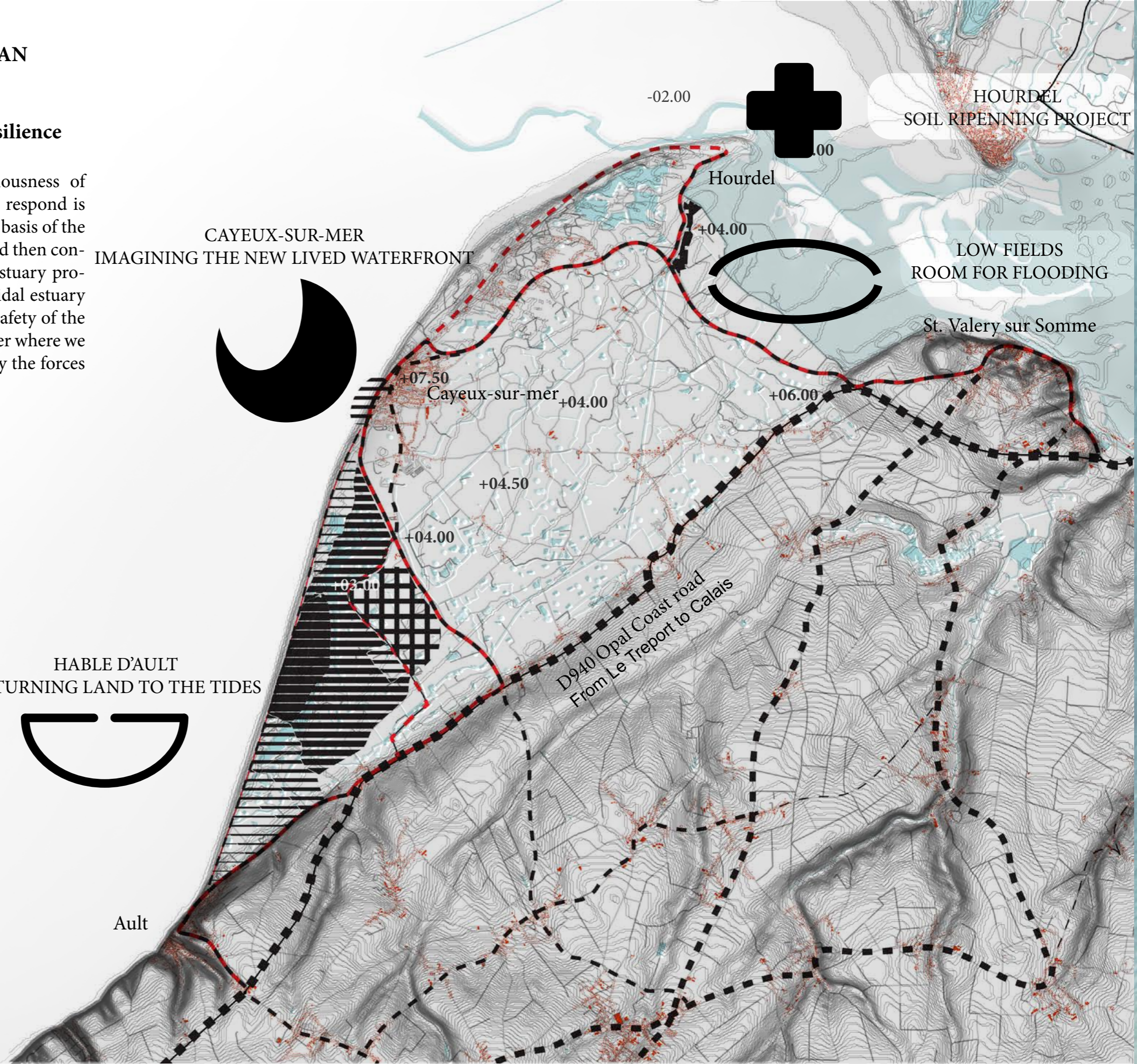
62

CAYEUX-SUR-MER  
IMAGINING THE NEW LIVED WATERFRONT

HABLE D'AULT  
RETURNING LAND TO THE TIDES

HOUREDEL  
SOIL RIPENNING PROJECT

LOW FIELDS  
ROOM FOR FLOODING





# MASTER PLAN TERRITORIAL DESIGNING FLOOD

## System of Solutions for Coast Resilience

Based on the complexity and seriousness of the challenges of territory the only way to respond is through a system of projects that each is the basis of the other. If the territory is not properly drained then construction is not possible. The over silted estuary provides material for construction. The new tidal estuary provides the biological conditions for the safety of the coast and Finally we come to Cayeux-sur-mer where we allow habitants to experience equally the force of the territory.



HABLE D'AULT  
RETURNING LAND TO THE TIDES

CAYEUX-SUR MER  
IMAGINING THE NEW LIVED WATERFRONT

LOW FIELDS  
ROOM FOR FLOODING

HOUREL  
SOIL RIPENING PROJECT

Ault

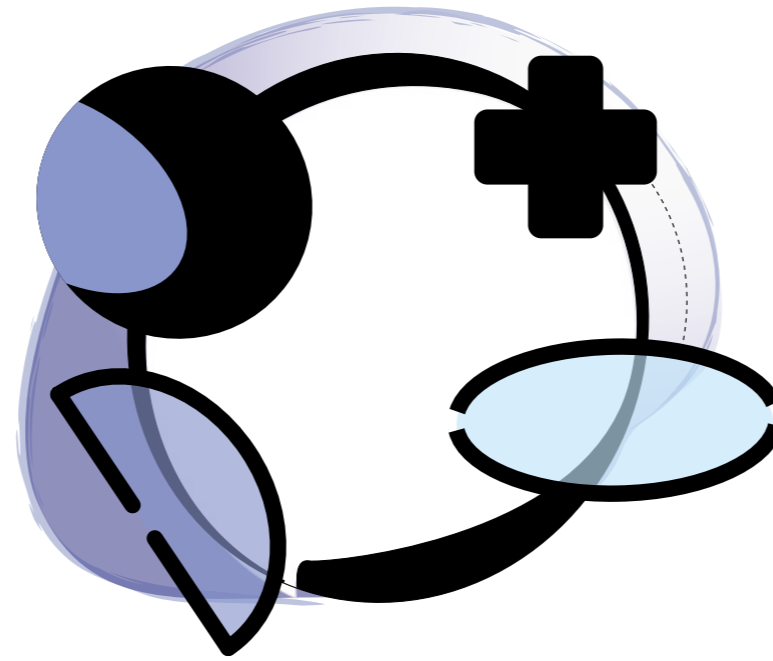


# MASTER PLAN TERRITORIAL

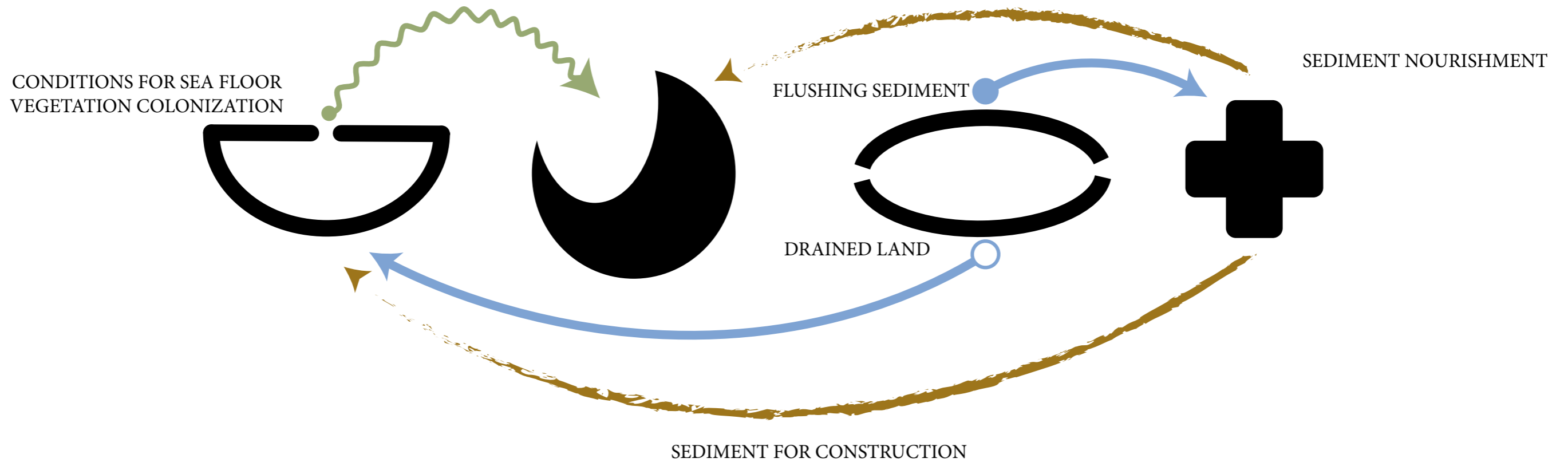
## System of Solutions for Coast Resilience

### Diagram of Synergies Between Projects

The goal is to be able to continue living in the territory for the next century and in order to do this we need system of conditions. These conditions are to be found in the periphery of each project. For this reason the one project needs the existence of the other because it prepares and sets the ground for construction and function. So the projects are intrinsically linked to each other. At the same time the benefits provide an economical and well being base for the sustainable habitation of the territory.



64



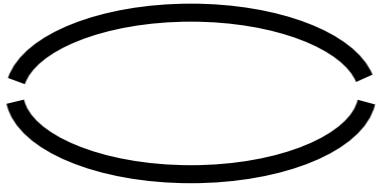
HABLE D'AULT  
RETURNING LAND TO THE TIDES

CAYEUX-SUR MER  
IMAGINING THE NEW LIVED WATERFRONT

LOW FIELDS  
ROOM FOR FLOODING

HOURDEL  
SOIL RIPENING PROJECT





**LOW FIELDS  
ROOM FOR FLOODING**



# MASTERPLAN

## BAS CHAMPS ROOM FOR FLOODING

All channels that drain the territory connect in a single point which collects all the water and then it flushes in the estuary when the tides are lower. The main idea is to keep the identity of a channel but to add, through a change of topography, a new floodable landscape that can collect the excess water until it is quickly flushed in the time between two high tides. At the same time the location is perfect for the development of eco-responsible grazing.



## LOW FIELDS ROOM FOR FLOODING

Ault





THEN

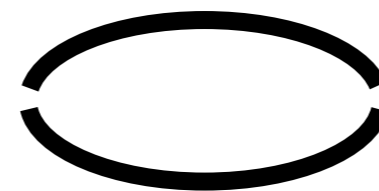


Farmer with his sheep then

NOW



Farmer accessing his crops now after Heavy rainfall for several weeks, combined with high tides and the storm raised the water levels in the Bas-Champs de Cayeux.



**BAS CHAMPS**  
PRODUCTIVE IDENTITY THEN AND NOW



## MASTERPLAN BAS CHAMPS ROOM FOR FLOODING

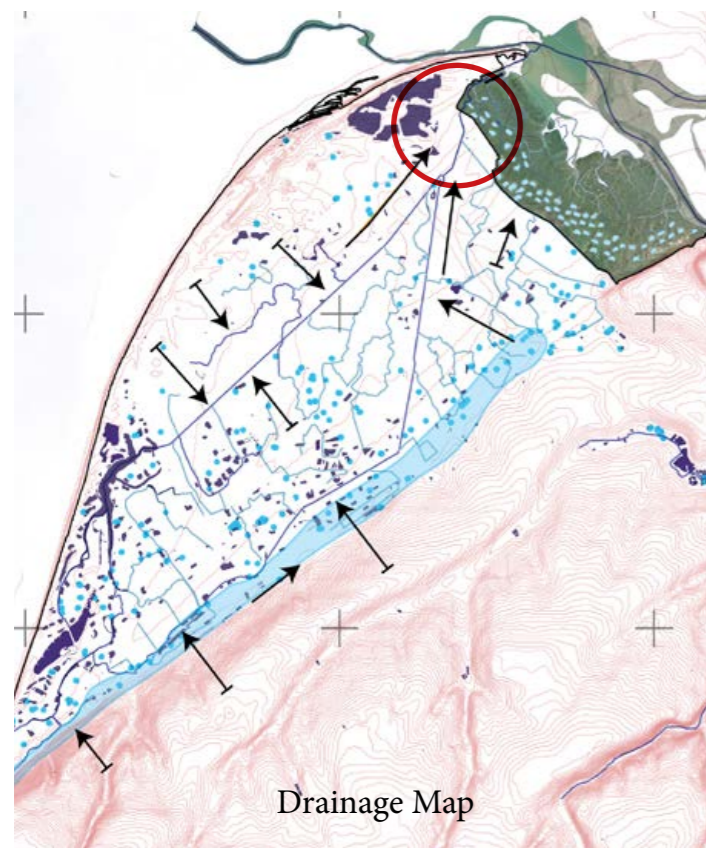
The whole territory is drain from a single point. All the channels that drain the territory connect in a single point which collects all the water and then it flushes it in the estuary when the tides are lower. The channel is situated in interesting position between three important touristic villages Cayeux-sur-mer, St. Valery-sur-Somme and Point d'Hourdel, at the same time just on the junction point of the channel we can find the House of Somme environmental education centre for the territory. Moreover this area is in the margin of the agriculture fields with the estuary. The main idea is to keep the identity of a channel but to add, through a change of topography, a new floodable landscape that can collect the excess water until it is quickly flushed in the time between two high tides. At the same time the location is perfect for the development of eco-responsible grazing so the productive identity of the place is not lost.



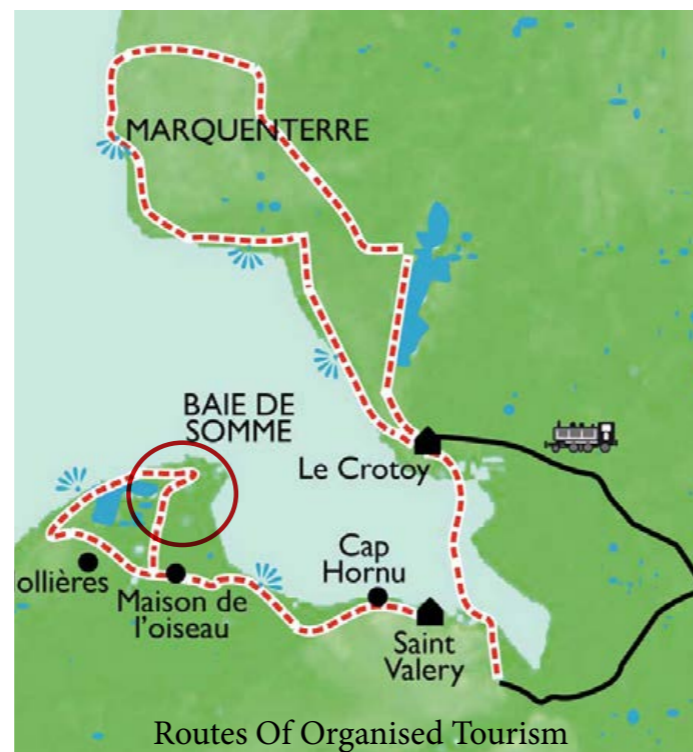
Doors To The Estuary



Water Flowing From The Channel To The Estuary In Low Tides



Drainage Map



Routes Of Organised Tourism



Section of Channel



# MASTERPLAN BAS CHAMPS ROOM FOR FLOODING

## REFERENCE

### Room for the River

“In the Netherlands, Room for the River (Dutch: Ruimte voor de Rivier) is a government design plan intended to address flood protection, master landscaping and the improvement of environmental conditions in the areas surrounding the Netherlands’ rivers. The project was active from 2006–2015. Measures in the plan include: placing and moving dykes, depoldering, creating and increasing the depth of flood channels, reducing the height of the groynes, removing obstacles, and the construction of a “Green River” which would serve as a flood bypass.” [en.wikipedia.org/wiki/Room\\_for\\_the\\_River\\_\(Netherlands\)](https://en.wikipedia.org/wiki/Room_for_the_River_(Netherlands))

“The Room for the River programme encompassed four rivers: the Rhine, the Meuse, the Waal, and the IJssel. At more than 30 locations, measures were taken to give the river space to flood safely. Moreover, the measures were designed in such a way that they improved the quality of the immediate surroundings.

A total of 19 partners - the provinces, municipalities, regional water authorities and Rijkswaterstaat cooperated in the implementation of the Room for the River Programme. The Ministry of Infrastructure and Water Management was responsible for the overall programme.” [dutchwatersector.com/news/room-for-the-river-programme](http://dutchwatersector.com/news/room-for-the-river-programme)

The chosen strategies here are Lowering Floodplains and Water Storage which is simply a topographical transformation (normally an extraction of soil) so that excess water can be directed in cases of storms.

## A menu of measures



**Lowering floodplains**  
Lowering/excavating part of the floodplain increases room for the river in high water situations.



**Lowering groynes**  
Groynes stabilise the location of the river and ensure its correct depth. However, in a high water situation, groynes may obstruct the flow to the river. Lowering groynes speeds up the rate of flow.



**Dyke relocation**  
Relocating a dyke inland widens the floodplain and increases room for the river.



**Removing obstacles**  
If feasible, removing or modifying obstacles in the riverbed will increase the rate of flow.



**Depoldering**  
The dyke on the riverside of a polder is lowered and relocated inland. This creates space for excess flows in extreme high water situations.



**Water storage**  
The Volkerak-Zoommeer provides temporary water storage in extreme situations where the storm surge barrier is closed and there are high river discharges to the sea.



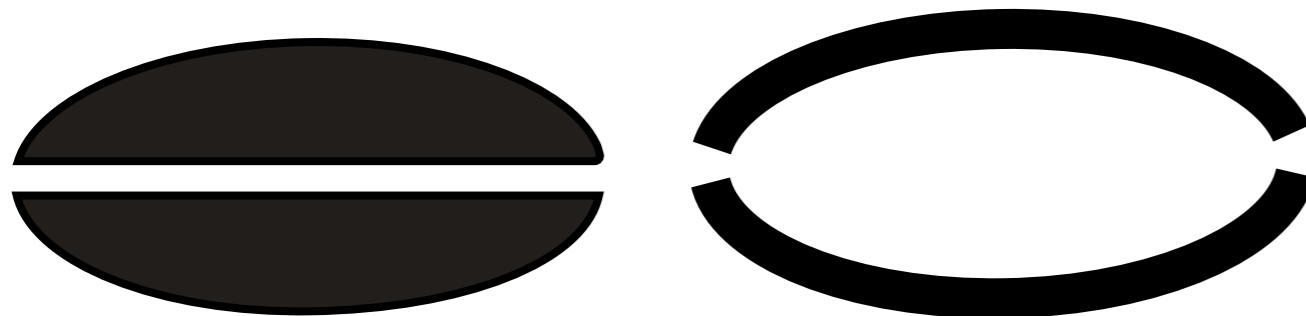
**Deepening summer bed**  
Excavating/deepening the surface of the riverbed creates more room for the river.



**High water channel**  
A high water channel is a dyke area branching off from the main river to discharge some of the water via a separate route.



