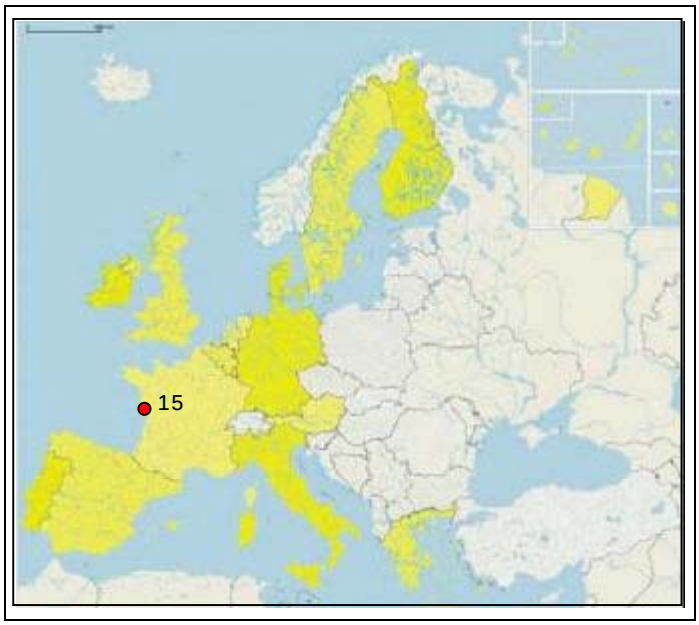
# SABLES D'OLONNE
# (FRANCE)

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# 1. GENERAL DESCRIPTION OF THE AREA

Localised on the Atlantic coast in the south of Britain the beach of Les Sables d'Olonne extends at bottom of a bay open onto the south. Les Sables d'Olonne is one of the most famous seaside resort of the Atlantic coast, known for his fine sand and protected beach.

## 1.1 Physical process level

### 1.1.1 Classification

- Coastal guide: Coastal plain.

Les Sables d'Olonne extends at bottom of a bay open onto the south. On the west, the bay is closed by a headland and by the west pear of the harbour. They both protect the bay from the west dominants swells. On the east-south-east, the bay is closed by an other headland. The length of the beach is approximatively 1500 meters between, on the west, the pear of the harbour and on the east, the rocks of the red light house. A continuous seawall from west to east is built on the upper-shore and protect from flooding. The slope of the upper-shore is around 4-7% the slope of the shore is around 2%. The seepage point is between these two parts of the beach. The seepage of the water table, very important, is due to the clay layers located one meter bellow the shore-face.

### 1.1.2 Geology

The site is including on the south of the Britain Massif. This region of the littoral is a metamorphic plateau plunging into the Atlantic Ocean, notched by several rivers. The littoral have evolved during the quaternary with the sea level variations. The estuaries of the rivers, and the marshlands were filled up with fine sand and mud. In the downstream side of the rocky headlands, the sandy arrows had progressively closed the estuaries and marshes. This point could explain the presence of clay layers one meter bellow the shore face. The sediments characteristics of the beach are fine sand: 150µm<D50<250µm and very homogeneous.

