The New



A new deltaic strategy for the Rhone Delta and Port-Saint-Louis-du-Rhone.

The New Delta Economy

A new deltaic strategy for the Rhone Delta and Port Saint Louis du Rhone.

Luuk van Zwam

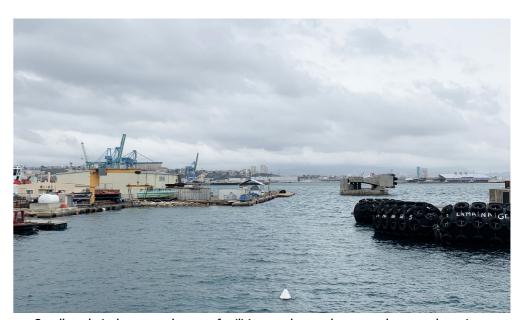
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Minimal tidal influences in the Mediterranean Sea results in minimal coastal protection.



Tidal influences make sure that the port of Rotterdam needs to have a wide buffer of nature to protect the port from erosion and storm surges.



Small scale industry and water facilities are located next to the sea, there is not extra infrastructure needed due to the minimal tidal differences.



Small scale industry and water facilities need to adapt to tidal influences in the



Large scale industry is over-scaling the nature. Historical and natural systems are replaced by a landscape system that facilitates a functionallity and effeciency.



Large scale industry in Rotterdam is over-scaling the tidal influences. It ignores the 2 meter difference between high and low tide. Nature in port is totally dissappeared.



River dominated delta has a lot of sedimentation at the coast. The overload of land results in an inefficient use of land at the cost of nature.



Tidal dominated delta has a lot of erosion. Protecting the port from land loose is a real challenge. This results in a scarcity of land for industrial purposes. Only sea-ward port expansion is possible by sand suppletion.

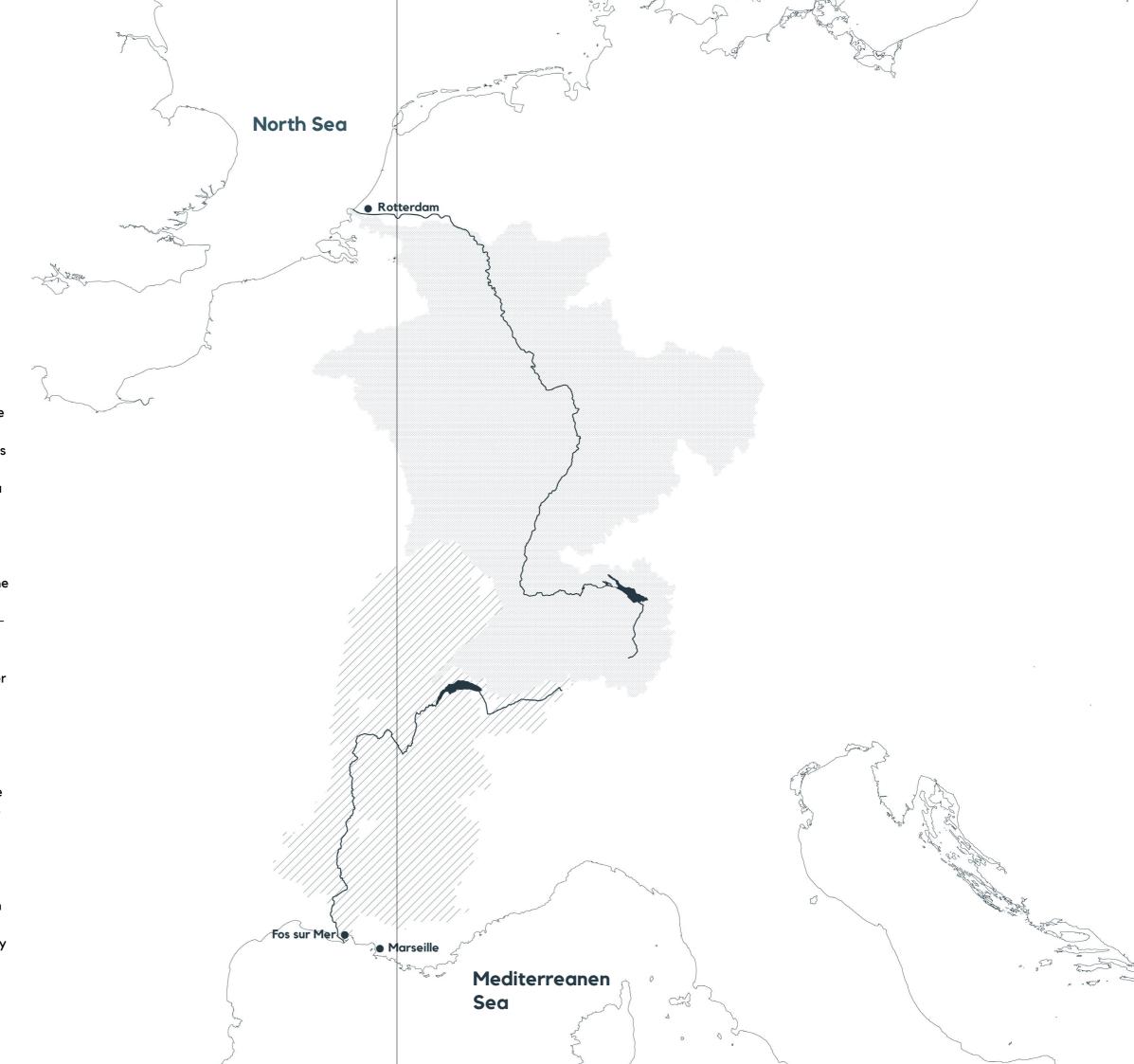
The river bassins of Rotterdam and Marseille.