**Dyke reinforcement**  
Dykes are reinforced at given locations where river widening is not feasible.

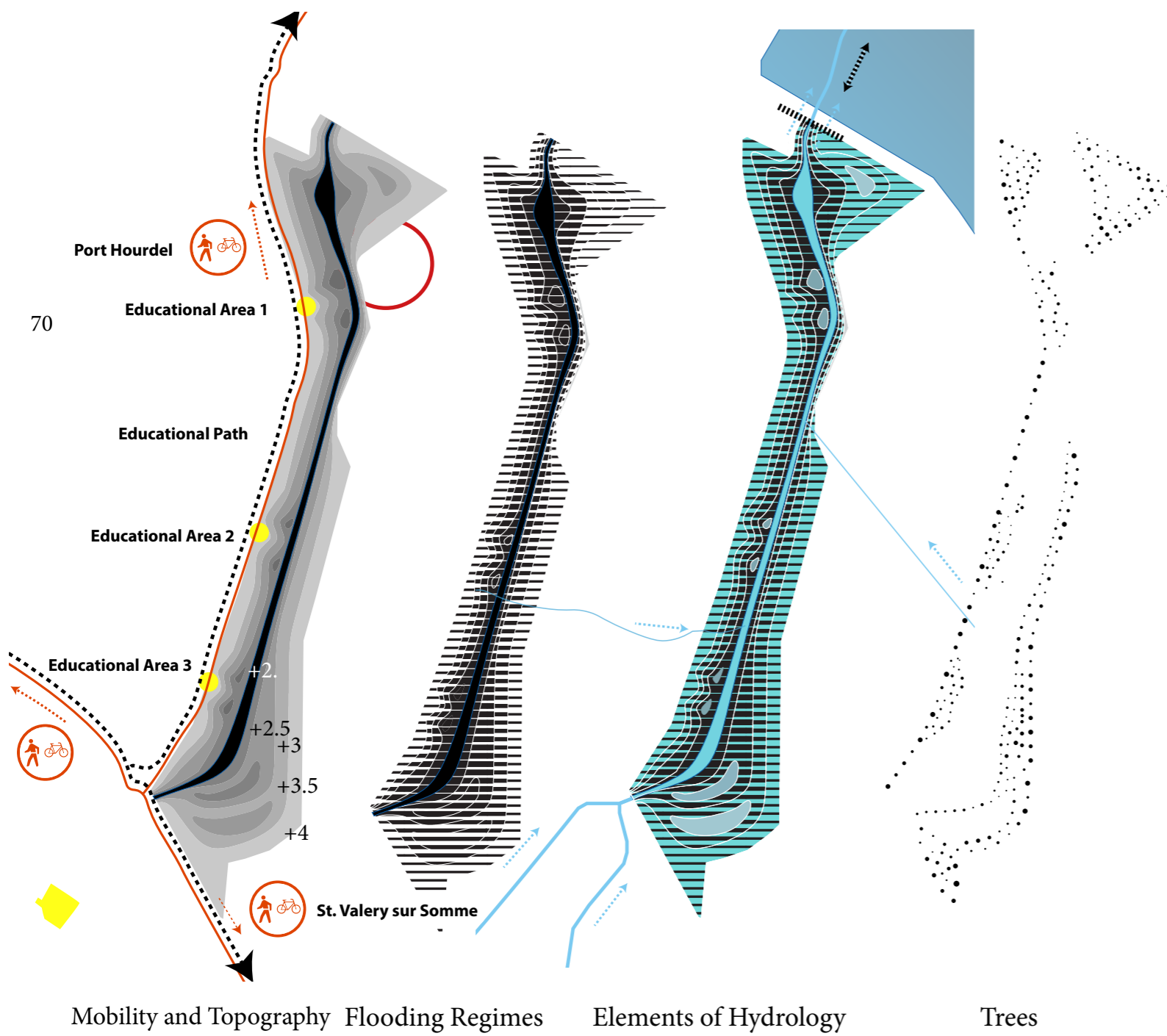




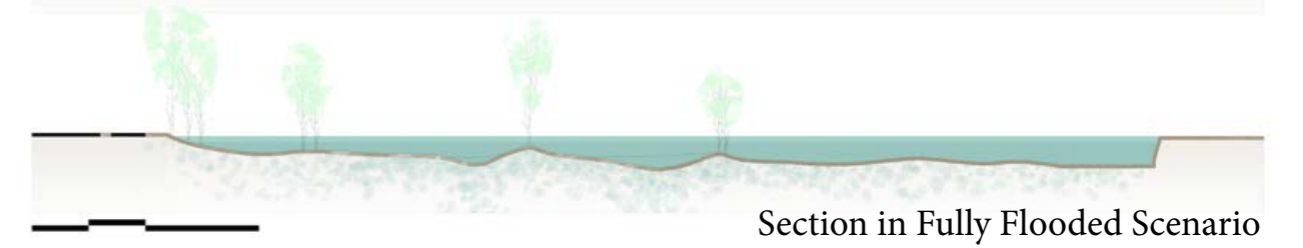
# MASTERPLAN BAS CHAMPS ROOM FOR FLOODING

The main idea is to keep the identity of channel but to add additional qualities. Through a change of topography, a new floodable landscape can collect the excess water until it is quickly flushed in the time between two high tides, the shape of the channel is not discarded as it's function serves best to flush as much water as possible in the shortest amount of time. The new landscape with rich topography has ponds of different sizes and with different flooding regimes. These ponds offer water to grazing animals but generally serve as an area for the migratory species. At the same time specific areas for educational/environmental immersion points along the path offer distinct ways to connect to nature. The distances and visibility from the path to the ponds are thought as elements not to disturb animals.

## LAYERS

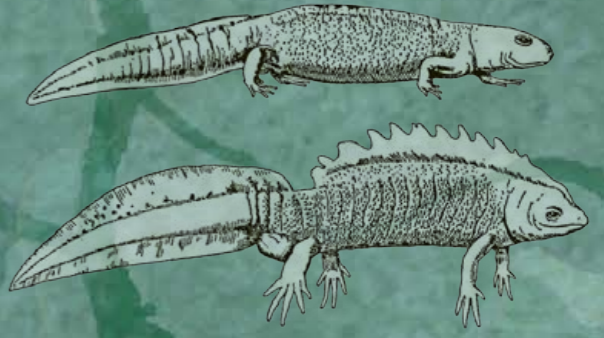


Mobility and Topography Flooding Regimes Elements of Hydrology Trees



Section in Fully Flooded Scenario

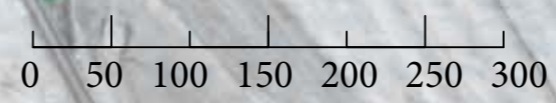




*Triturus cristatus*



BAS CHAMPS  
CHANNEL ENLARGEMENT  
HIGH TIDE / HIGH FLOOD SCENARIO







*Apium repens*



BAS CHAMPS  
CHANNEL ENLARGEMENT  
LOW TIDE / FLUSHING OUT SCENARIO



0 50 100 150 200 250 300





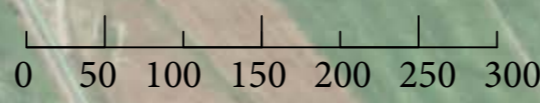


*Calimorpha quadripunctaria*

ZOOM



**BAS CHAMPS**  
CHANNEL ENLARGEMENT  
EMPTY CHANNEL SUMMER SCENARION





+4

+3.5

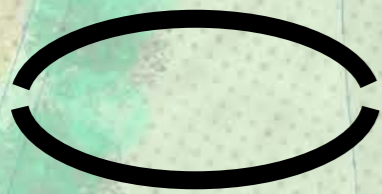
+3

+2.5

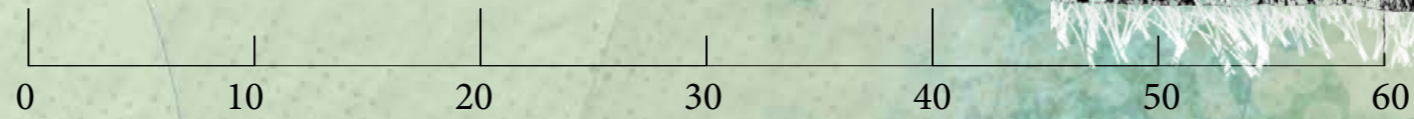
+2



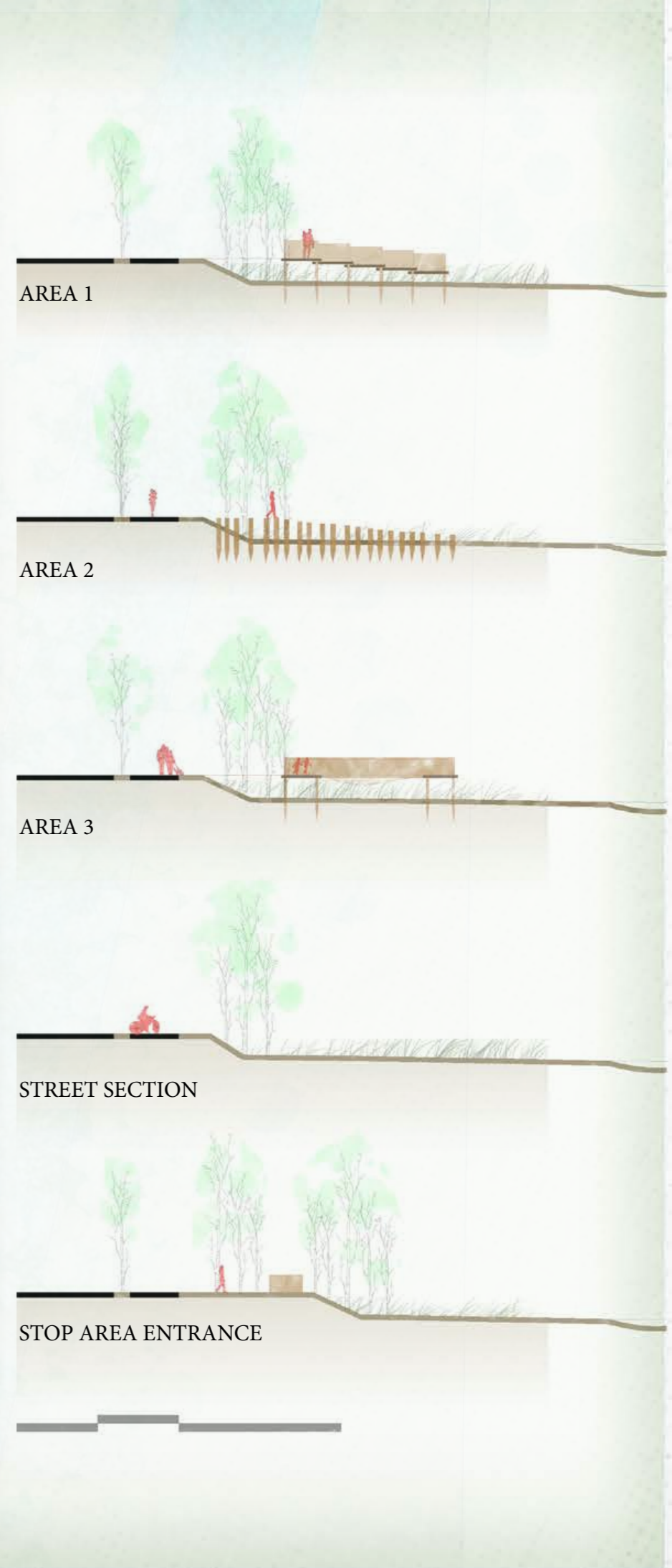
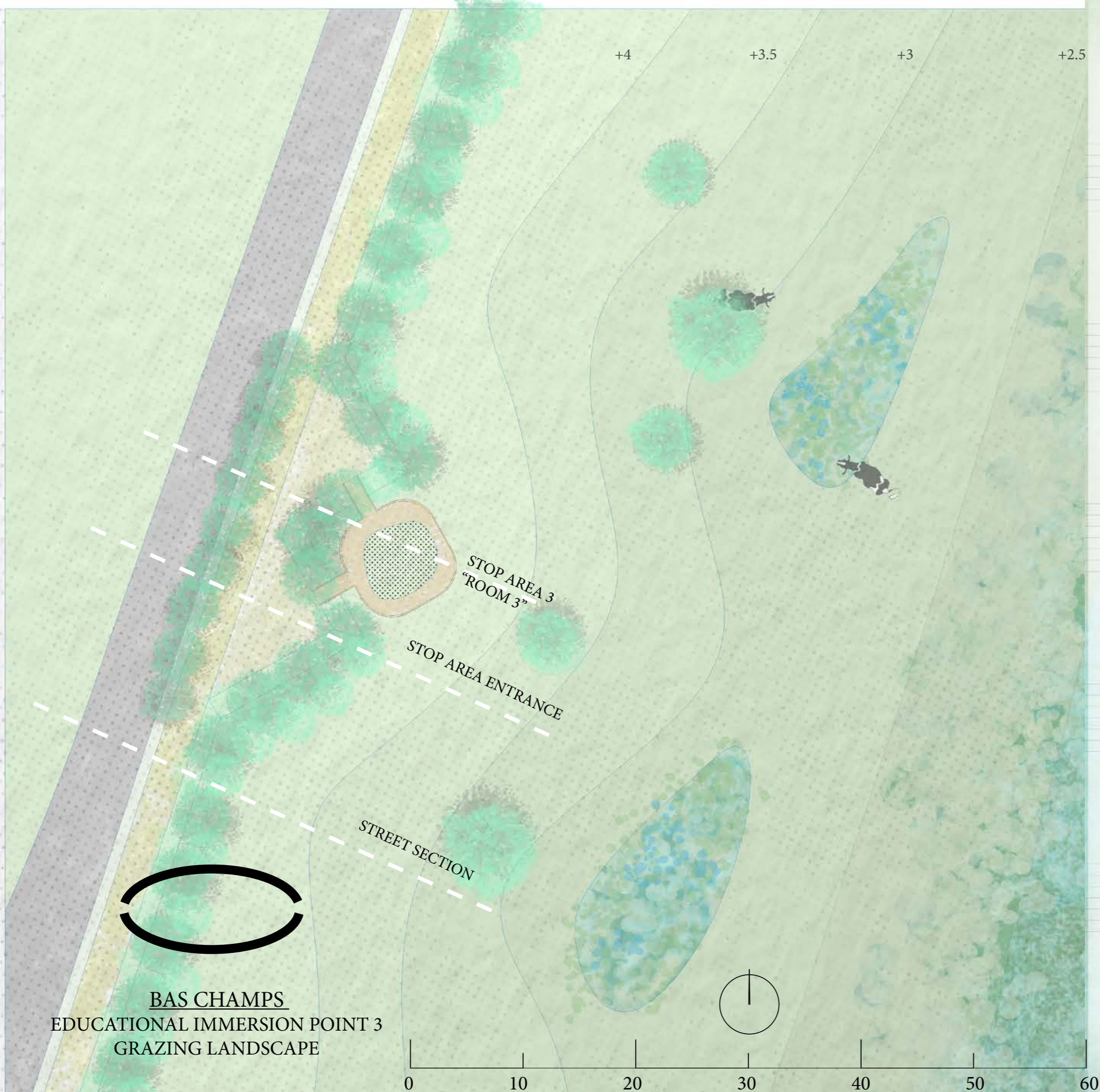
*Juncus Sp.*



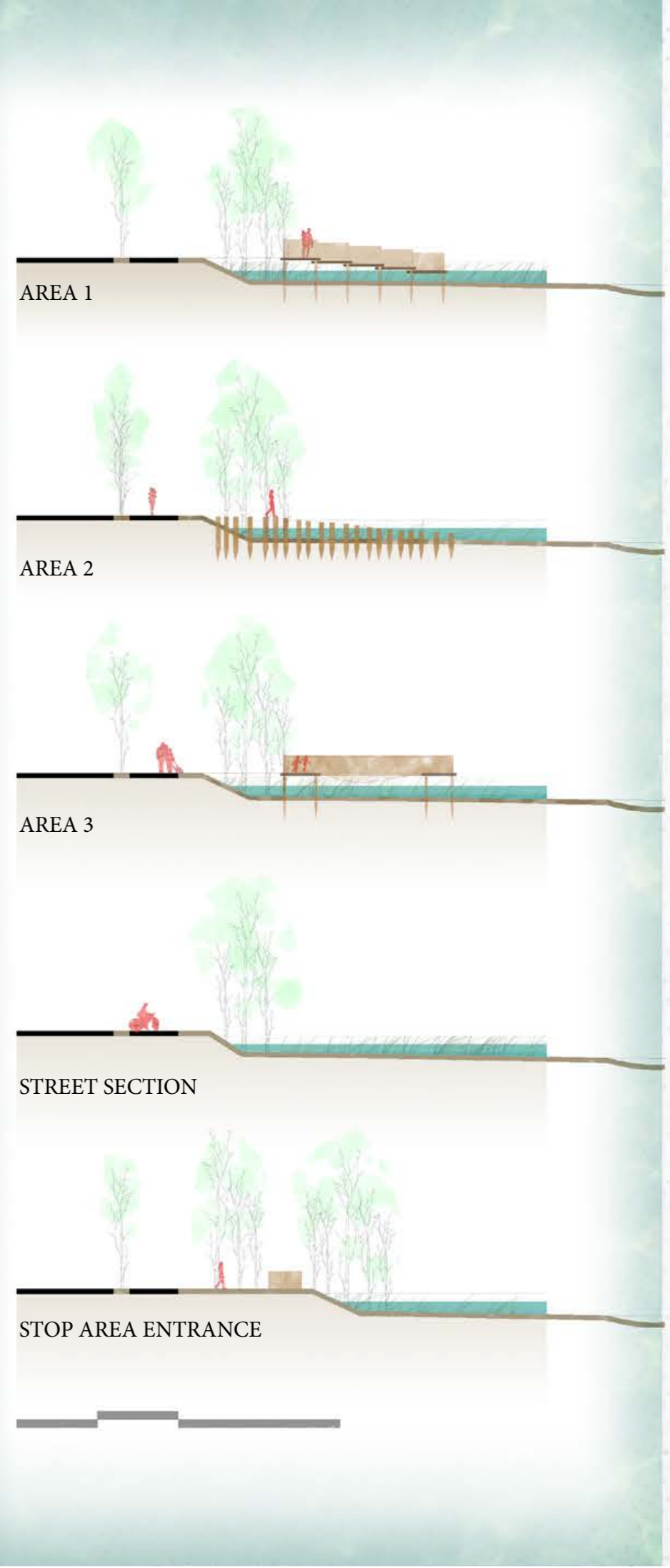
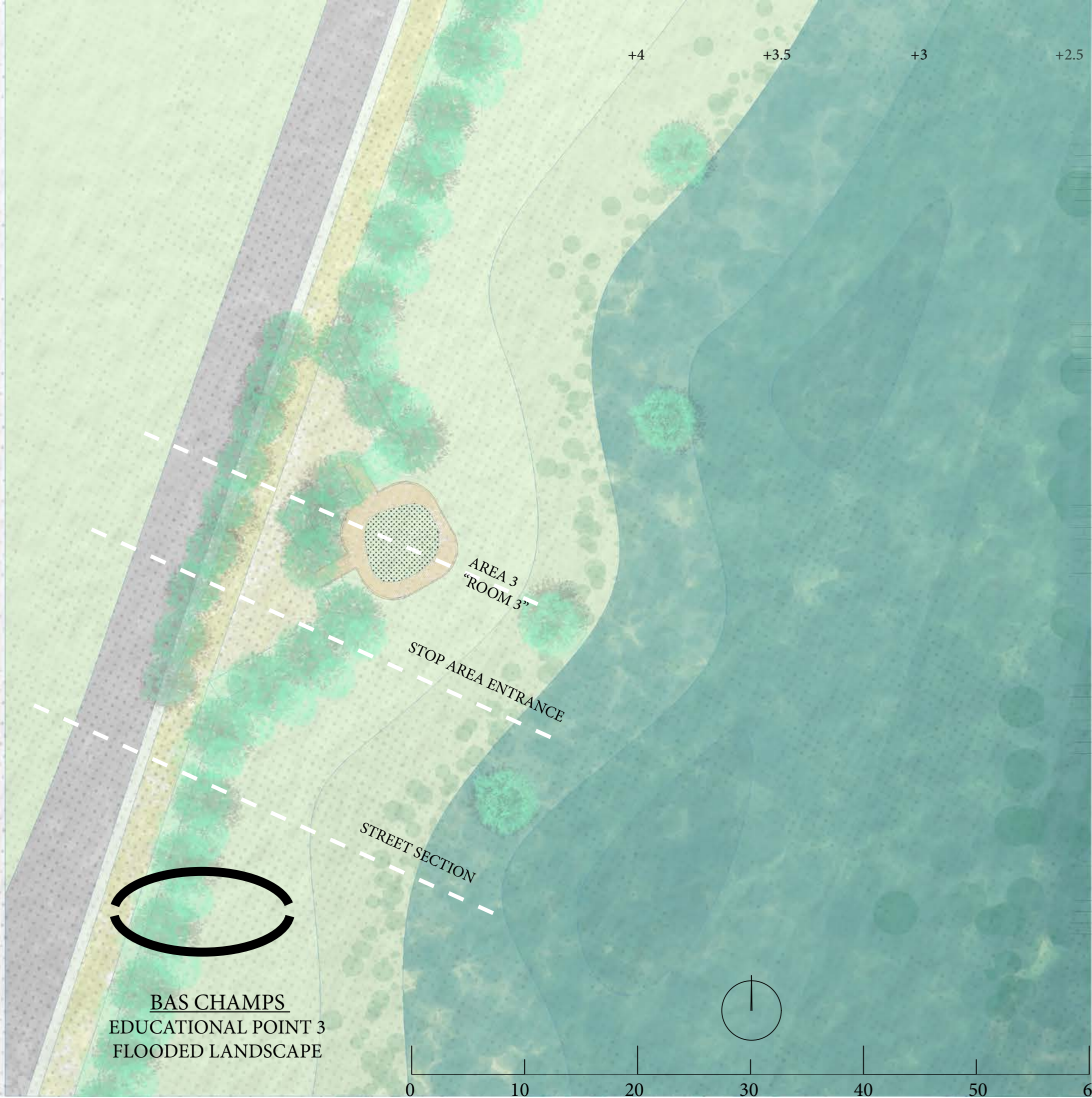
**BAS CHAMPS**  
CHANNEL ENLARGEMENT  
EDUCATIONAL EMERSIVE ZOOM















BAS CHAMPS  
CHANNEL ENLARGEMENT  
-Floodable Wet Prairie-





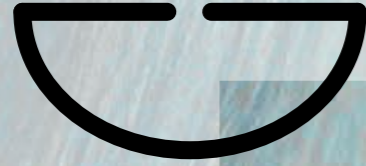
**HABLE D'AULT  
RETURNING LAND TO THE TIDES**



## MASTERPLAN

### HABLE D'AULT RETURNING LAND TO THE TIDES

All channels that drain the territory connect in a single point which collects all the water and then it flushes in the estuary when the tides are lower. The main idea is to keep the identity of a channel but to add, through a change of topography, a new floodable landscape that can collect the excess water until it is quickly flushed in the time between two high tides. At the same time the location is perfect for the development of eco-responsible grazing.