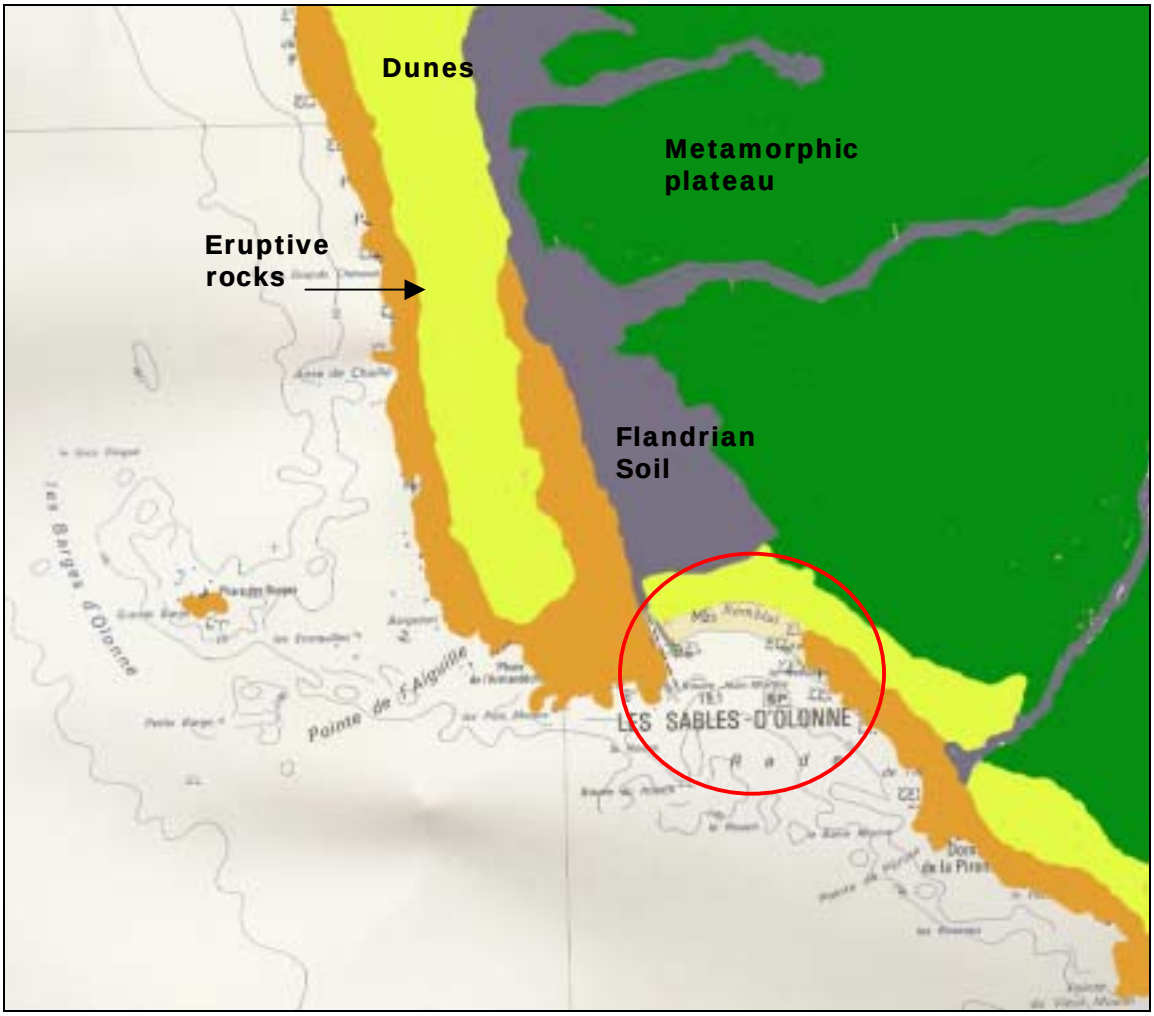


*Fig. 1 : Geologic map of the bay of Les Sables d'Olonne*

### 1.1.3 Morphology

The marine bottoms are few depth due to the continental shelf which extents 100 km in the west of the coast. Off-shore, some rocky-shoals close the bay to the south swells. The entire bay is well protected from the most dominant swells, but the whole of the littoral drift of the Atlantic coast can not bright sediments into the bay. The bay has to live with an autonomous stock of sediments.


*Fig. 2: Map of bathymetry of the bay of Les Sables d'Olonne*

### 1.1.4 Physical processes

- The dominant winds are south-west to north-west. The wind speeds more than 8 m/s represent 10%.
- The spring tidal range is about 5,6 meters
- The main current is the tidal current. The flood current go to the south-east with a speed around 0,4 m/s and the ebb currents go to the west-north-west with a speed around 0,25 m/s.
- Only the swells from south-east to south-west could penetrate directly into in the bay. The swells from the West to north-west are diffracted by the headland, and the shoals.