Rotterdam and Fos — Marseille are both located at the mouth of big river basins. Near Rotterdam the Rhine — Meuse rivers basin finds its way to the North Sea. The mouth of the Rhône river basin is located near Fos. The map on the next page shows the basin of both rivers. All the rain that falls in the hatched area of Europe, will reach the sea via Marseille. All the rain that falls in the dotted area of Europe will reach the sea via Rotterdam.

The Rhine- Meuse basin basin is located north of the Alps and deals with more precipitation than the Rhône basin. The basin of the Rhine Meuse has a bigger surface than the Rhône basin so the catchment area of the river Rhine and Meuse together is more significant than the Rhône one. Therefore, the Rhine- Meuse basin has to deal with more river discharge and so more sediments.

The Rhône river ends in de Mediterranean Sea. It is a quite sea without strong currents of huge tidal differences. Around the Mediterranean Sea is a specific climate with a unique biodiversity. The mouth of the river results in an exceptional nature area.

The Rhine- Meuse rivers are ending in the North Sea. A sea with strong currents and big tidal differences. Combined with specific circumstances in weather, powerful storm surges can occur. Despite the flatness of the land, the landscape is very rough.



River Dominant Delta

Due to the quite sea and the strong current of the Rhône river, the river dominates over the sea when the river meets the sea. This is visible by the amount of sedimentation that reached the sea. The Rhône river is able to bring large amounts of its sediments in the Mediterranean Sea. The wave power of the sea is pushing the sedimentation back to the coast. This pro-

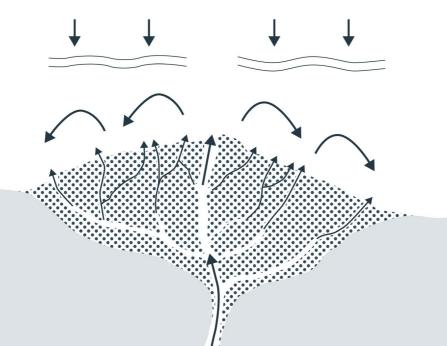
cess of fluvial sedimentation and marine wave energy creates a triangle shape of land, land of fertile fluvial sedimentation in the shape of a delta as is shown on the image above.

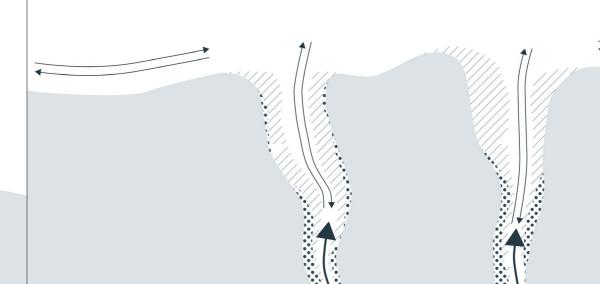
This type of delta is very common in the area of the Mediterranean Sea. Large rivers are dominant over this quite sea.

Tidal Dominant Delta (Estuary)

The tide of the North Sea is dominating the river mouth. The currents of the sea are over-powering the current of the river. Therefore, erosion and sedimentation caused by marine influences are take place in the mouth of the river. The more land inwards the less influences by the sea. This process creates a funnel shape. Sedimentation is changing gradually from fluvial sediments to marine sediments.

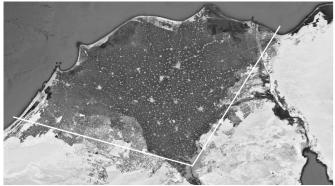
The estuary that is shaped by marine and fluvial influences, is very common around the North sea. The sea is very rough and tidal differences are big. Beside tidal differences, extreme storm surges are quite common in this sea.