### HABLE D'AULT RETURNING LAND TO THE TIDES

Ault





THEN

NOW



Before the enclosure of the land to the tides. Fisherman waiting for the tides to arrive

The storm of 1990 breaches the shore and enters in the low fields in Hable D'Ault



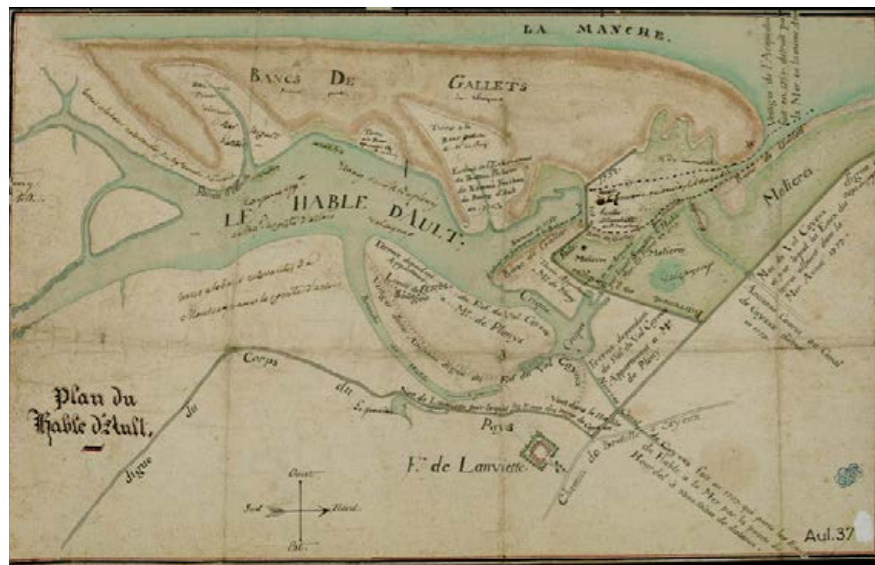
**HABLE D'AULT**  
HYDRAULIC IDENTITY THEN AND NOW



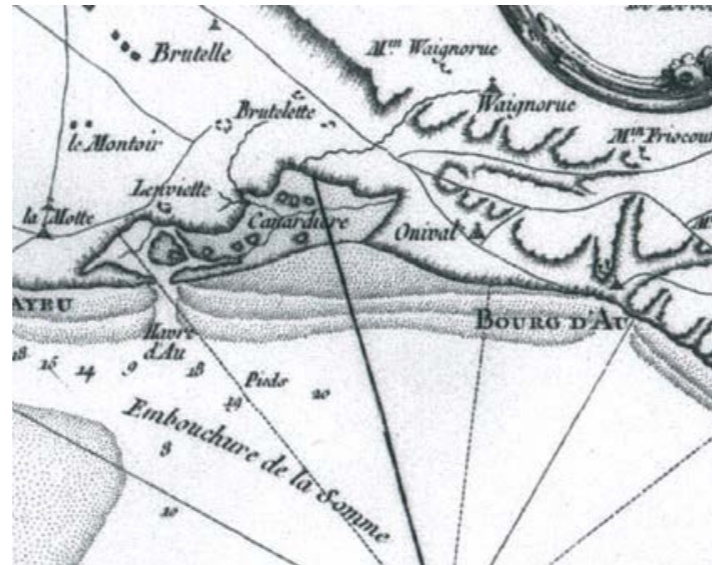
# MASTERPLAN HABLE D'AULT RETURNING LAND TO THE TIDES

## A LANDSCAPE SENSITIVE TO EROSION

On the south-east side of the territory we find Hable d'Ault. Here the coast is suffering from erosion and a hard protection of groins was created to protect the low fields from submerging to the tides. As we have seen this wasn't always the case, in the past this landscape was part of the tides. At another point in time here was a harbour which is now still visible as one of the lower "lakes", the other was a site extraction of minerals. The traces of time are not only found in the marks of subtraction but they can also be seen through the succession of dykes that signify the gradual expansion of man in the territory. The fragility of the landscape lies in the fact that the expensive protection of the coast with sediment nourishment of gravel does not guarantee that the outer dyke will not be breached by the 10 year return period storms. Once this dyke is breached then the complete territory gets flooded by salty water.



Casini Historic Map of Hable d'Ault



Historic Map of 1771 Identifying opening of the shore.



Low Fields Inundated by the Storm in 1990





# MASTERPLAN HABLE D'AULT RETURNING LAND TO THE TIDES

## REFERENCES

The proposed strategy is called **Managed Realignment**:

“Managed realignment is a measure that usually results in the creation of a salt marsh by removing coastal protection and allowing for an area previously protected from flooding to become flooded. Managed realignment is a measure dealing with sea level rise and coastal erosion. It is also often a method that replaces hard coastal defense measures with soft coastal landforms. Rather than relying on hard structures for defense, managed realignment depends on natural defenses to absorb or dissipate the force of waves.” [coastal-management.eu](http://coastal-management.eu)

Wallasea Island Wild Coast Project, located in the British coast of Essex is a project of managed realignment developed by The Royal Society for the Protection of Birds (RSPB) and with the partnership of Crossrail and Environment Agency. The project focuses on breaching the seawall in specific points in order to create different cells so that flooding and erosion can be managed.

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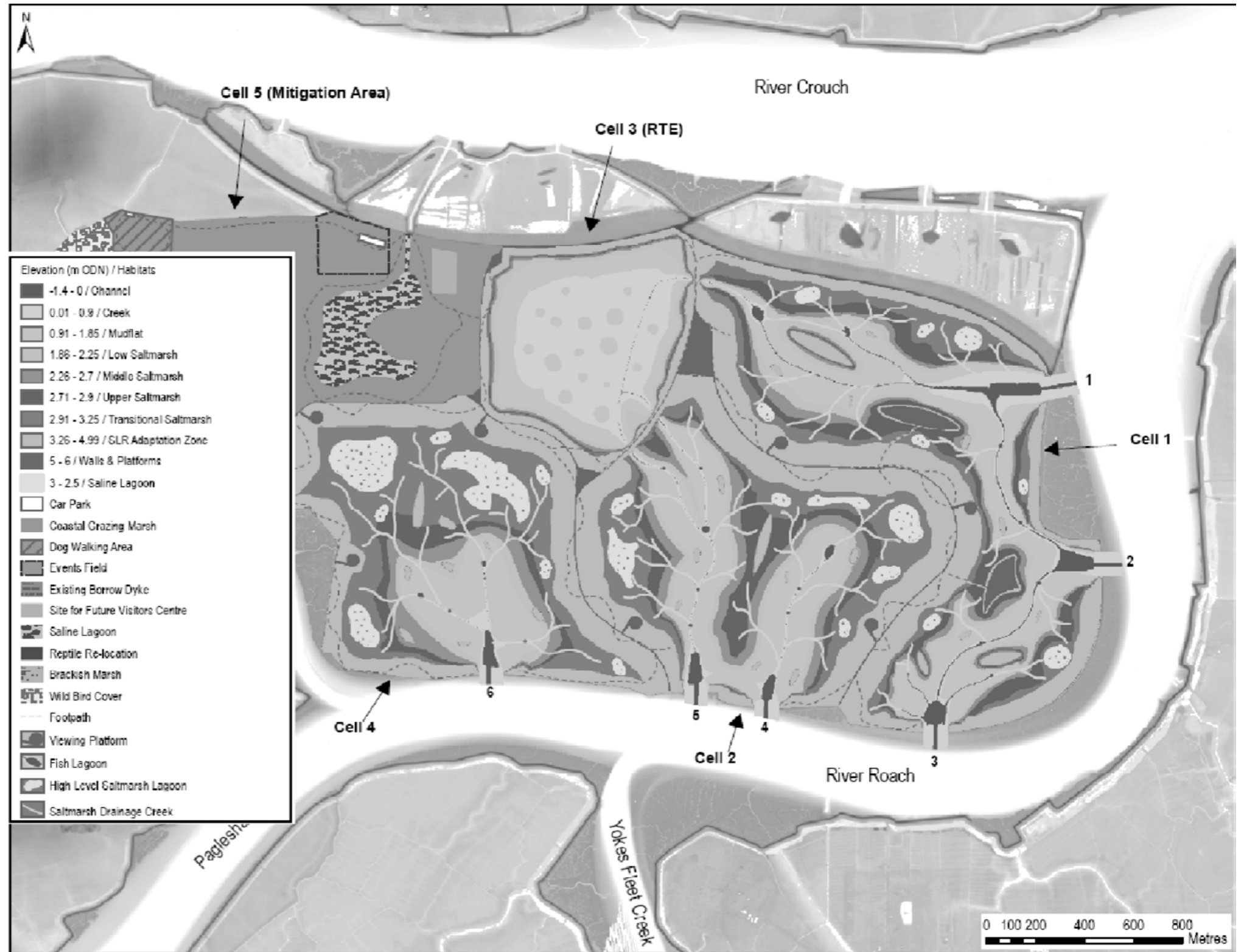


Figure 5 Proposed Scheme Design for the Wallasea Island Wild Coast Project





# MASTERPLAN HABLE D'AULT RETURNING LAND TO THE TIDES

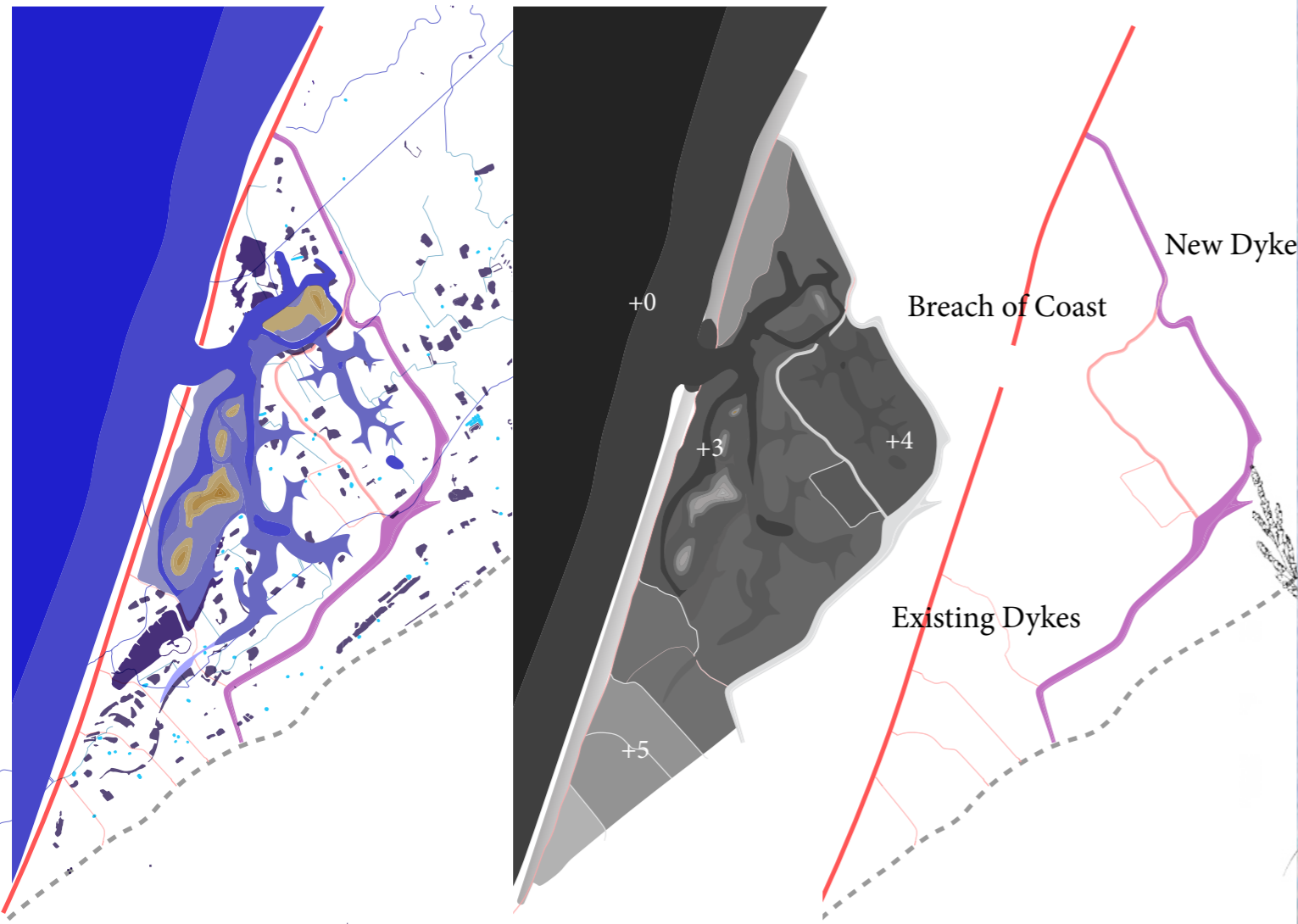
## PROPOSAL

By relocating the protective envelope from the outer dyke to a new inner dyke we provide a new floodable landscape that protects the territory from storm surges. The actions of the transformations are 1) Create a new dyke and 2) create a breach in the shore's dyke. The new tidal landscape apart from protecting through the dyke and the wetlands it also has productive and ecological functions that will be explained shortly.

This is an important project because if the seawall is breached without the inner dyke then the whole area would be flooded. In the contrary now by allowing water to enter through the breach of the seawall the landscape is being transformed into a tidal landscape that will gradually adapt and transform to its new identity.



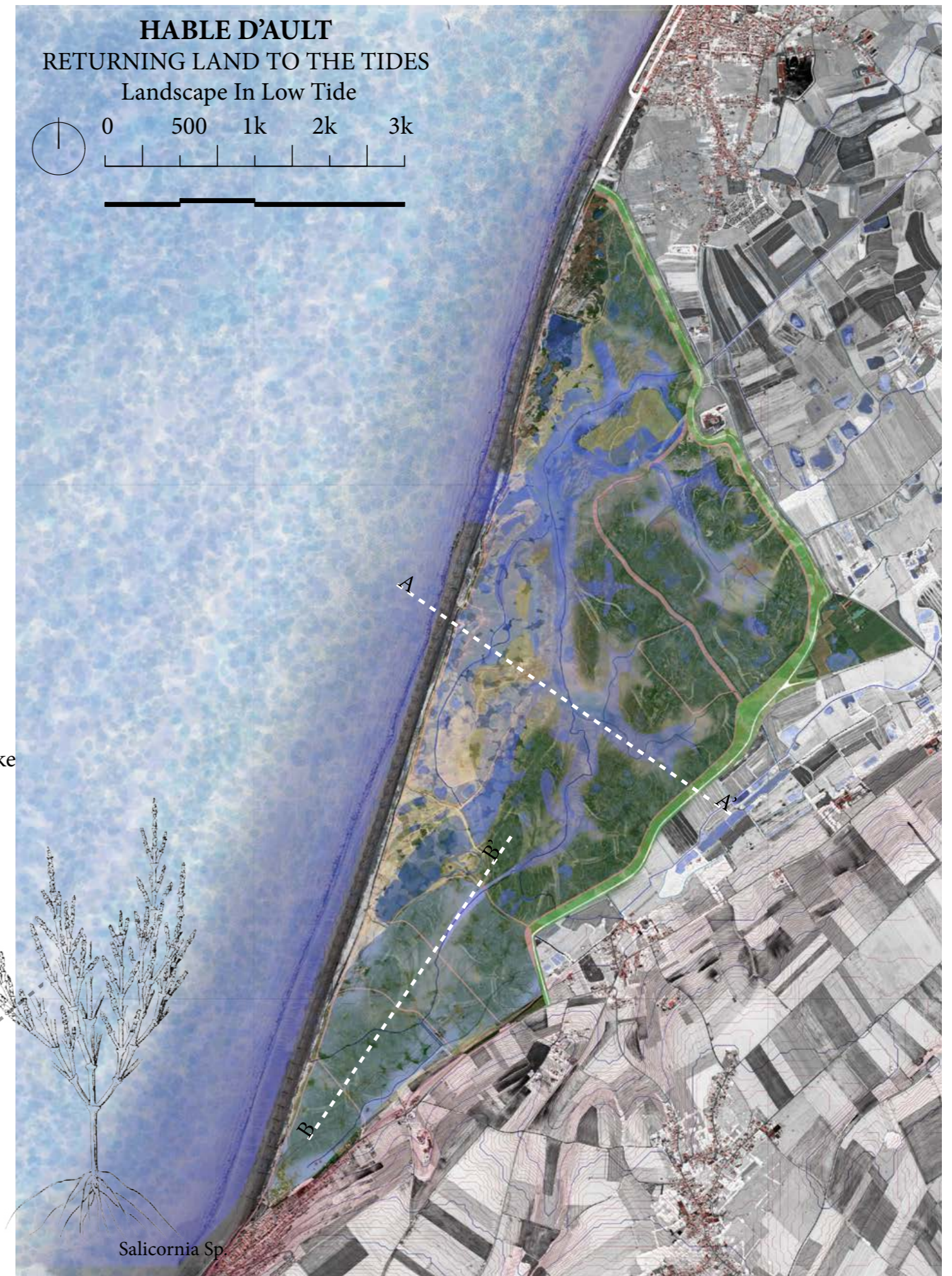
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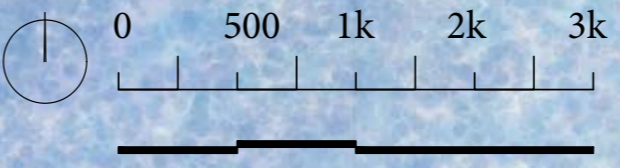
Inner 'Coast' - Mudflat Area

Topography

Dykes Old and New



## HABLE D'AULT RETURNING LAND TO THE TIDES Landscape In Low Tide



Salicornia Sp.