### 1.1.5 Erosion

The cross-shore and long shore transport is around 1.000 cubic meters each year. The main action of the transport is cross-shore, between the bottoms of the bay (shoals) the lower beach, and the upper beach. The bay, closed by the headlands and the rocky shoals is a homogeneous sedimentary cell where the entry and the lost of sediment are possible but very weak. The stock of sediment on the beach does not improve by the littoral drift, but only by the cross-shore transport.

The reflections of the waves on the seawall, and the cross-shore transport due to the action of the waves have increased the erosion. In the 60's the beach disappeared at high tide. The foot of the seawall were regularly damaged.

## 1.2 Socio-economic aspects

### 1.2.1 Population rate

The population rate of the city of Les Sables d'Olonne is around 3000 inhabitants per square kilometres. The greatest part of the inhabitants lives close to the seaside. All the agglomeration has around 40.000 inhabitants.

### 1.2.2 Major functions of the coastal zone

- **Industry, transport and energy**: the main industry in Les Sables d'Olonne is the naval constructions, for fishing boats ferry-boats and pleasance yachts.

- **Tourism and recreation***:* les Sables d'Olonne is one of the most famous seaside resort of the Atlantic coast, known for his fine sand and protected beach. The presence of the Casino, the hippodrome, the marine hydrotherapy center, the pleasance harbour, and the hotels make Les Sables d'Olonne an attractive seaside resort for the tourists.

- **Urbanisation (safety of people and investments)***:* the urbanisation is concentrated close to the sea side. The risk of flooding is moderate due to the position into the bottom of the bay, the high of the seawall. However, as a great part of the houses is built close to the mid sea level, the risk of flooding increase with the destruction of the seawall. Currently, the plan for the future urbanisations, and the plan for preventing the risks (PPR) are made according these risks of flooding.

- **Fisheries and aquaculture (exploitation of renewable natural resources):** for the site, the fisheries play an important economic role. The fishing port of Les Sables d'Olonne is one of the first ten in France, and specialised for a high quality of the fishes. The fishermen were against the project of beach-nourishment, because the site of the extraction of the sand for the beach was close to the nurseries of fishes.

- **Nature conservation**: the site is well urbanised, without special natural area. Some marshes are classified as protected, in ZICO (Community Interest Area for the Birds). The classification as "Natura 2000" of the marsh on the north of the city is provided.

- **Agriculture and forestry**: the west side of the coast is occupied by 10 square kilometers of a maritime pines and evergreen oak. The agriculture and forestry are not important functions for the country.

### 1.2.3 Assessment of capital at risk

For the moment the value of the endangered property is not established.

# 2. PROBLEM DESCRIPTION

## 2.1 Eroding sites

The sediments move between the bottoms of the center of the bay, and the upper-shore. When the set-up of the waves is on the seawall, the reflexion of the waves causes the greatest part of the erosion. The diffraction of the south-west swells causes a concentration of the energy of the waves on the east side of the beach. More over, the clay layers are less deep in the east side of the beach. The volume of sand moving from east to west, and this moving in the cross-shore direction are around 5.000 cubic meters. A part of this littoral drift lays on the channel's harbour. The impact of the beach drainage system on the littoral drift is not yet established.

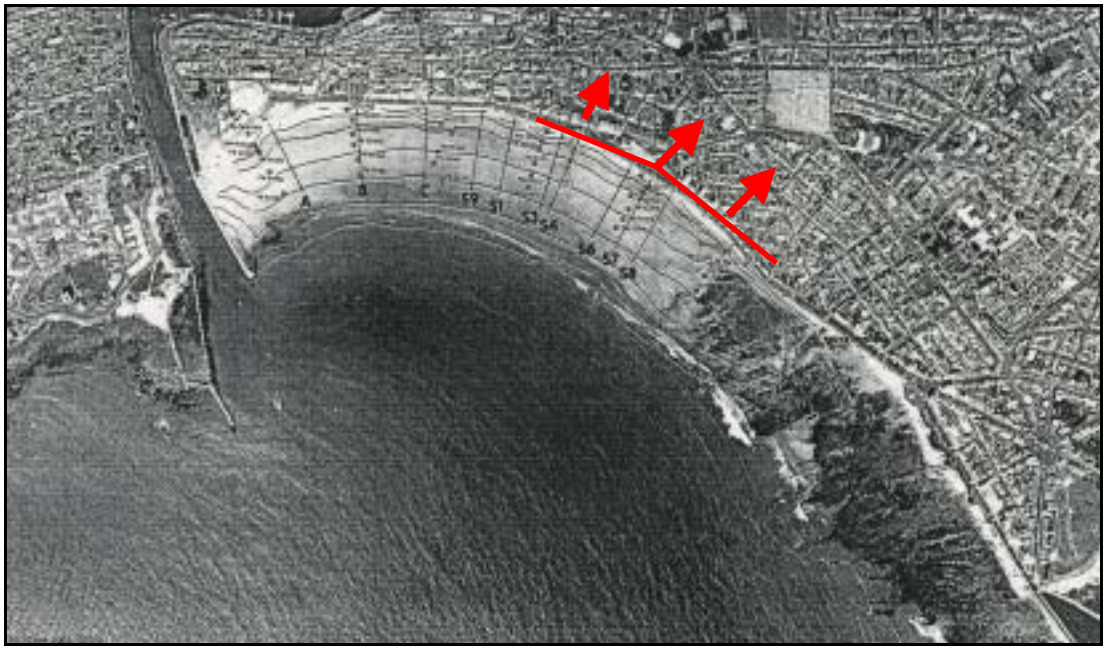

*Fig. 3: Map of the eroding points in the Bay of Les Sables d'Olonne.*

## 2.2 Impacts

The erosion is visible by the lowering of the beach profile. The consequences are mainly on :

- The urbanisation and safety. If the seawall is destroyed by the down side (lost of sand bellow the dikes and the road), the urban areas are being threat.

- The tourism and recreation. The lowering of the beach profiles decreases the touristy capacity. The tourism is the fundamental element for this seaside resort. The effects of the upper drain of the BEACH DRAINAGE SYSTEM® system cause the rising of the wide of the upper-shore above the high tides. In summer 2002, the wide of the upper-shore had increased around 10 to 20

meters. The touristy capacity was increased and the conflicts between publics and privates beaches decreased.

*Fig. 4: Before the installation of the beach drainage system, the erosion of the beach caused some damages to the foundations of the seawall.*

# 3. SOLUTIONS / MEASURES

## 3.1 Policy options

The policy option is hold the line with the most suitable solution for the environment and the landscape. Is it necessary for a seaside resort to protect and conserve is beach, but with the greatest respect of the landscape and the environment.

## 3.2 Strategy

### 3.2.1 Approach related to the problem

The engineering option is soft for the environment and the landscape. All the south littoral of the city is already protected by seawall and dikes which are unable to stop the lowering of the beach profiles. The strategy is, now, to work as much possible with natural processes. The beach drainage system has been chosen for his respect of the environment, the landscape, and is capacity to use the natural processes to protect the beach.

### 3.2.2 Issues concerning threat to life and property

Currently a PPR (Plan de Prevention des Risques): Map of the prevention of the risks is applied for all the littoral of the department.

## 3.3 Technical measures

### 3.3.1 Historic measures

April 1999, in order to stop the erosion and to stabilise the beach profile an beach drainage system is installed on the east part of the beach, the most expose to the swells, the most eroded. This first system consists on a gravity drain of 300 meters of length, installed 70 meters in front of the seawall, at the emplacement of the middle level of the sea.

March 2002, as the results are positive, the local public authority decides to improve the effects of the first system by a second on the west part of the beach, and improve the effects of the first one. So, a second drain of 300 meters of length is installed 60 meters in front of the seawall, and a third drain of 700 meters of length is installed, 30 meters in front of the seawall at the emplacement of the high tide level (see figure 5).