New Dyke





# MASTERPLAN HABLE D'AULT RETURNING LAND TO THE TIDES

## THE NEW LANDSCAPE

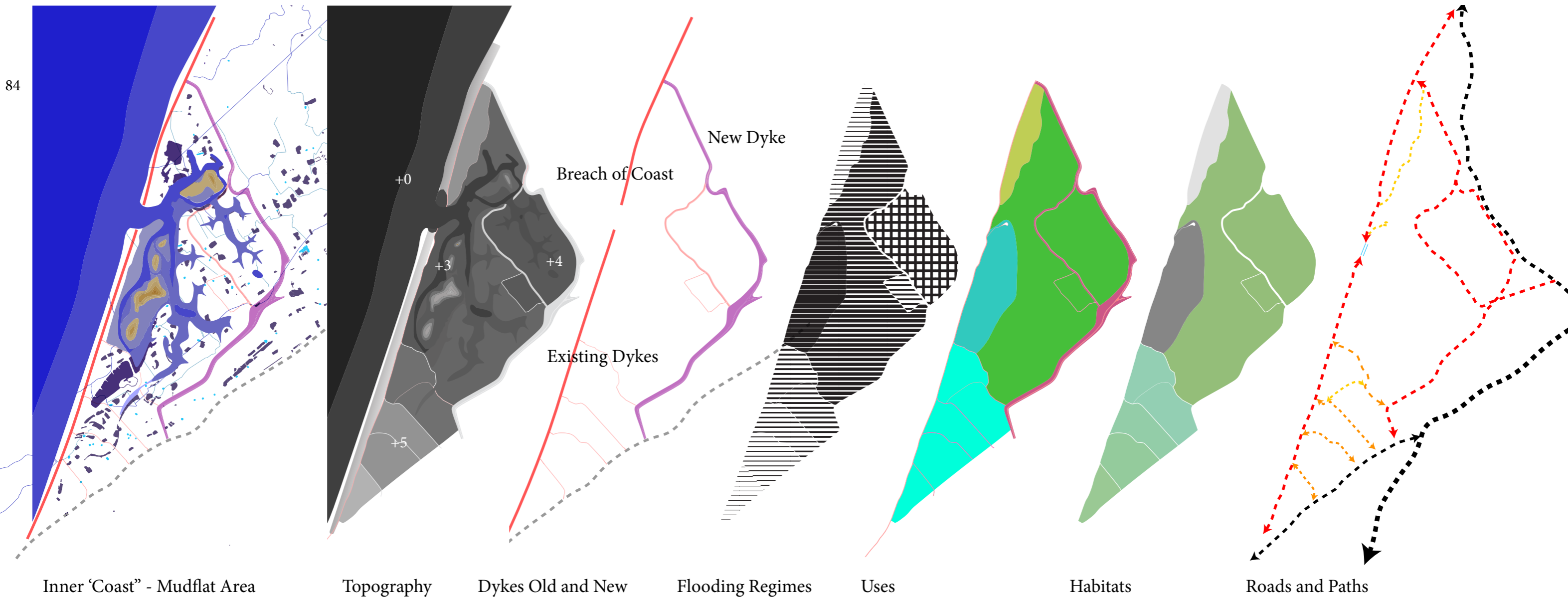
By analysing the current hydrological and topographical situation of the landscape we propose the creation of a new Inner Dyke and the breach of the outer dyke in a way that natural topography would align with the movement of tides. This inner coast is the area of the tidal wetland that is mostly affected by the tides. In the highest astronomical tides the whole landscape between the two dykes gets flooded and in the lowest it is completely empty.

The new tidal landscape is not only defined by topography but also through the existence of smaller pre-existing dykes that define the rhythm that higher tides will enter. Because of this we have a variety of flooding regimes which alongside topography create diverse conditions of flooding frequencies, flooding depths and salinity for the creation of habitats and uses. The new dyke is not only a border but also an element of the landscape because it has sufficient space to host different habitats on its terraces.

The productive uses, as a result of the habitats, can be divided in two groups: the marine and the agricultural. Access plays an important role in the way that the uses are elaborated. All marine uses have direct contact with the outer dyke and the shore and at the same time they have direct connection to the territory. On the other hand the agricultural uses have a direct connection to the inner dyke, which functioning as a transition zone between the agricultural fields and the tidal area. The low intensity productive function allows for the creation of refuge for biodiversity such as migratory birds.

Pre-existing and new dykes apart from controlling flows of water also allow for the flows of humans and animals. All dykes are connected to the greater network and can facilitate for access by car for the maintenance, productive and visiting purposes. At the same time access in the intertidal landscape is possible for visitors in the times of low tides through specific paths. The new dyke has diverse section profiles which allows the vertical accessibility of animals and farmers in specific points.

## LAYERS



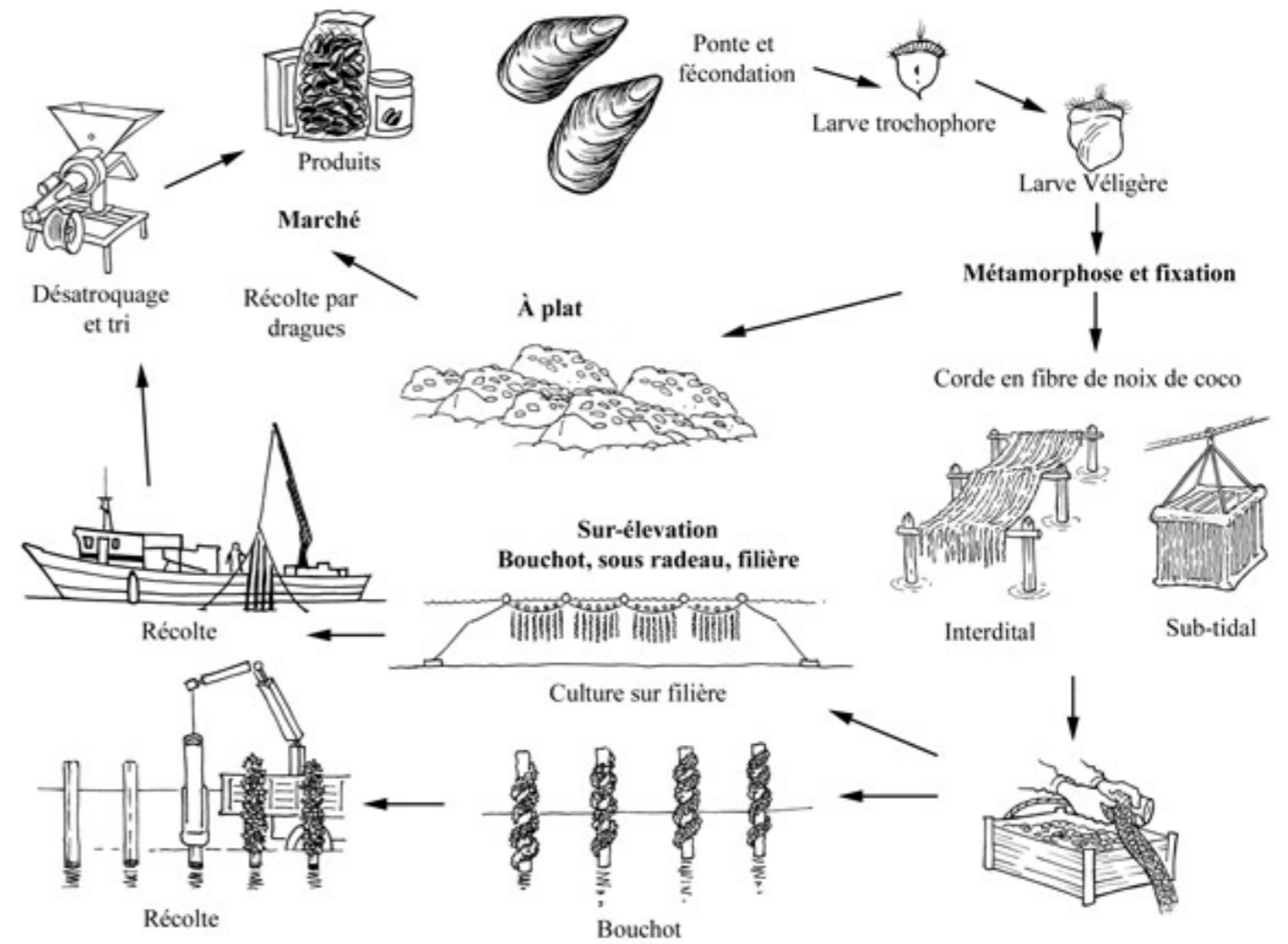


# MASTERPLAN HABLE D'AULT RETURNING LAND TO THE TIDES

## PRODUCTIVE OPPORTUNITIES

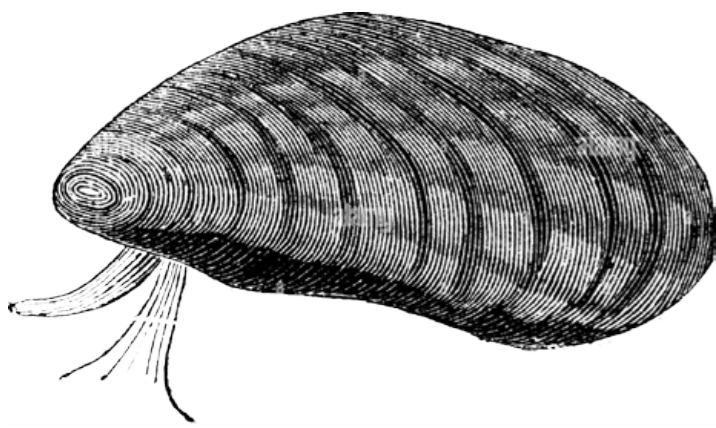
The transformation of the the landscape through the creation of a new inner dyke produces a new inter-tidal landscape that is not only a sustainable protection but also it has rich biodiversity and economic benefits. As far as production goes, intertidal habitats have many things to offer through the year. Namely the cultivation and collection oysters, plants (such as salicorns and *Aster maritime*) and the grazing of a local sheep species that is adapted to halophylic vegetation. All these local delicatessen products can create a rich gastronomic movement that will generate profit to the territory.

At the same time tidal wetlands play an important role in carbon sequestration. Due to salinity and the anaerobic conditions in the substrate, the dead matter of plants and animals decompose in a much slower rate than it would normally do. Another important aspect of intertidal wetlands is

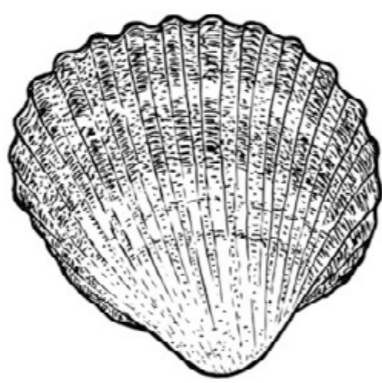


The Phases of Oyster Cultivation

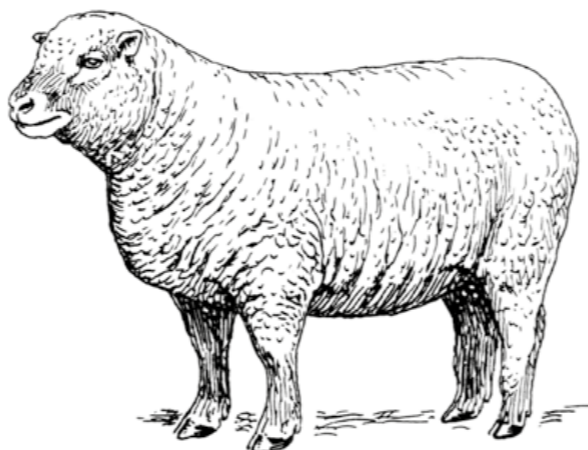
85



*Mitulus edulis*



*Cerastoderma edule*



"Agneau de pré-salé"  
Salt Marsh Sheep



*Salicornia Sp.*



*Aster tripolium*

Cultivation of Oysters in Tidal Conditions

Sheep Grazing in Tidal Conditions

Collection of Edible Halophylic Vegetation



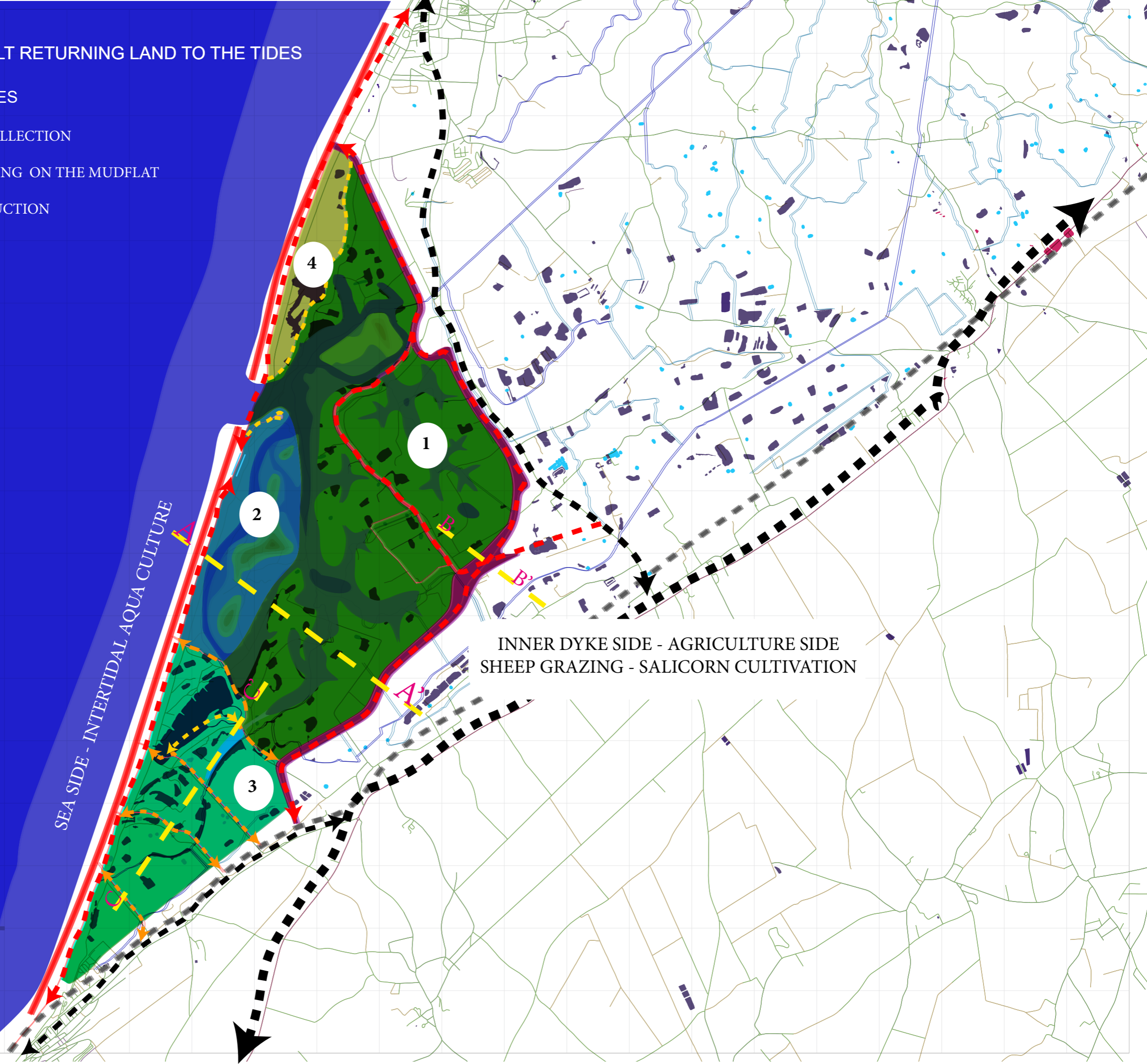
# MASTERPLAN HABLE D'AULT RETURNING LAND TO THE TIDES

## USES AND ACCESES

- 1) INTERTIDAL GRAZING AND SALICORN COLLECTION
- 2) INTERTIDAL OYSTER FARMING AND FISHING ON THE MUDFLAT
- 3) INTERTIDAL TERACES FOR OYSTER PRODUCTION
- 4) DUNES

SEA SIDE - INTERTIDAL AQUA CULTURE

INNER DYKE SIDE - AGRICULTURE SIDE  
SHEEP GRAZING - SALICORN CULTIVATION

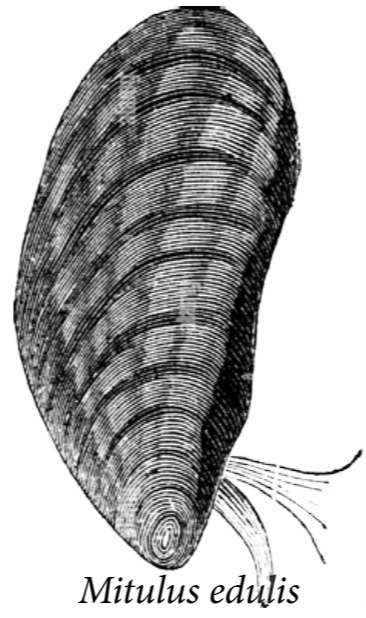




**MASTERPLAN HABLE D'AULT RETURNING LAND TO THE TIDES**

**FROM OUTER COAST TO INNER COAST**

In the new floodable landscape water from the tides enter and exit according to the tide coefficient and the elevation of the topography. Since other areas are flooded in different ways we get different habitats and uses. On the marine part there is a focus on production/collection of oysters and fishing. On the wetland area there is a focus on the collection of plants and the pasture of native sheep species that feeds on salty vegetation.



*Mitulus edulis*



*Cerastoderma edule*



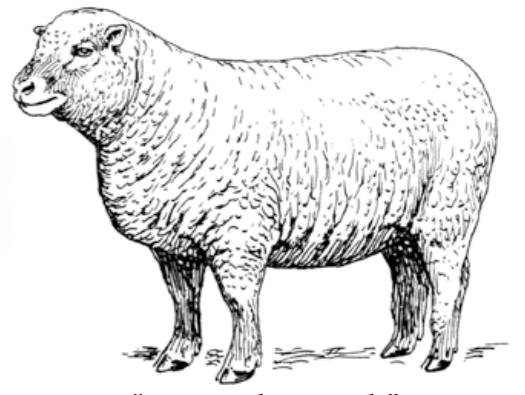
*Spatima Sp.*



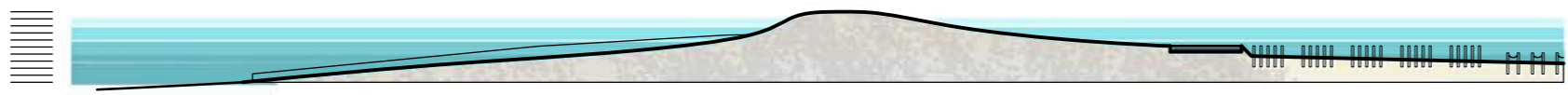
*Salicornia Sp.*



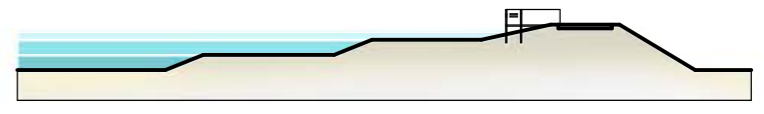
*Aster tripolium*



*"Agneau de pré-salé"*  
Salt Marsh Sheep



Section A - A'



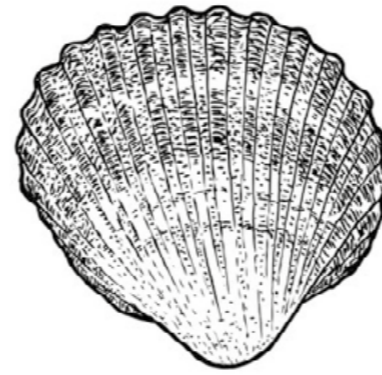
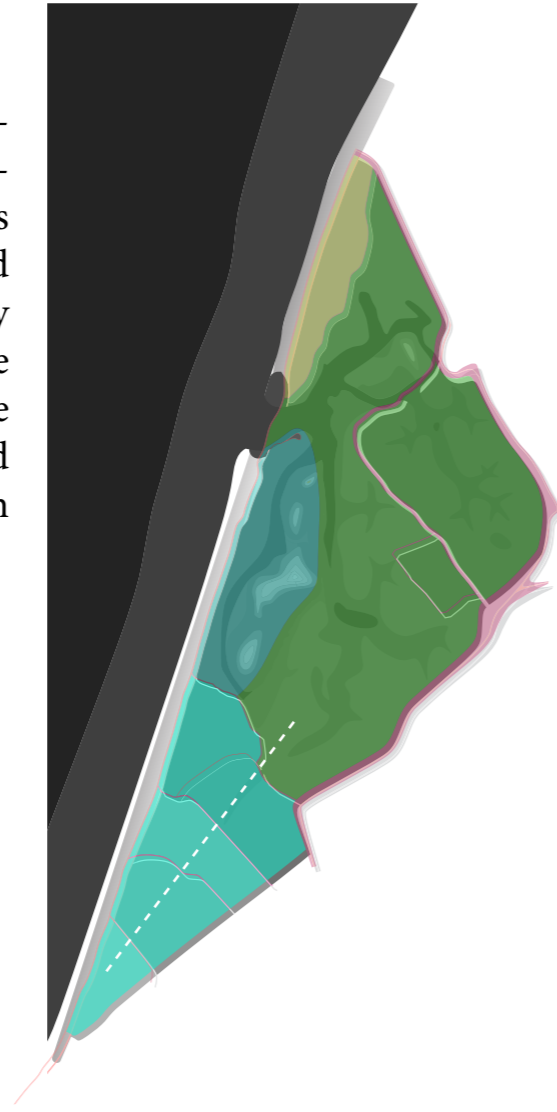
Section B - B'

Scale 1/1000



TIDAL TERRACES

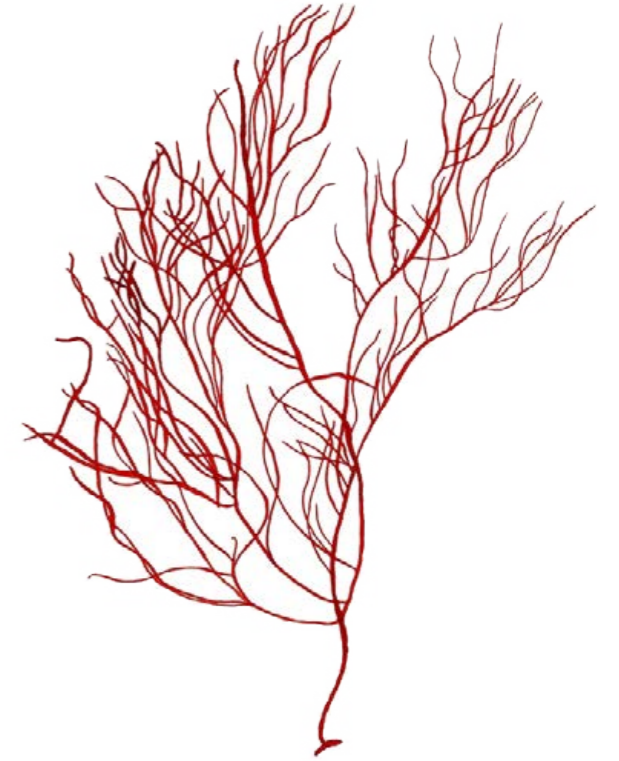
Tidal terraces are floodable structures that do not drain the salty water immediately. The different flooding regimes offer distinct conditions of salinity and sediments, this allows for a big diversity of growing habitats. The main productive activity of these flooded structures is the production of clams, oysters and sea weed that are different from the ones found in estuaries.



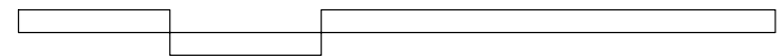
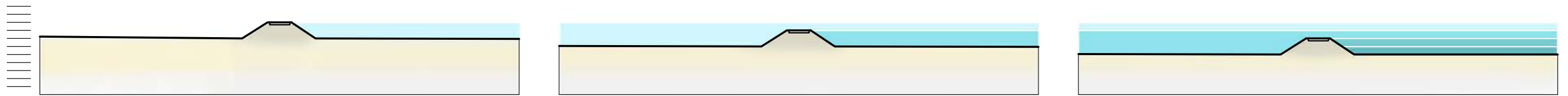
*Cerastoderma edule*



*Zostera marina*



*Gracilaria pp.*

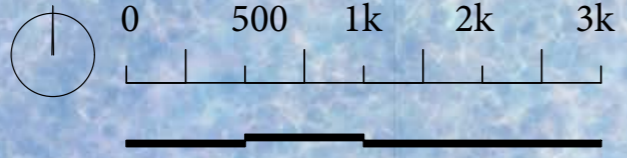


Section C - C'



# MASTERPLAN HABLE D'AULT RETURNING LAND TO THE TIDES

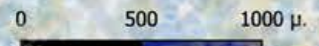
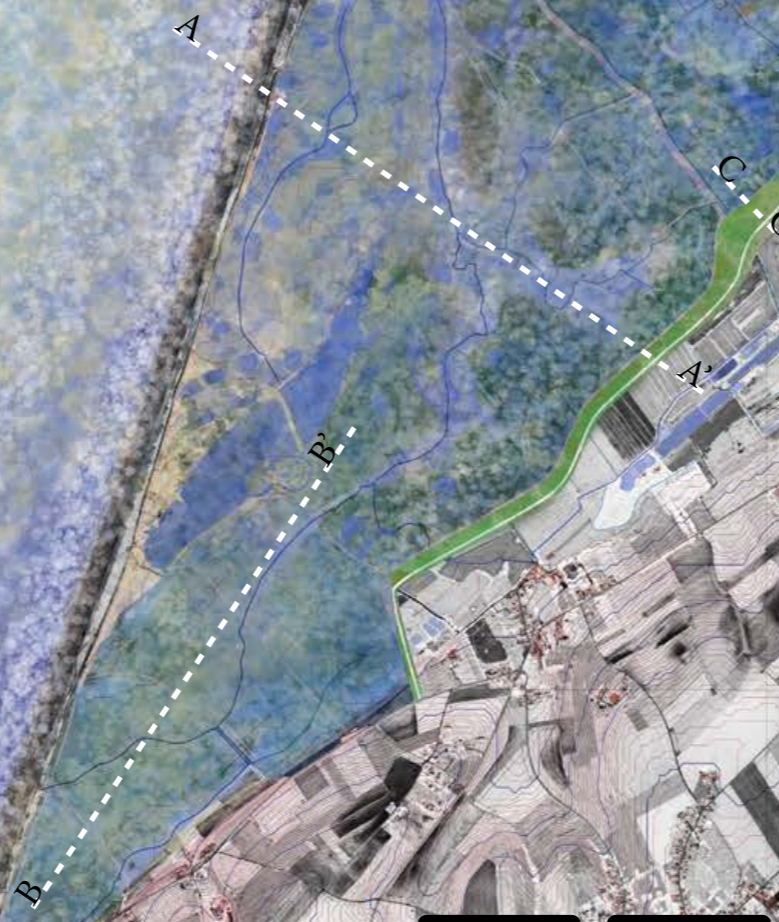
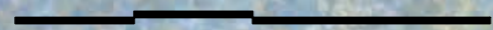
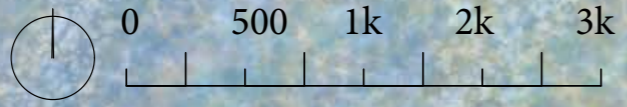
Landscape in Low Tide





# MASTERPLAN HABLE D'AULT RETURNING LAND TO THE TIDES

Landscape in High Tide / Storm







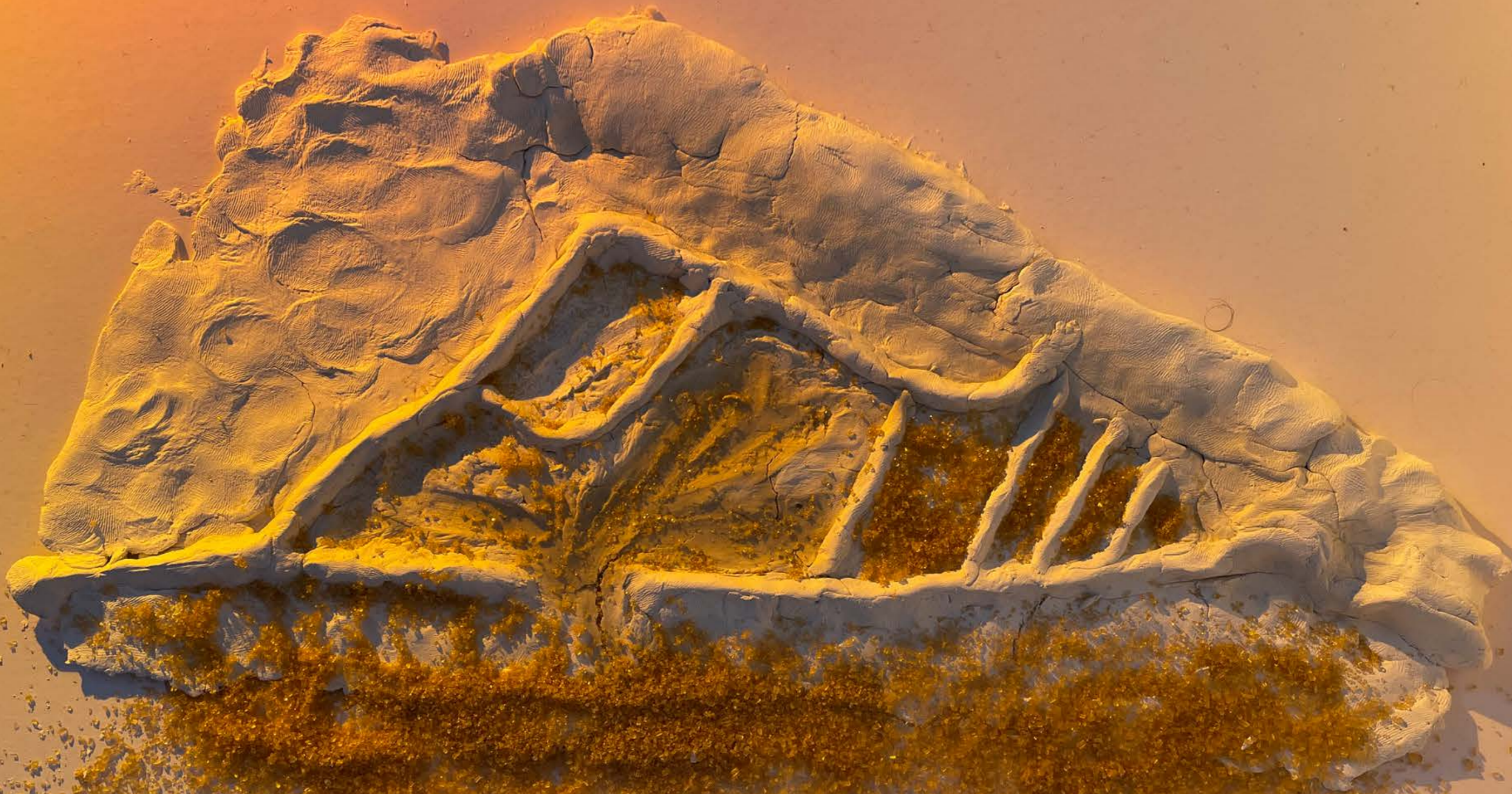
**HABLE D'AULT**  
RETURNING LAND TO THE TIDES  
Photo-montage





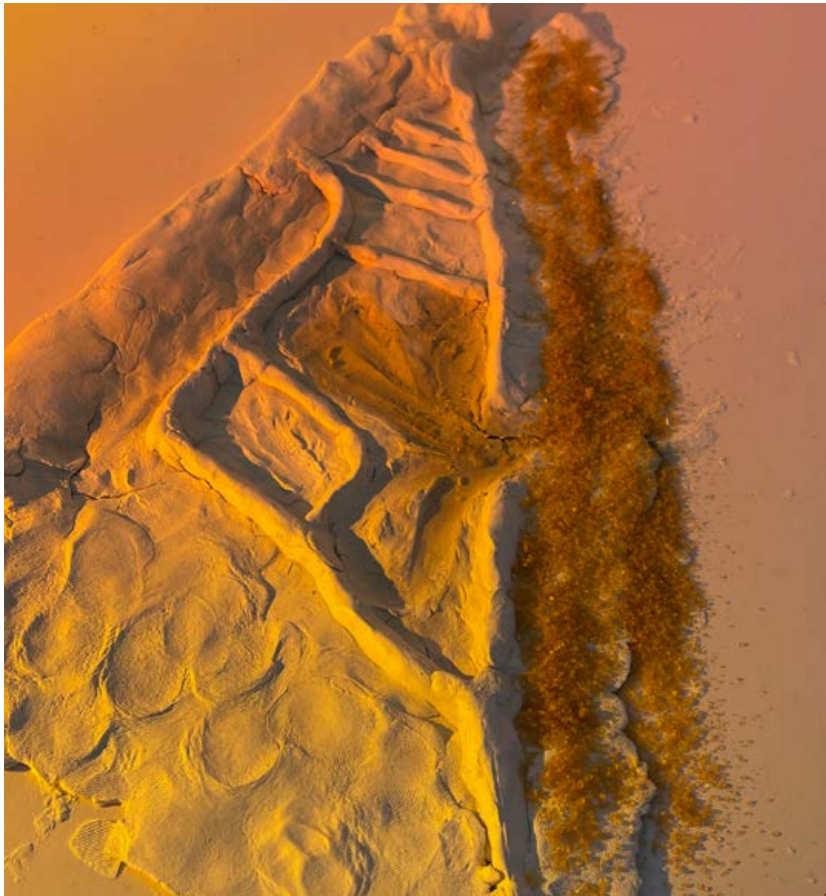
**HABLE D'AULT**  
RETURNING LAND TO THE TIDES  
Sea entering through the Breach



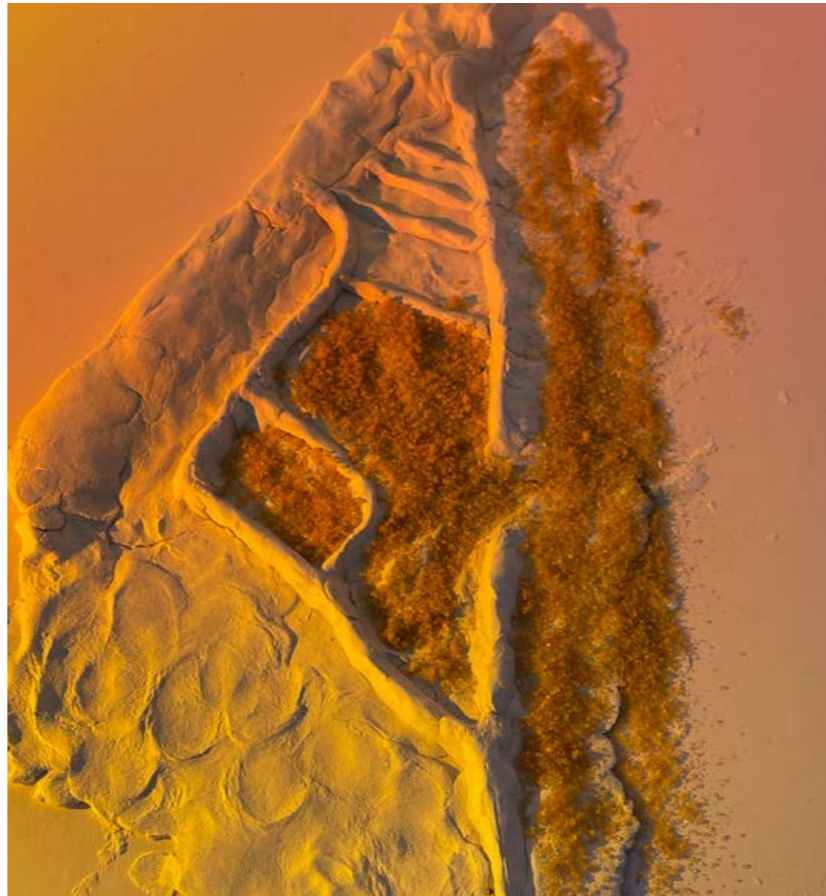


**HABLE D'AULT**  
RETURNING LAND TO THE TIDES  
Model

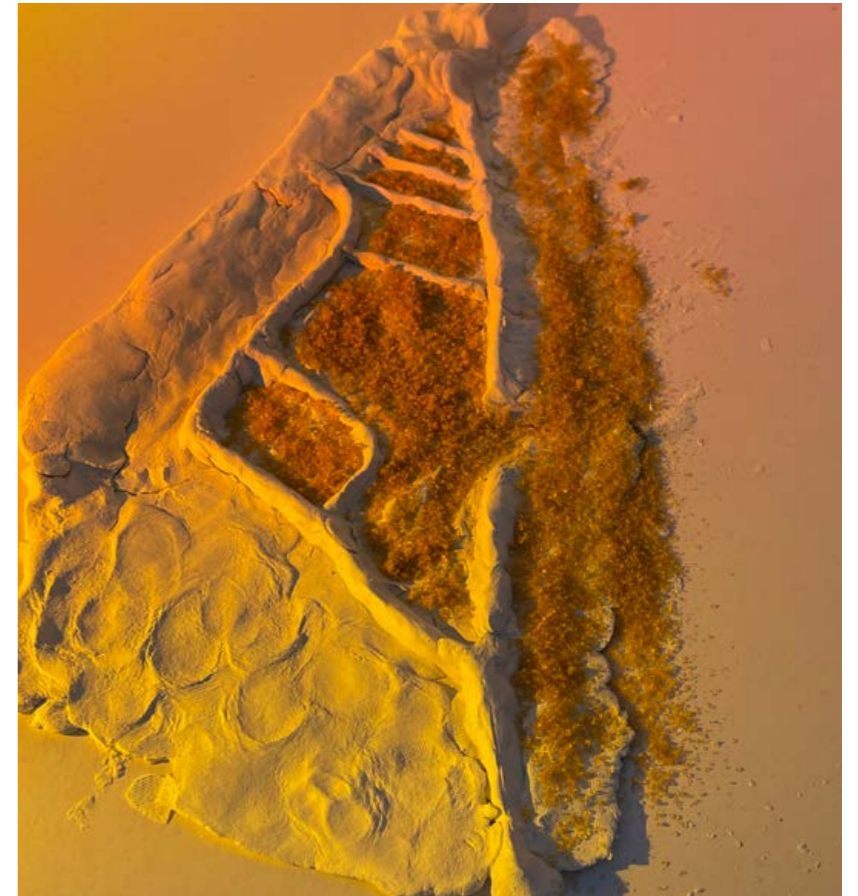




Low Tide



Tide Flooding the Inner Coast and Lowest Floodable Zone

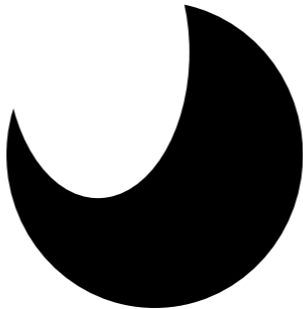


High Tide Flooding the Entire Floodable Landscape



**HABLE D'AULT**  
RETURNING LAND TO THE TIDES  
Model





CAYEUX-SUR-MER  
IMAGINING THE NEW LIVED WATERFRONT



## MASTERPLAN

### CAYEUX-SUR-MER IMAGINING THE NEW LIVED WATERFRONT

All channels that drain the territory connect in a single point which collects all the water and then it flushes in the estuary when the tides are lower. The main idea is to keep the identity of a channel but to add, through a change of topography, a new floodable landscape that can collect the excess water until it is quickly flushed in the time between two high tides. At the same time the location is perfect for the development of eco-responsible grazing.