### 3.3.2 Type of measures

The beach drainage system installed in the beach of Les Sables d'Olonne is the beach drainage discover and developed by the Danish Geotechnical Institute and called Beach Management System. The system consists on a gravity drain which creates the lowering of the water table under the beach. The beach is unsaturated in water when the waves break on the shore. The infiltration of the water in the sand is improves. The speed of the

water in the swash decreases and the sand transported is laying on the shore face. As a great part of the water down into the beach, the volume of sand in the backwash is less. The accumulation of sand increases and the erosion is stopped.

The water flows by gravity from the drain to a pumping. The water is then pumps and throws into the sea or used as filtered water in marine swimming-pool, aquaculture, fisheries, marine therapeutic center, aquarium…

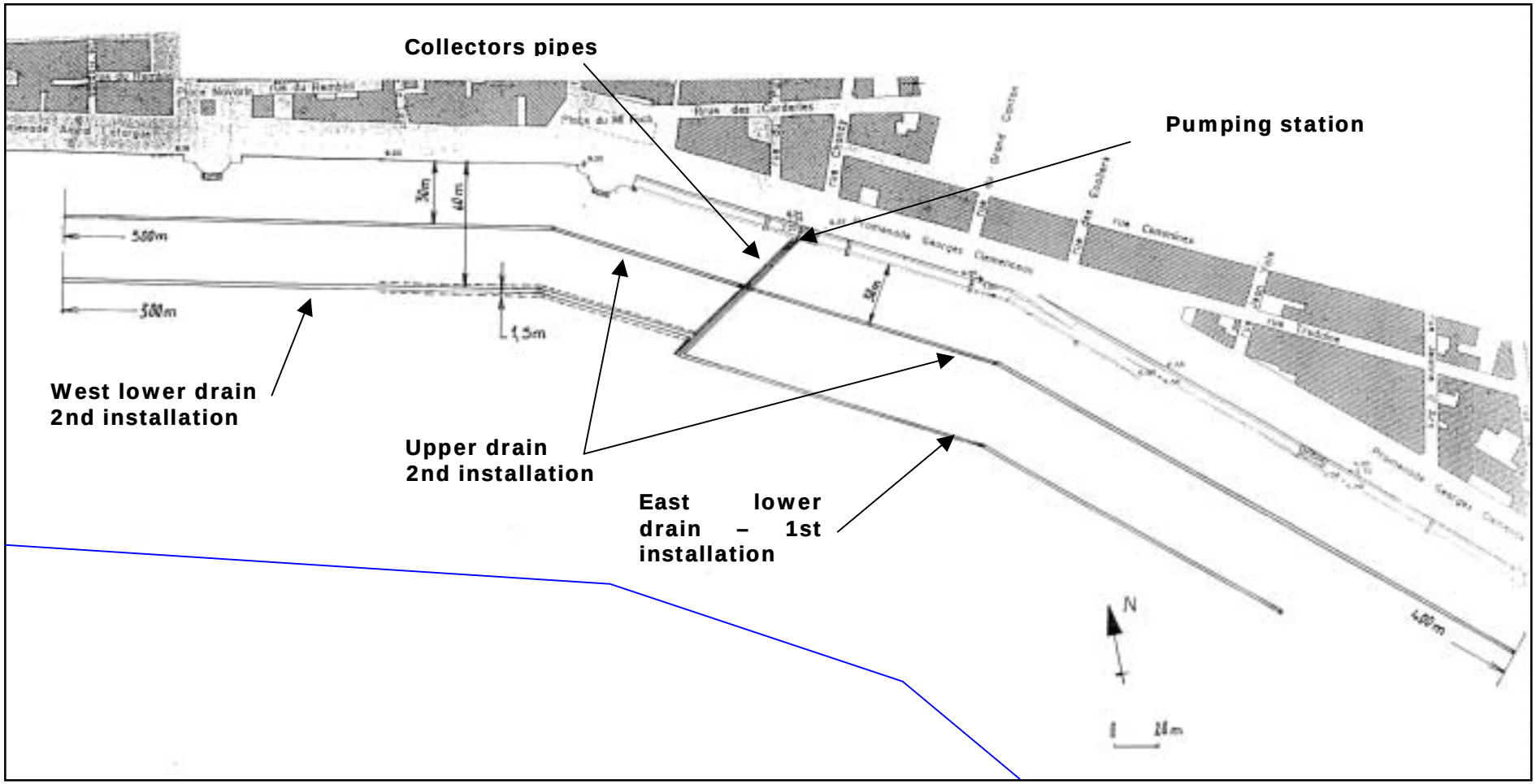


*Fig. 5: Map of installation of the system beach drainage system in the beach of Les Sables d'Olonne.*

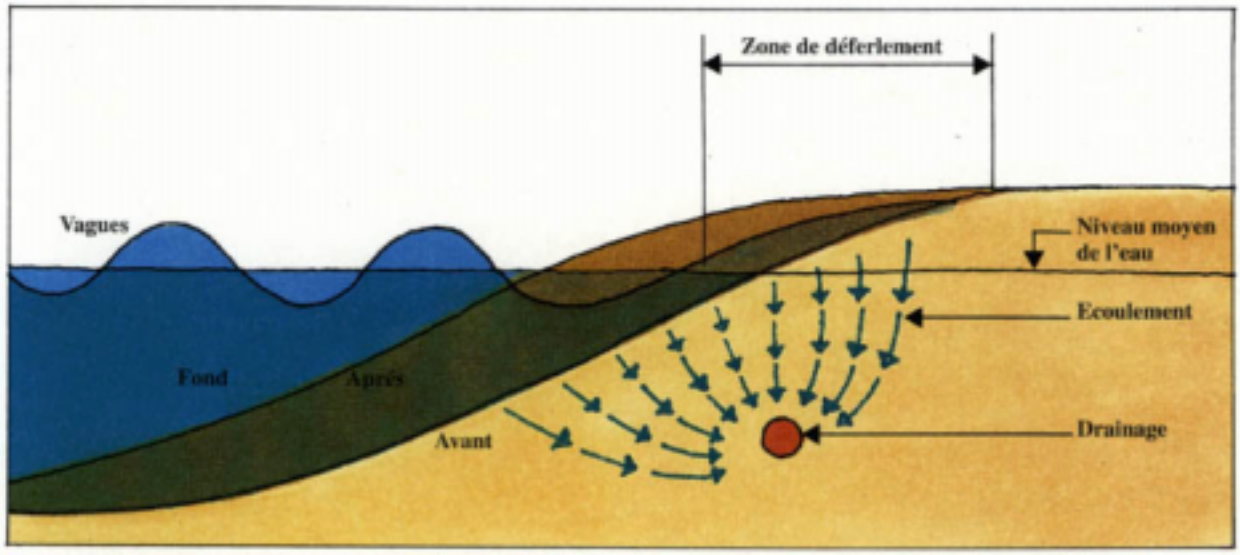


*Fig. 6: beach profile with a drainage system.*

In the beach of Les Sables d'Olonne, the first system was installed on the most exposed and eroded part of the beach. The soundings realised to know the different layers of the subsoil have indicated the presence of some clay layers one meter below the shore-face. In order to improve the running system, some furrows have been dug to increase the drainage of the beach.

***Table 1: Total costs of the beach drainage system.***

| Date of installation | Length of the system | Diameter of the drain | Tidal range | Slope of the beach | Pumping capacity | Cost of the studies | Cost of the installation | Cost of maintenance |
|---|---|---|---|---|---|---|---|---|
| 1999 | 300 M | 160 to 470mm | 4 m and 6 m (spring) | Upper-shore: 4 to 7% Shore: 2%; | 200 cubic meters | Around 40.000€ | Around 400.000€ | Electric cost for the one pump: 10.000€/year. Maintenance: 300€/year |
| 2002 | 1 * 300M 1 * 700M | 160 to 355mm | 4 m and 6 m (spring) | Upper-shore: 4 to 7% Shore: 2%; | 200 cubic meters | Around 40.000€ | Around 290.000€ | Electric cost for the 2 pumps: 15.000€/year. Maintenance for 2 pumps: 600€/year |

The pumping station built during the first installation receives the water from the drains of the 2 installations. The total cost for 700 meters of protected beach with an upper and lower drain is 760.000€ (without VA). The cost for ten years is around 916.000€ and 1.072.000 € for twenty years. Before the installation of the beach drainage system, the maintenance of the seawall was around 60.000€/year.