### CAYEUX-SUR-MER IMAGINING THE NEW LIVED WATERFRONT

Ault





CAYEUX-SUR-MER THEN

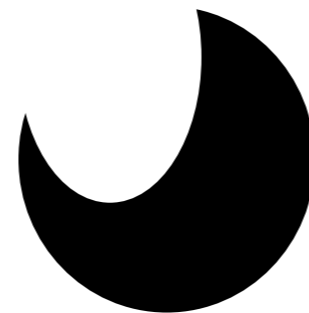


House of Fisherman in Cayeux-sur-mer in 1919

CAYEUX-SUR-MER NOW



The storm Eleanor in 2018 floods the city of Cayeux-sur-mer



CAYEUX-SUR MER  
IMAGINING THE NEW LIVED WATERFRONT



# MASTERPLAN CAYEUX-SUR-MER IMAGINING THE NEW LIVED WATERFRONT

## A VILLAGE TIED TO THE SEA BUT SENSITIVE TO SEA SUBMERSION

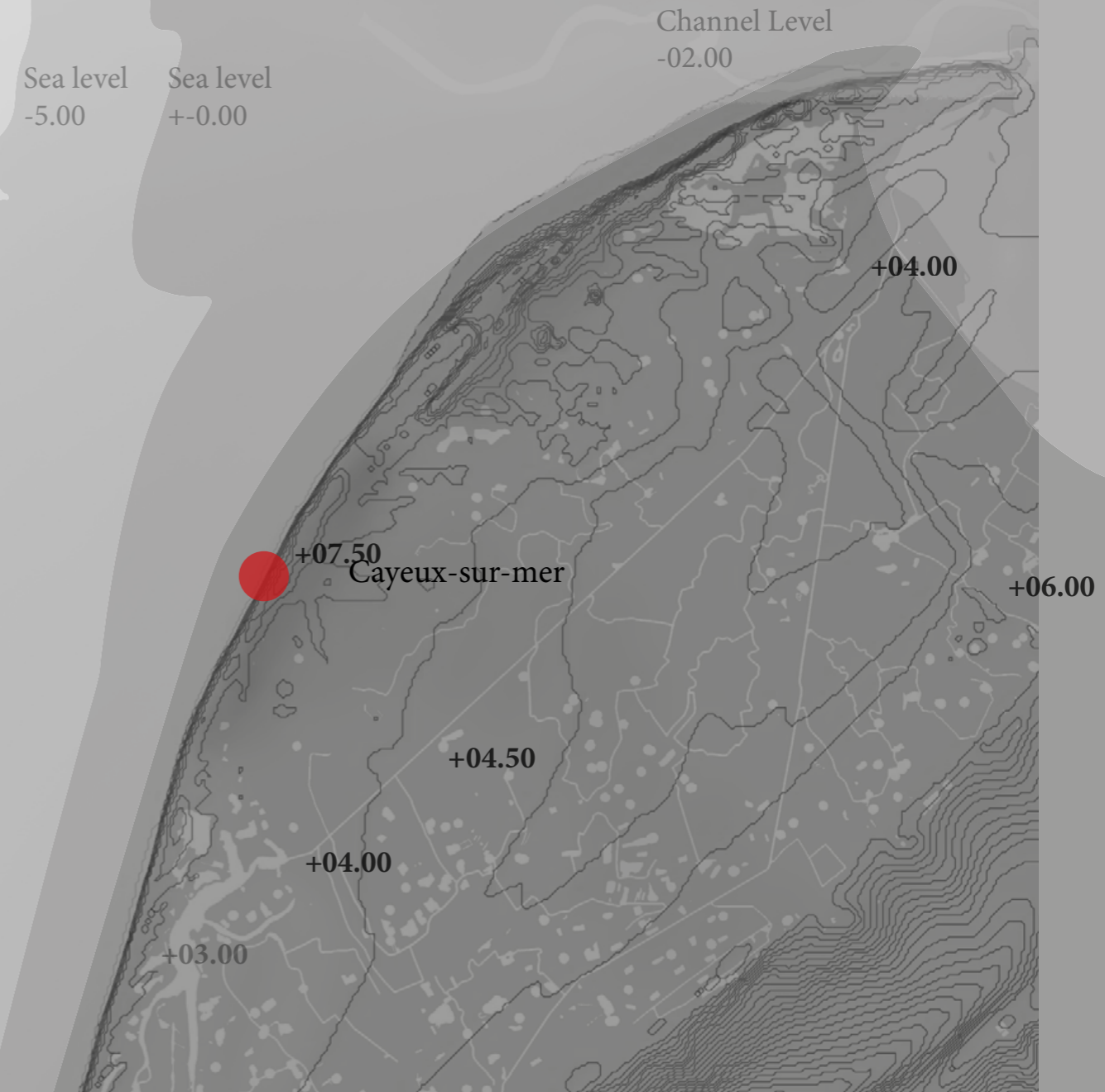
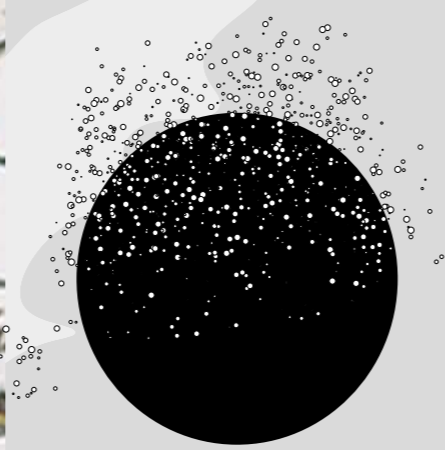
The first written mention of Cayeux dates back to 1005. In 1837, Victor Hugo described Cayeux as follows "...buried in the sands in a wild landscape where nothing reminds us of the life we live or the world we care about..." This small village probably dates back to the times when Celtic fisherman occupied the ancient estuary. Now Cayeux is inhabited by main and secondary inhabitants who occupy themselves in agriculture, fishing or tourism. What is to happen in Cayeux in the next 100 years? Habitants are afraid that they are going to loose their houses to the Sea. If already during the winter months a storm can flood the city, what will happen when the sea level rises 2 more meters in the next 100 years?



Cayeux in Cassini Maps 1790



Storm Entering Cayeux







Cayeux Sur Mer

**CAYEUX SUR MER**  
IMAGINING A NEW LIVED WATERFRONT  
Marine topography 1m

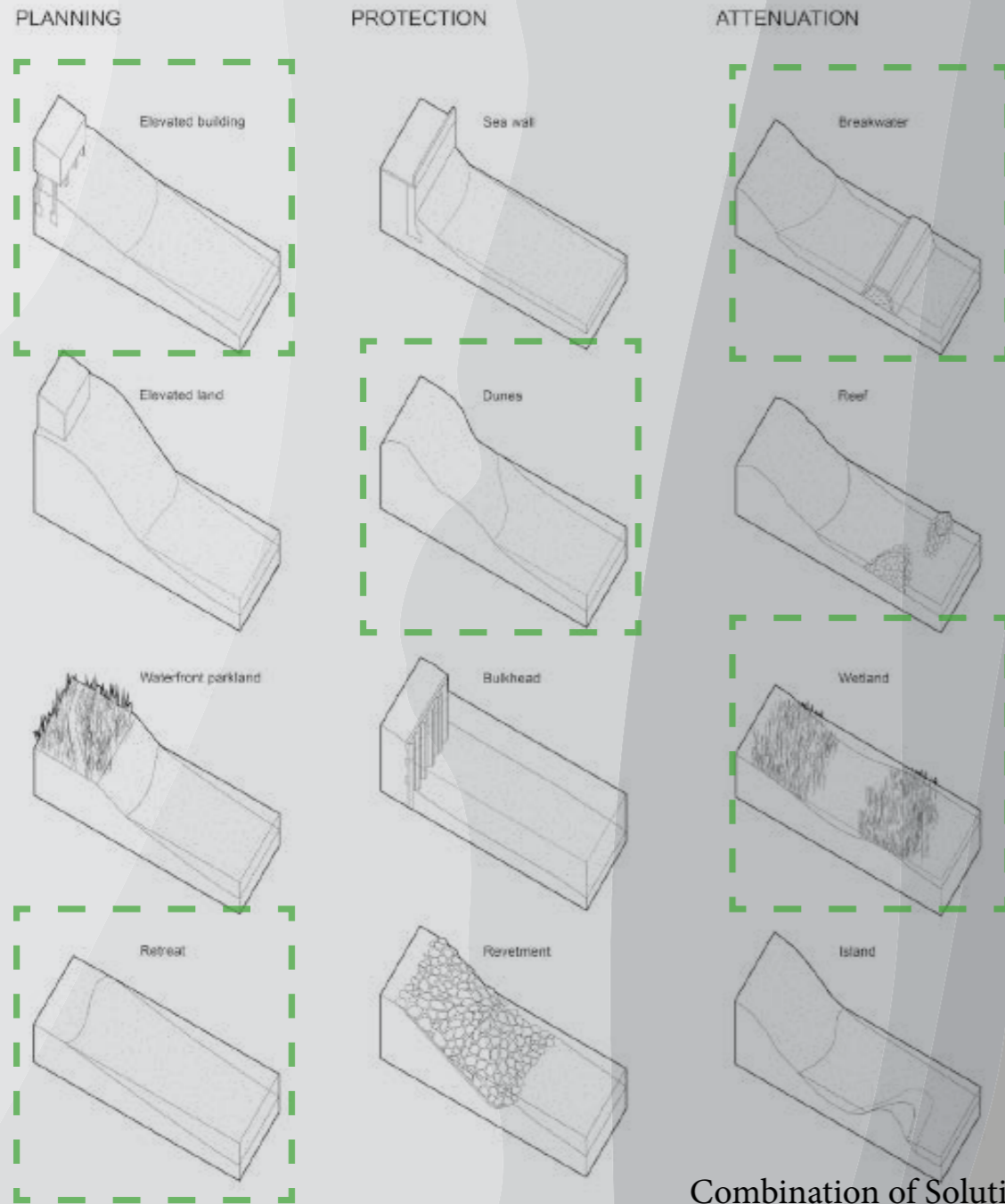


# MASTERPLAN CAYEUX-SUR-MER IMAGINING THE NEW LIVED WATERFRONT

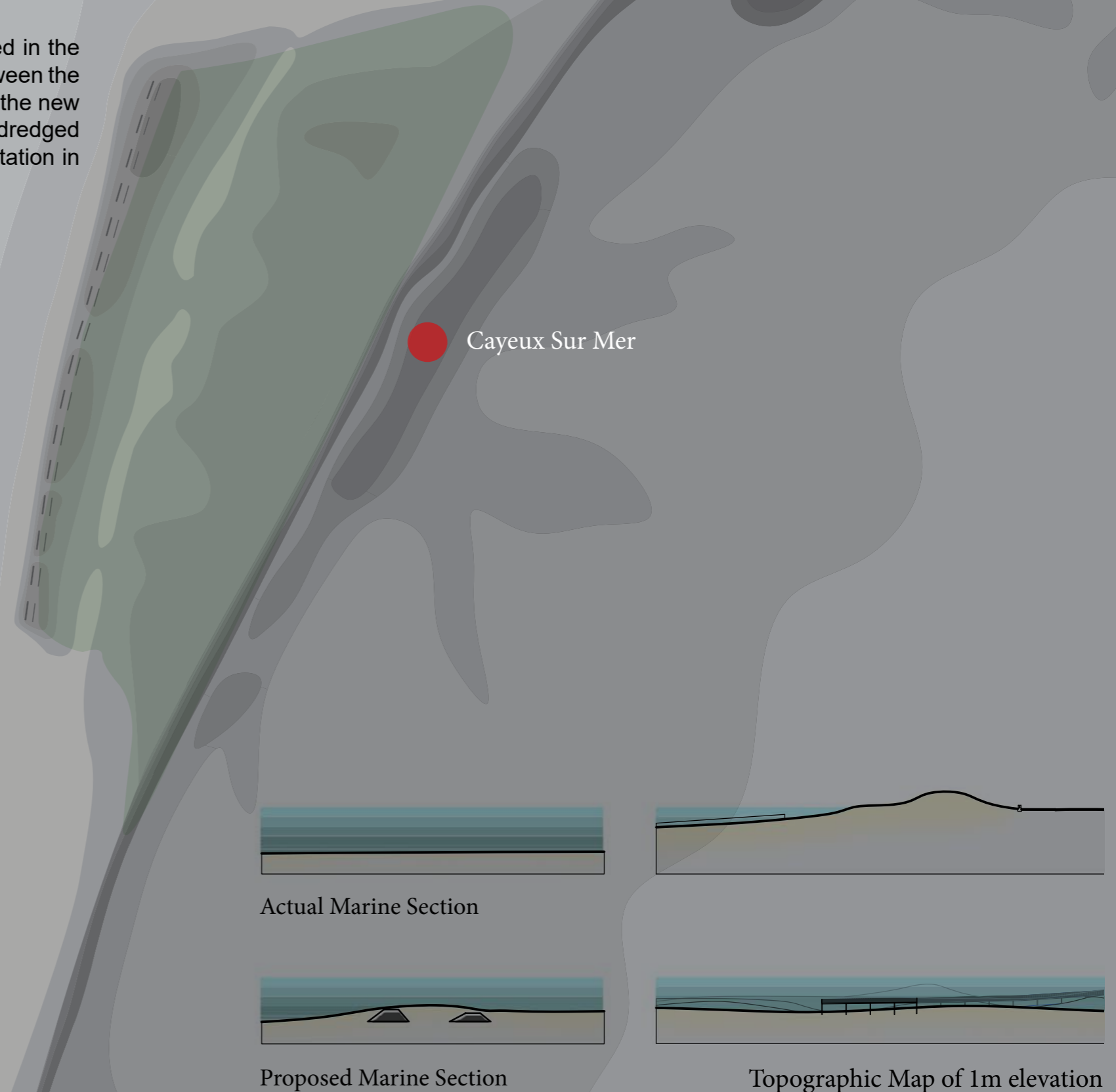
## OFFSHORE TREATMENT - MARINE TOPOGRAPHY - STRATEGIES

We have to understand that no hard solution can withstand the power of the waves during a storm in the long term.. According to prof Olivier Bain the most appropriate solution is a combination of soft solutions. For this reason a small rise in sea floor topography along side biomimetic solutions such as coastal wetlands can give a soft protection against the growing sea waters.

The offshore proposal is composed by two parallel break-waters that are placed in the zone where 80% of the sediment flow occurs. For this reason the trapped sediment between the breakwaters and the shore creates a soft elevation where vegetation can colonize, so the new shore can become stabilized. At the same time we punctually provide sediment that is dredged from the estuary. The diversification of the marine topography has shown an augmentation in colonization by flora and fauna.



Combination of Solutions  
Catherine Seavitt, Guy Nordenson, Julia  
Chapman, 2015



Actual Marine Section

Proposed Marine Section

Topographic Map of 1m elevation



# MASTERPLAN CAYEUX-SUR-MER IMAGINING THE NEW LIVED WATERFRONT

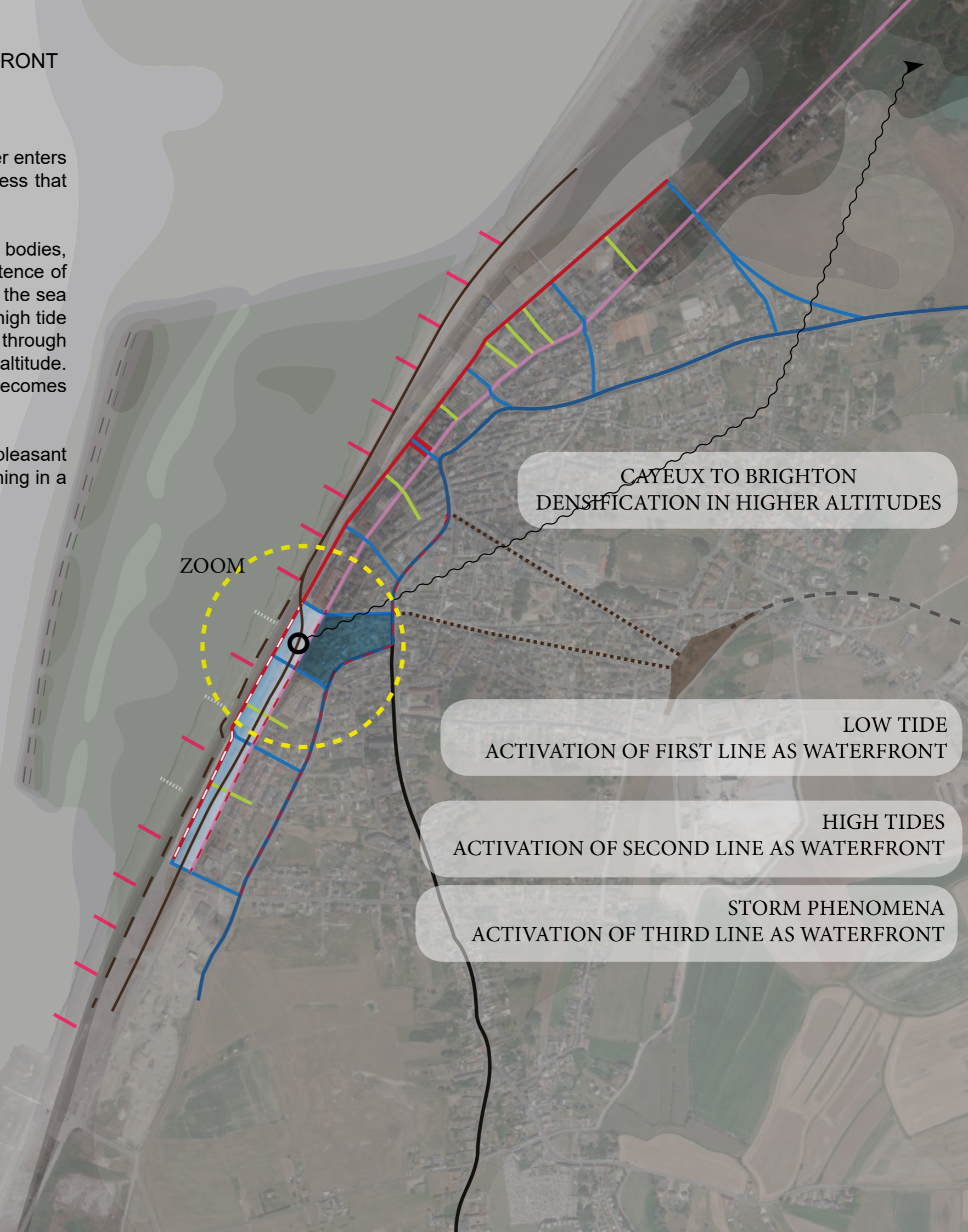
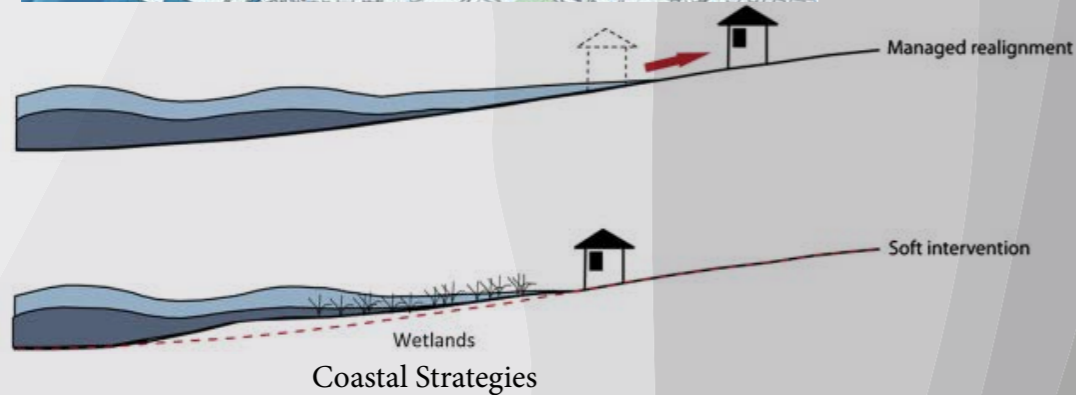
## TIDAL WATERFRONT ADAPTATION - 100 YEAR STRATEGY

We tend to think that waterfront of a city is its first line to the sea, but when water enters the city where is this line? Tides and storms represent not a line but a zone of wetness that occurs in different temporal rhythms.

Rhythms of days, weeks, months and years mark our relationship to the water bodies, and i want this richness to be felt through design. For this reason I propose the existence of not one but three waterfronts, the waterfront of low tide, high tide and of storm. When the sea is in low tide then the first line to the sea is activated as the waterfront. In the case of high tide in specific areas of low topography the waterfront it moved in the second line, where through managed retreat the precarious waterfront constructions have been moved in a higher altitude. In the case of storm surges the first and second line are flooded and then the third line becomes the storm waterfront.

The new hybrid approached and displays nature through all its facets. The pleasant aspect of nature and the ones that cause us suffering become part of the urban planning in a way that they are accepted into the experience of the inhabitant..

Very High Storm Coinciding With High Tide



CAYEUX TO BRIGHTON  
DENSIFICATION IN HIGHER ALTITUDES

ZOOM

LOW TIDE  
ACTIVATION OF FIRST LINE AS WATERFRONT

HIGH TIDES  
ACTIVATION OF SECOND LINE AS WATERFRONT

STORM PHENOMENA  
ACTIVATION OF THIRD LINE AS WATERFRONT





CAYEUX-SUR-MER  
IMAGINING A NEW LIVED WATERFRONT  
Zoom - Where Water Merges with City



# MASTERPLAN CAYEUX-SUR-MER IMAGINING THE NEW LIVED WATERFRONT

## PROJECT REFERENCES

Some references in the relation of how coast and city merge are referenced from existing and research projects. Notably through the seminal text of Structures of Coastal Resilience and the exposition Rising Currents in Moma.

On the right, on the diagrams of Paul Lewis we can see how coastal structures come in contact and merge with the urban grid. Wetlands groins, and breakwaters act as measures of attenuation in case of storms. More over merging city and coast has notable environmental benefits.

Bellow on the sections of dlandstudio we can see how the urban identity changes as the city approaches different zones of wetness. Buildings in the wet areas are equipped by pilotis and their own private docks.

Through the exposition of RisingCurrents: Projects for New York's Waterfront in Moma we can see a shift on the way that landscape architecture as a profession can get more experimental in relation to a future that is uncertain. This uncertainty does not require fixed projects but flexible ways of thinking beyond the ordinary.

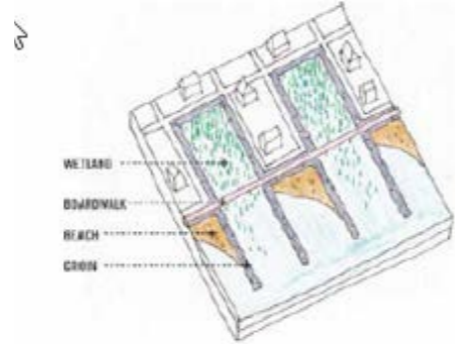
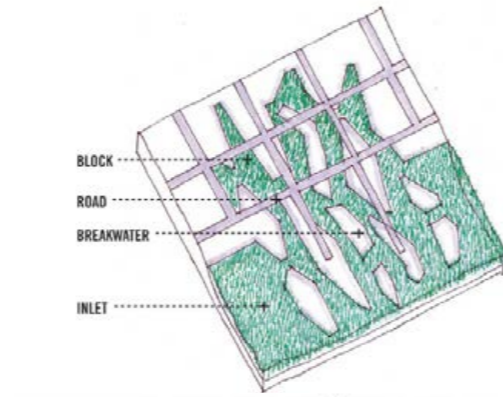
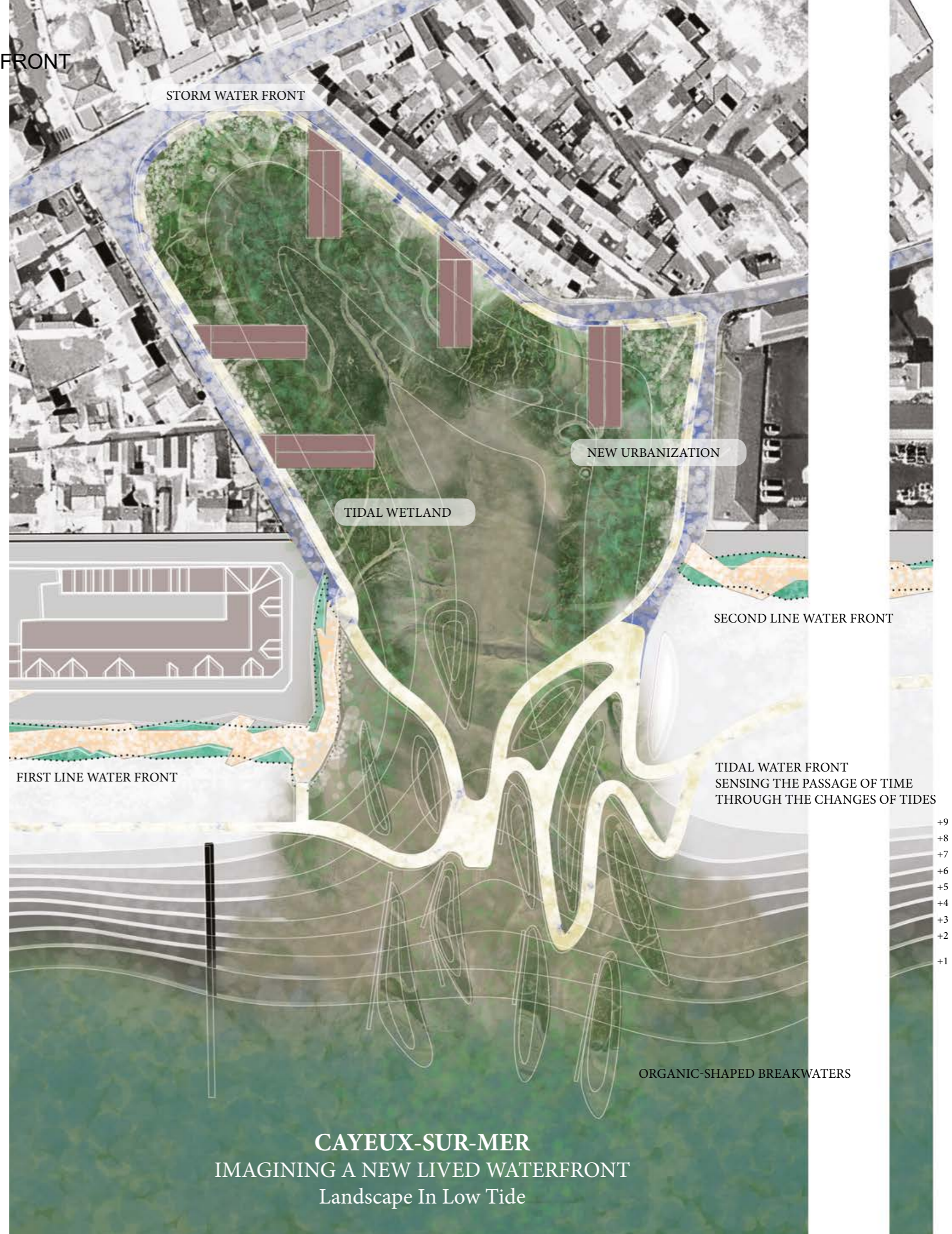
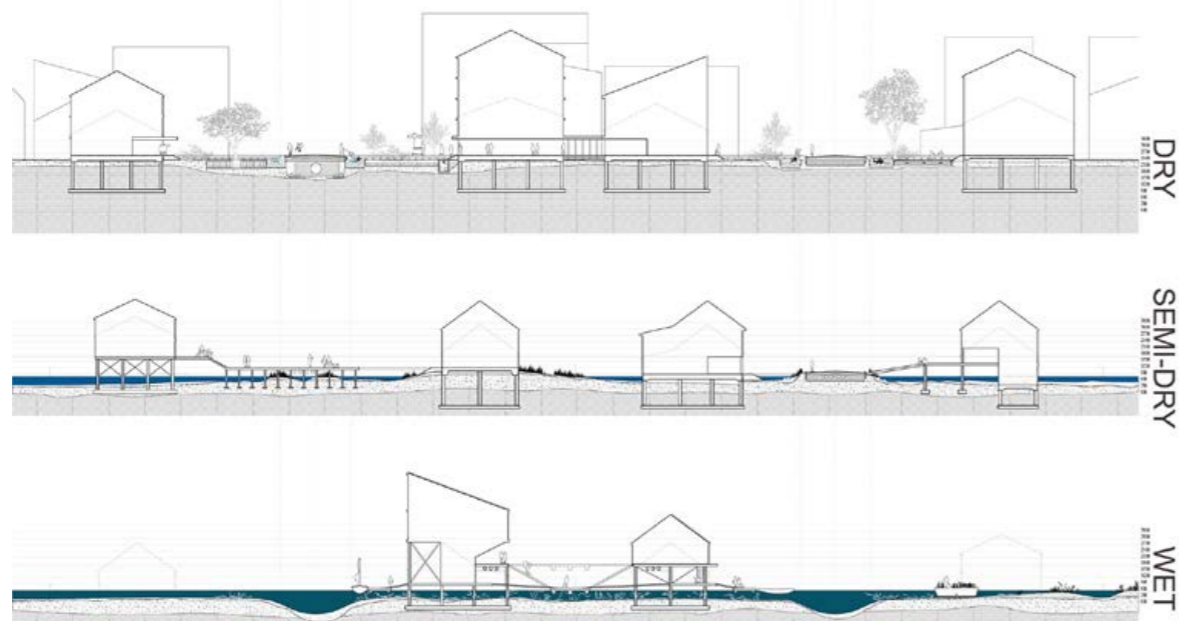


Figure 8.39: Groin + Wetland

Paul Lewis/Princeton University School of Architecture, Structures of Coastal Resilience, 2015



CAYEUX-SUR-MER  
IMAGINING A NEW LIVED WATERFRONT  
Landscape In Low Tide



dlandstudio Bight: Coastal Urbanism



# MASTERPLAN CAYEUX-SUR-MER IMAGINING THE NEW LIVED WATERFRONT

## THE NEW WATERFRONT

Through the strategy of Managed Retreat and Managed Realignment we propose the diversification of the waterfront of Cayeux-sur-mer for a sustainable and rich future. When loss is accepted we get the physical space that would otherwise constrain us through the fear of loss. This new space can now be given to the tides and to the humans of the future, so they can construct their identity alongside of nature.

### Diverse Coastal Topography

Through the diversification of coastal topography we accomplish the merging of the city with the tides. Water enters the new coastal habitat slowly in the high tides, with it it brings the necessary chemical for the formation of coastal wetlands. These chemicals come from the new tidal wetlands from Hable d'Ault.

### Multiple Protection Measures

The tidal wetlands are only one of the multiple protection measures. Apart from the offshore protection and the tidal wetlands we also have the groins and the seasonal

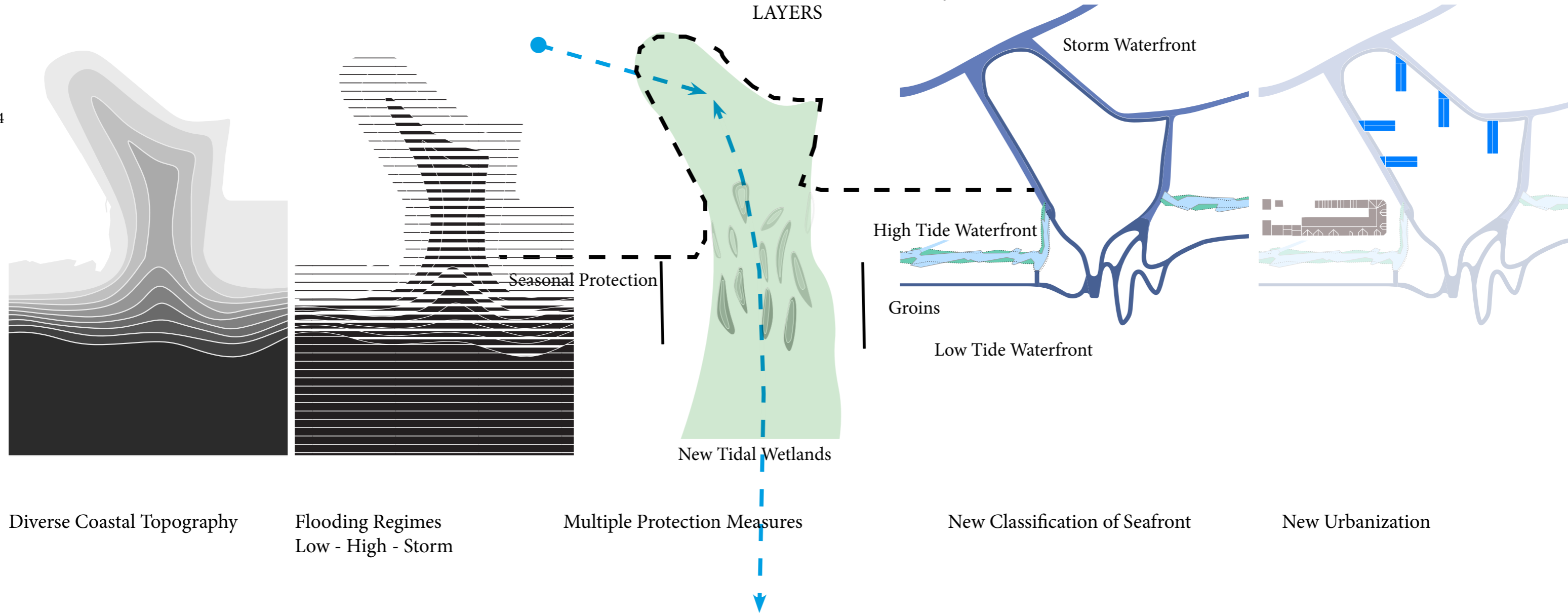
protection with gravel stones. Because of the retreat of the city the protection is more efficient

### New Classification of Seafront

The new waterfront is not one line but three. The low tide waterfront allows the humans to approach the sea in lower elevations, this is not a limit but the acknowledgment of a zone where time is relative, just like the rhythm of the tides. The low tide waterfront in the lower elevation takes the space where the first line of the waterfront used to be. The waterfront of high tide is more formal but still hybrid. Its location occupies the limit of the first line to the sea but where the city has retreated it moves

to the second line. The third type of waterfront is that of the storm. In case of storm the high tide waterfront is inaccessible but that does not mean nature should not be experienced by the inhabitants. For this reason the storm waterfront gets activated in the third line. It's qualities allow for an safe experience of the strength of storms. Through this experience we aim to provoke a resilient/hybrid citizen of Cayeux-sur-mer