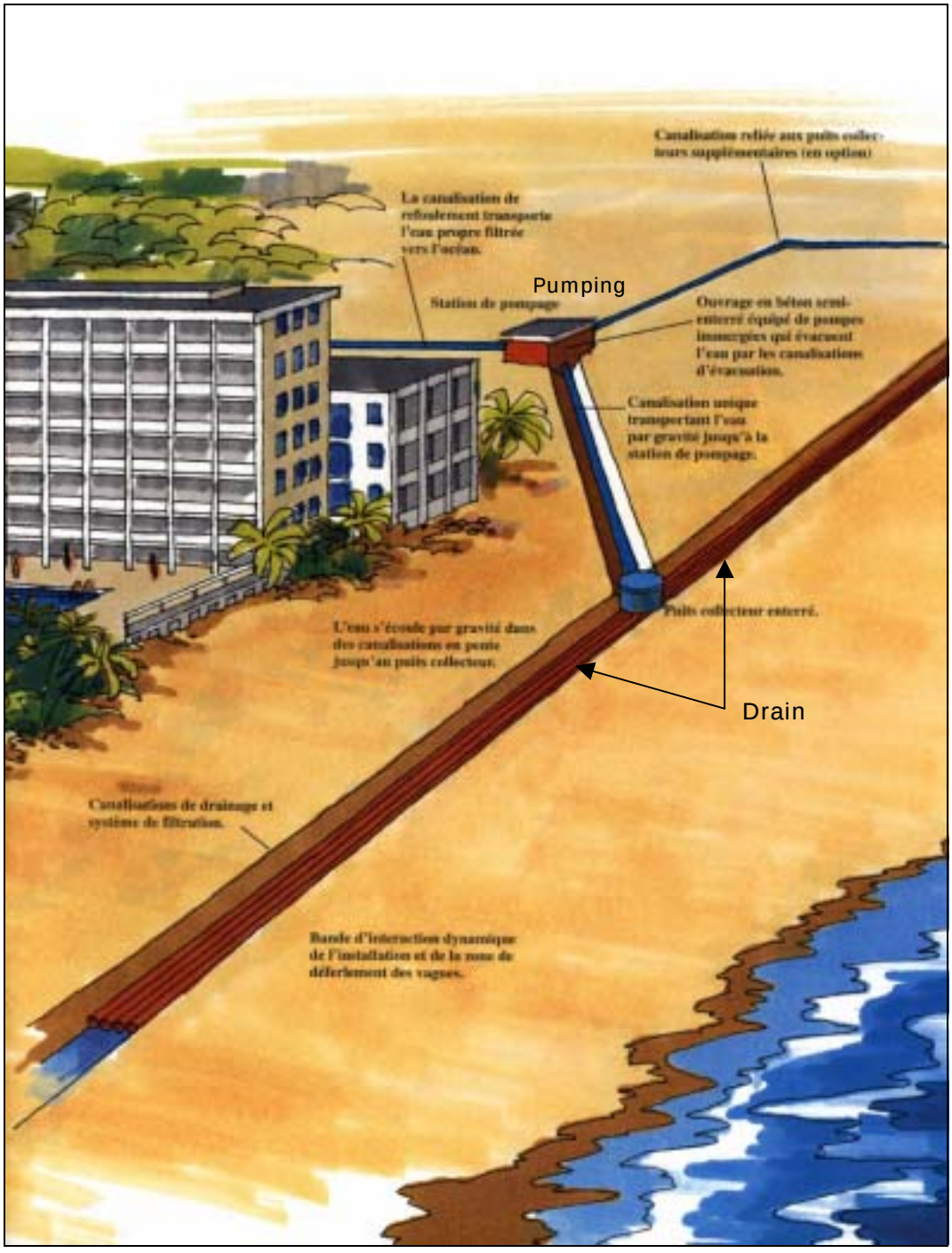


*Fig. 7: Draw of a drainage system.*

# 4. EFFECTS AND LESSONS LEARNT

## 4.1 Effects related to erosion

A special survey for this first installation of an beach drainage system has been established in order to understand the running of the system and the effects on the environment. The comity for the survey is composed by the “Ministère of the Equipement” (CETMEF), the University of Nantes (IGARUN), the regional and local public authorities.

After the first installation of the beach drainage system, in 1999, the survey made by the public authorities (Service maritime DDE VENDEE) and the University of Nantes has shown that on the treated beach:

- The beach profiles are stabilised
- The erosion is quasi stopped
- The beach is dry
- An accumulation of sand is time to time visible above the drain area
- The system is able to quickly recovery the sand loosed after a storm event.
- No negative impact have been recorded nor on the upstream side neither on the downstream side.

The study of the results of the first installation has shown a problem of drainage on the upper-shore due to the presence of the clay layers. So in order to unsaturated the upper beach and improve the sedimentation of this area, an upper drain collected to the same station has been installed on the upper beach, 30 meters in front of the seawall.

After the second installation of an beach drainage system in March 2002, the survey made by the public authorities (Service maritime DDE VENDEE) and the University of Nantes has shown that the positive effects visible on the first installation are visible on the second. The improvement brought by the second installation with the upper drain has been established by the comity for the survey (December 2002). The upper drain has able to keep the summer upper-beach till December even some severe storm events are occurred.

## 4.2 Effects related to socio-economic aspects

After the installation of the first drain system, the touristy capacity of the beach has been improved, due to the drying of the foreshore and the wider beach during high tide. Since the installation of the system, no damage on the seawall has been established. The cost of the damages before the installation could be more than 60.000 € (In 1996). The chosen strategy for the protection of the beach works. The beach profiles are stabilised and the erosion is stopped.

*Fig. 8: Before the installation of the beach drainage system the beach were always wet due to the seepage of the underground water.*

*Fig. 9: Improvement of the touristy capacity due to the drying beach in the drain area.*

## 4.3 Effects in neighbouring regions

The beach drainage system installed on the upstream side of the long-shore current, of the beach have no negative impact. The system does not block the littoral drift like a groin. The treated beach is stabilised and the untreated beach is continuing to be eroded. The consequences of the system are only visible on the bay due to her morphology very closed.

## 4.4 Relation with ICZM

Safety of the inhabitants of the seaside resort still has highest priority. A minimum safety for flooding must be guaranteed by studying the maximum set-up during the most severe storms. It is the aim of the PPR (map of the prevention of the risks). Other functions as regarded as well. The survey and the coastal maintenance are carried out by the public's authorities (Service maritime DDE VENDEE). Before the installation of the drainage system, the impacts on the environment, the landscape, the quality of the sand, of the water, the impacts on the neighbouring areas are studied on the "Impacts study" and some public meetings could be organised to debate and explain the different effects of the operation in the region.

## 4.5 Conclusions

### Effectiveness

The beach drainage system has shown to be effective for stabilise the beach profiles and stop the erosion. The improvements provide by the upper beach drain, in march 2002 show the success of the system to stabilise the profiles, stop the erosion and increase the sedimentation, Even is it to early to conclude on the efficiency of the system to increased the width of the beach. The erosion of the beach and the profiles are stabilised above the drains area. A better knowledge of the system in the great tidal range is necessary to successful apply the system

### Possible undesirable effects

No undesirable effects on the environment have been recorded.

### Gaps in information

The effectiveness of the beach drainage system can only be evaluated after a longer period.

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