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Diverse Coastal Topography

Flooding Regimes  
Low - High - Storm

Multiple Protection Measures

New Classification of Seafront

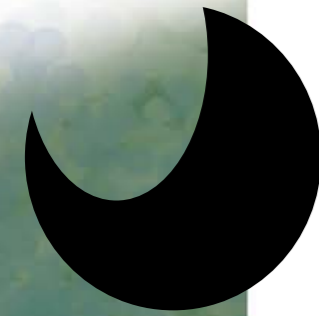
New Urbanization



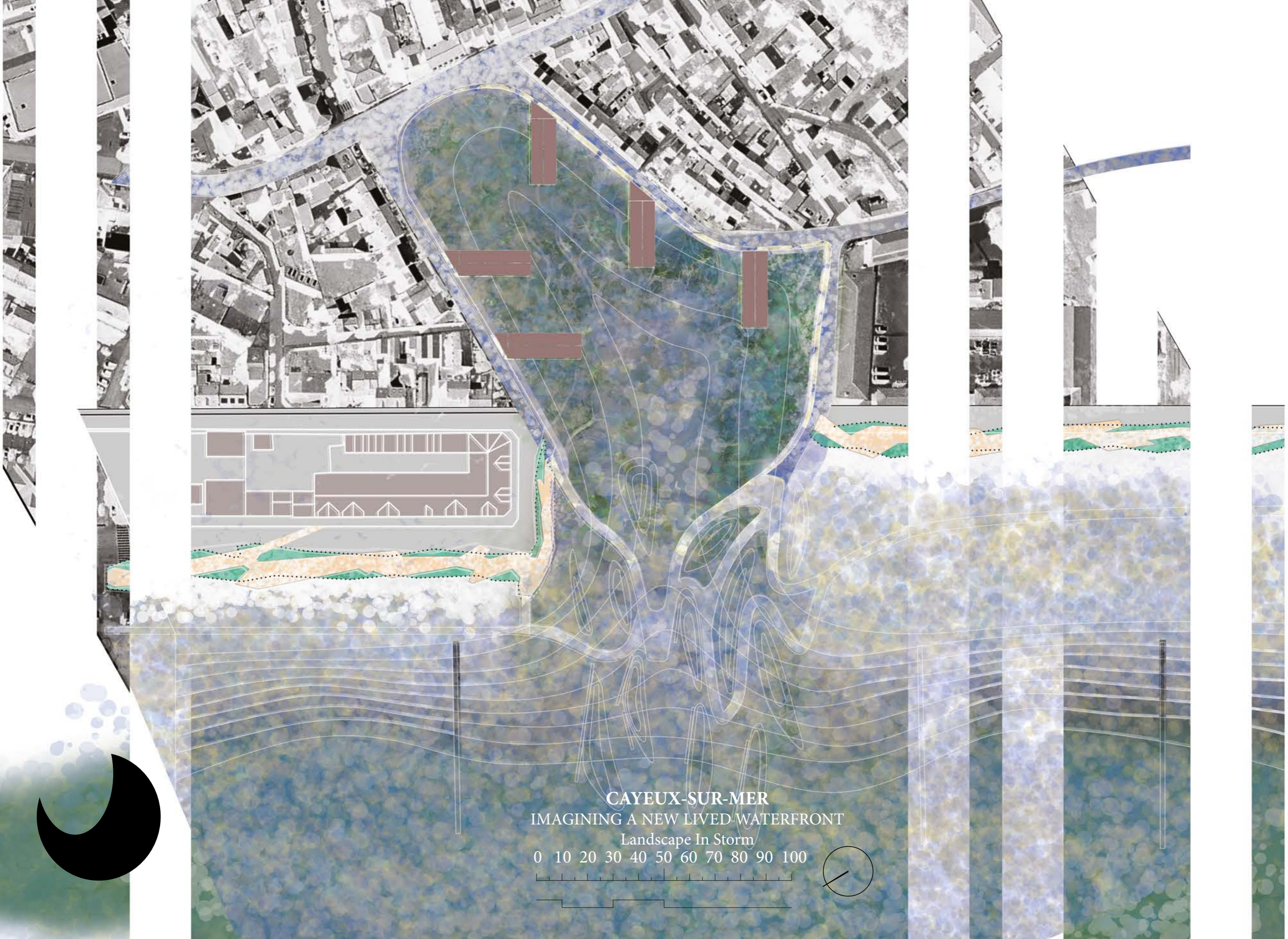


**CAYEUX-SUR-MER**  
IMAGINING A NEW LIVED WATERFRONT

Landscape In Low Tide  
0 10 20 30 40 50 60 70 80 90 100

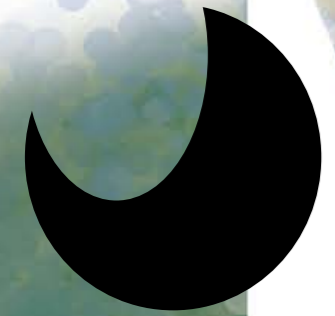






**CAYEUX-SUR-MER**  
IMAGINING A NEW LIVED WATERFRONT  
Landscape In Storm

0 10 20 30 40 50 60 70 80 90 100



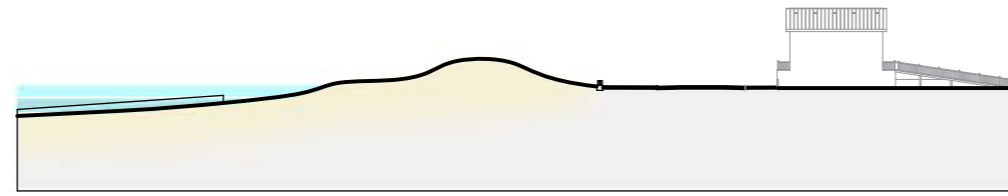


# CAYEUX-SUR-MER IMAGINING THE NEW LIVED WATERFRONT

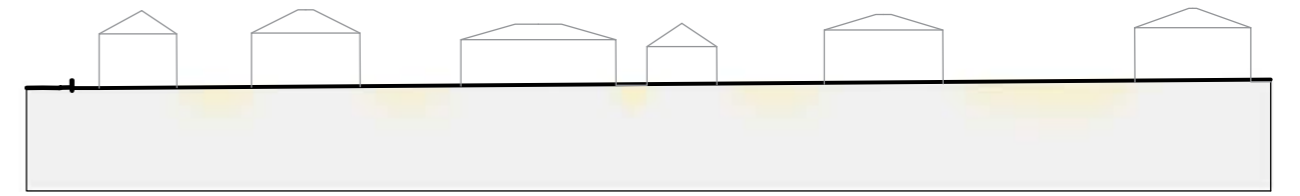
## Waterfront Sections



Offshore Before

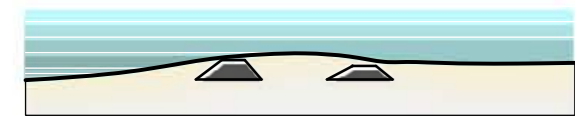


Beach and Traditional First Line Waterfront

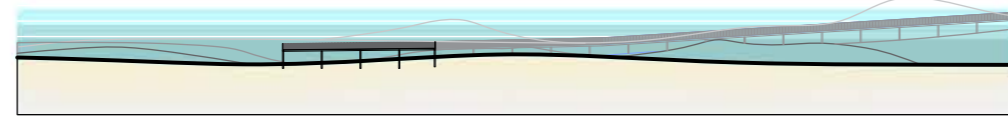


Part of the City Before

Waterfront Section Before



Offshore Now: breakwaters



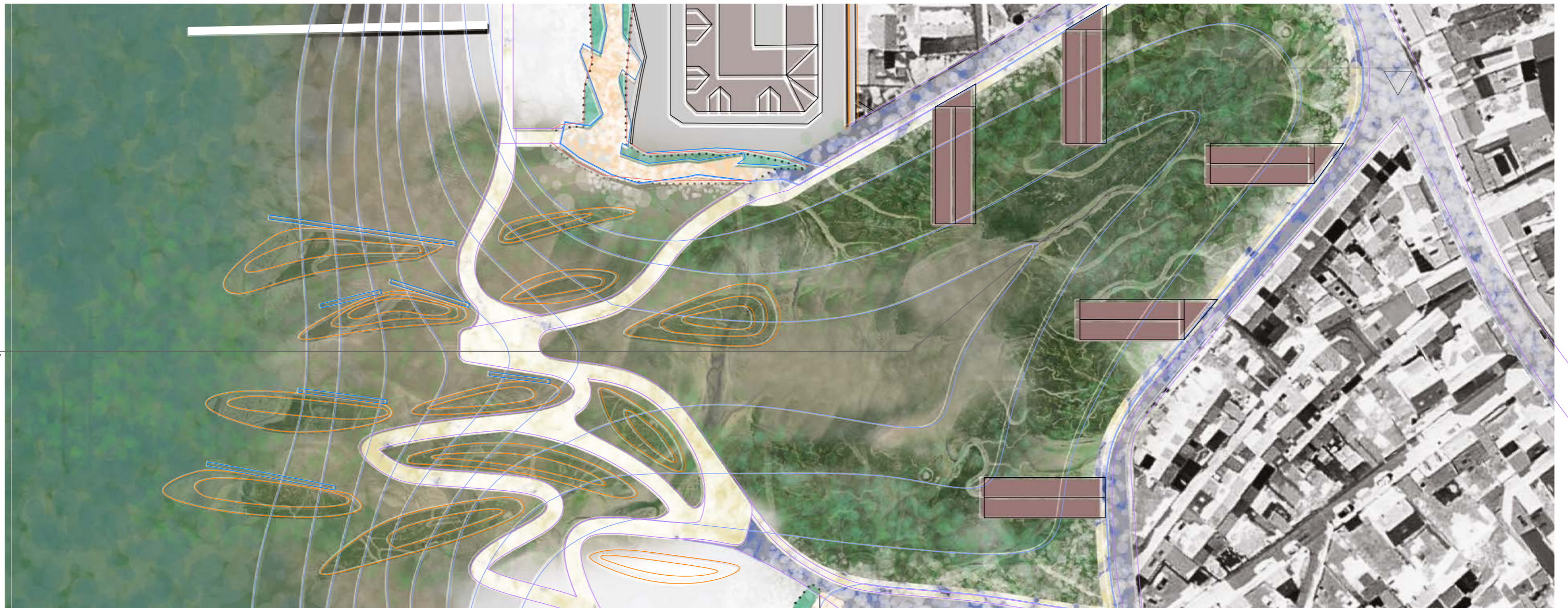
Beach and Low Tide Seafront



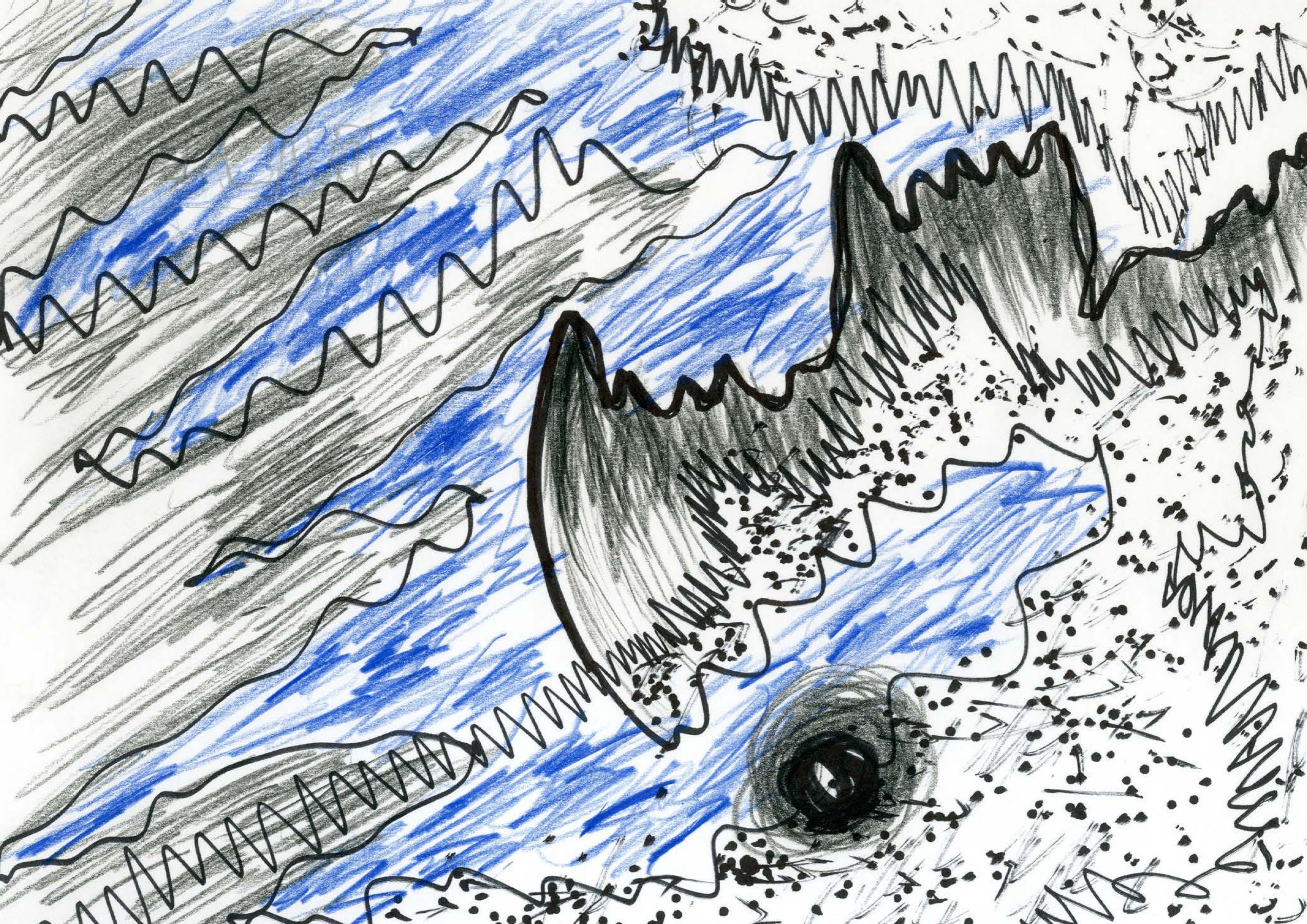
City and Sea Merging

Waterfront Section After

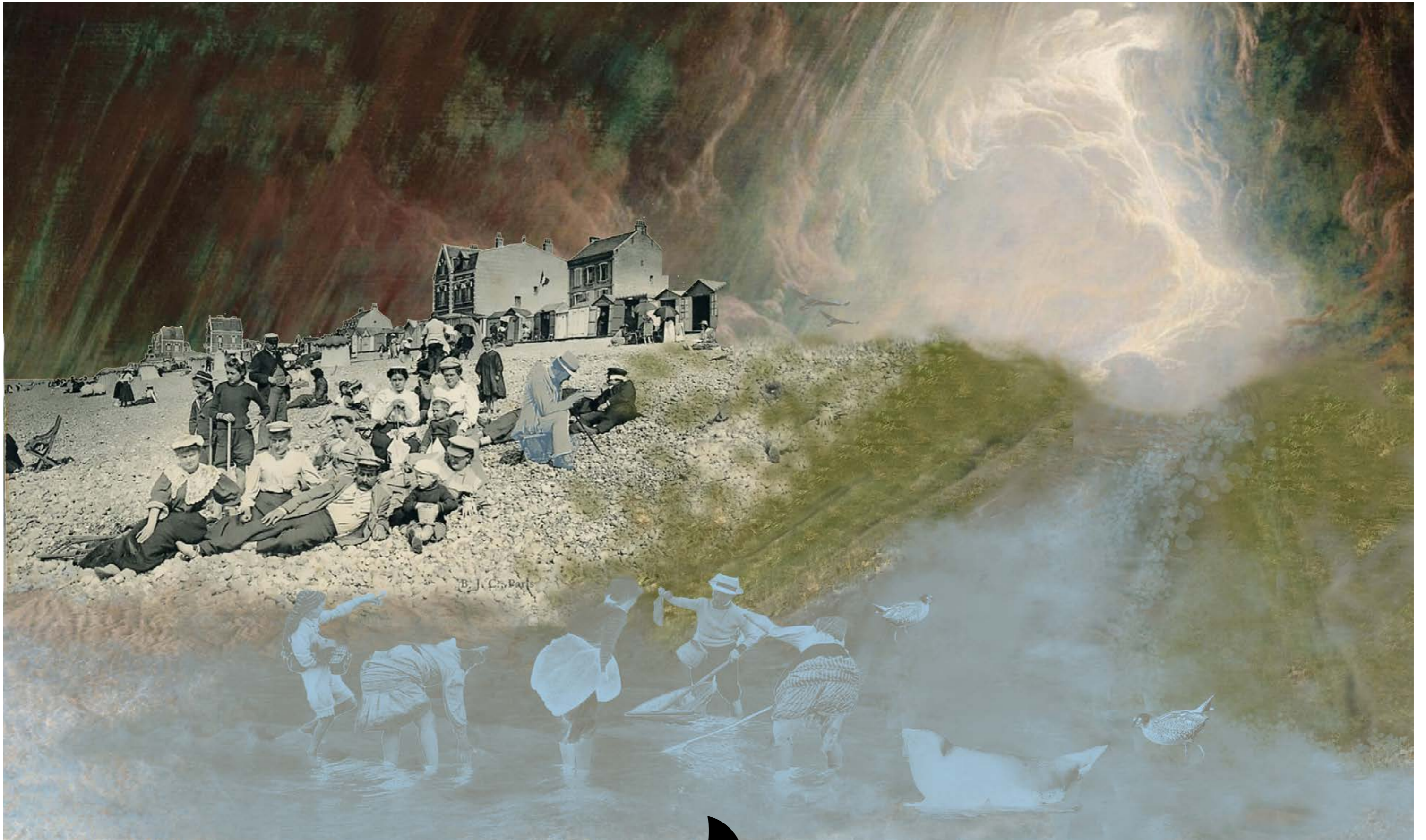
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**CAYEUX-SUR-MER**  
IMAGINING A NEW LIVED WATERFRONT  
Photomontage in Low Tide



## Chapter 04 Links of Images

1) <https://www.delcampe.net cayeux-sur-mer>

2) <https://youtu.be/GeBM1bOEw7Y>

3) [https://www.labalaguere.com/randonnee\\_dans\\_baie\\_somme.html](https://www.labalaguere.com/randonnee_dans_baie_somme.html)

4) <https://www.delcampe.net cayeux-sur-mer>

5) <https://www.caissedesdepots.fr/blog/article/chroniques-des-tempestes-12-xynthia>

6) <http://l.brenet.free.fr/baschamps.htm>

7) <http://l.brenet.free.fr/baschamps.htm>

8) <http://l.brenet.free.fr/baschamps.htm>

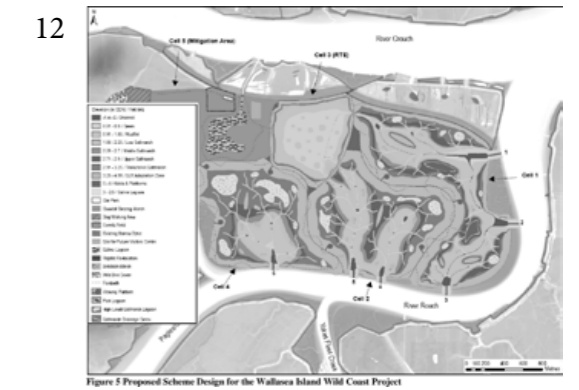
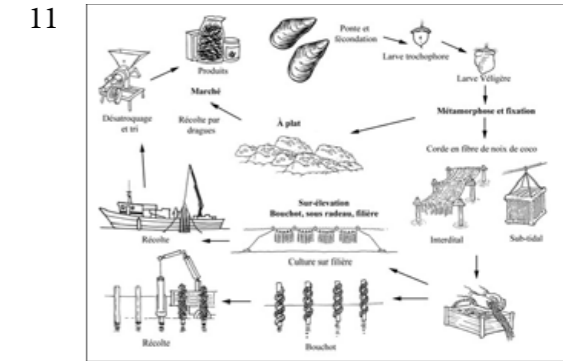
9) <https://www.delcampe.net cayeux-sur-mer>

10) <https://www.cayeux-sur-mer.fr/tempeste-eleanor-a-cayeux-mer-de-leau-rues-digue-a-bien-resiste/>

11) [https://www.fao.org/fishery/docs/DOCUMENT/aquaculture/CulturedSpecies/file/en/en\\_bluemussel.htm](https://www.fao.org/fishery/docs/DOCUMENT/aquaculture/CulturedSpecies/file/en/en_bluemussel.htm)

12) <https://panorama.solutions/en/building-block/creating-technical-advisory-panel-sound-planning>

3) [https://www.labalaguere.com/randonnee\\_dans\\_baie\\_somme.html](https://www.labalaguere.com/randonnee_dans_baie_somme.html)





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Cartography was produced by the author using the data base of IGN - Institut national de l'information géographique et forestière.

Cartography related to the ocean was produced by the author using as data base of data.shom.fr

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<sup>111</sup> LOISEL Jean François, 1990. Les Moulins de la Haute Vallée de la Bresle, Éditions Corps puce, 242p. ISBN : 2-907-525-19-0. Disponible sur BNF Gallica

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LA VIDA ES SUEÑO

The tide of Time was at my feet  
Flowing with calm and equal motion;  
With gladdened heart my eyes might greet  
The coming of the sunlit ocean,  
Till at its full, a fatal storm  
Wrapt in grim shade the mighty form.

Then backward rolled the ebb of Time  
While I with eager steps pursue,  
And though the hour had lost its prime,  
Still as the dim beach wider grew,  
I passed along the utmost verge  
Of the inconstant fleeting surge.

Back and more back the waters rolled  
And, faster yet the waves receding,  
Made now, alas! My hopes grow cold,  
As I, the vacant prospect heeding,  
Gaze on the bleak and desert strand,  
As sad I pace the barren sand.

**Mary Shelley**  
1833

LA VIDA ES SUEÑO

Contemplaba a mis pies la marea del Tiempo,  
fluyendo en un vaivén tan rítmico y calmado  
que, alegre el corazón, mis ojos saludaban  
a las aguas del mar por el sol encendidas.  
Entonces estalló la tormenta fatal,  
y en sombras envolvió su forma poderosa.

La marea del Tiempo retrocedió de pronto,  
y, con ansiosos pasos, yo misma la seguí.  
Después de la pleamar, caminé sin descanso  
hacia el borde del agua mientras la vasta arena  
se iba abriendo, infinita, por delante, y las olas r  
egresaban batiendo de forma intermitente.

Fueron retrocediendo las aguas más y más,  
y, en cuanto el oleaje por fin se hubo calmado,  
mi esperanza se heló al ver el horizonte  
vacío ante mis ojos y seguir recorriendo  
aquella playa lóbrega y la desierta arena,  
triste como mis pasos hacia ninguna parte.

**Mary Shelley**  
1833

**Translation by Victoria Leon - Coleccion Visor de Poesia**



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THE CASE STUDY OF BAIE DE SOMME**

**Máster Universitario en Paisajismo MbLandArch Trabajo Final de Máster  
Universitat Politècnica de Catalunya. ETSAB-UPC**

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