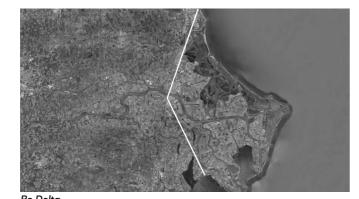




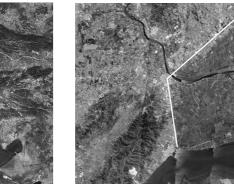
Comparative deltas

Deltas like the Rhône delta are several around the Mediterranean Sea. As shown here the Nile Delta, Ebro Delta and Po delta. Those delta's have the same shape and are dominated by fluvial sedimentation.





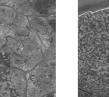




Rhone Delta

The Rhine- Meuse delta is a sequence of a few Estuaries. The mouth of the Meuse used to be an estuary as well. Like other estuaries as shown on the page on the right: Western Scheldt, Seine, and Loire estuary.













Loire Estuary

Human influences on the mouth of the Rhone.

1850: The mouth of the river was on another location. Port Saint Louis wasn't there yet, there was only one tower. In this period, the delta was mainly dominated by nature, there wasn't hardly any man made land.

1950: The delta landscape became more artificial. Port Saint Louis was already developed as a village with a port. The port had a connection by road and railroad. A channel has been made to the port of Saint Louis. Other parts of the nature has been changed into salt land.

2020: The nature area east of Port Saint Louis has been changed in industrial port area. Huge docks are made to facilitate the large ships. New infrastructure, railroads and roads has been attached to the port. The new port made a jump is scale compared to the old harbor of Port Saint Louis. The amount of nature area has been declined compared to 1950.



Port Saint Louis du Rhone 1850



Port Saint Louis du Rhone 1950



Port Saint Louis du Rhone 2020

Human influences on the mouth of the Rhone.

1850: The estuary of the Meuse was divided in two mouths with a marshland in between. The south mouth was the main entrance for Rotterdam and other cities around the estuary. A long the coast, large nature areas as coastal protaction have been alternated by nature from the estuary. Only around the cities were some small port activities.

1950: Port activities were growing, so the ships did. The north mouth of the estuary has been turned on into a manmade channel, the Nieuwe waterweg. The south route became too shallow. This resulted in a decline of estuary nature. In the east, the expenses of the port are already visible.

2020: The Estuary has been closed off from the sea. All the nature of the estuary has been replaced by port area. The southern mouth has become a lake with less ecological value. Around the estuary the urban area has been grown significant.



Oostvoorne 1850



Oostvoorne 1950



Oostvoorne 2020

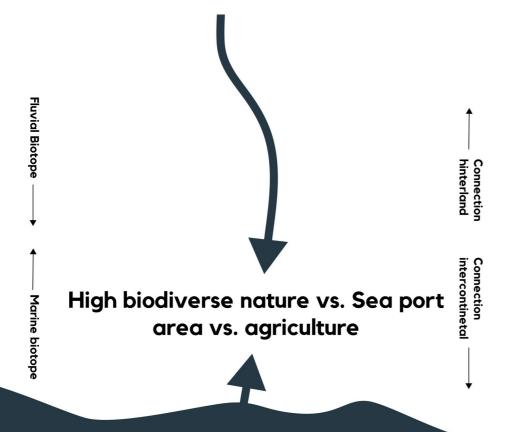
The conflict

Delta areas contain of high biodiverse nature. Nature that consists of fluvial (fresh water) flora and fauna and consists of marine (saline water) flora and fauna.

The collusion of fluvial sedimentation and marine processes results in a flat and fertile land. The delta has a direct connection with the sea and the river. For this reason, the delta is a perfect location for

industrial and port activities. The fertile land is also very suitable for agriculture.

A delta has excellent circumstances for several forms of land use. A lot of parties are trying to claim the land and make the land as much as possible suitable for their use. Therefore, the pressure of the delta is immense. This creates conflicts between nature, agriculture, industry, port area and infrastructure.







Closing the estuary: Urbanized estuary

The port of Rotterdam is located at the mouth of the Meuse river. This mouth used to be an estuary. This estuary is completely urbanized. Starting in the east with the city of Rotterdam. In the west, the river front is dominated with port activities. The black lines on the map are the primary flood defenses. Following these black lines the river has still the funnel-shape of an estuary.

The older port areas, Maashaven, Waalhaven, Eemhaven, Pernis and Botlek are more in-land.
These areas are protected by a sea dike and the Maeslantkering. The storm surge barrier should be

able to protect the port and the metropolitan area of Rotterdam until 2100. But due to rising sea level and climate change, the storm surge barrier needs to be replaced by 2060. This makes the city of Rotterdam and the older port areas vulnerable for the rising sea level.

The new port areas, Europoort, Maasvlakte I and Maasvlakte II are situated outside the primary flood defenses. These areas are protected by a natural barrier around Maasvlakte II.



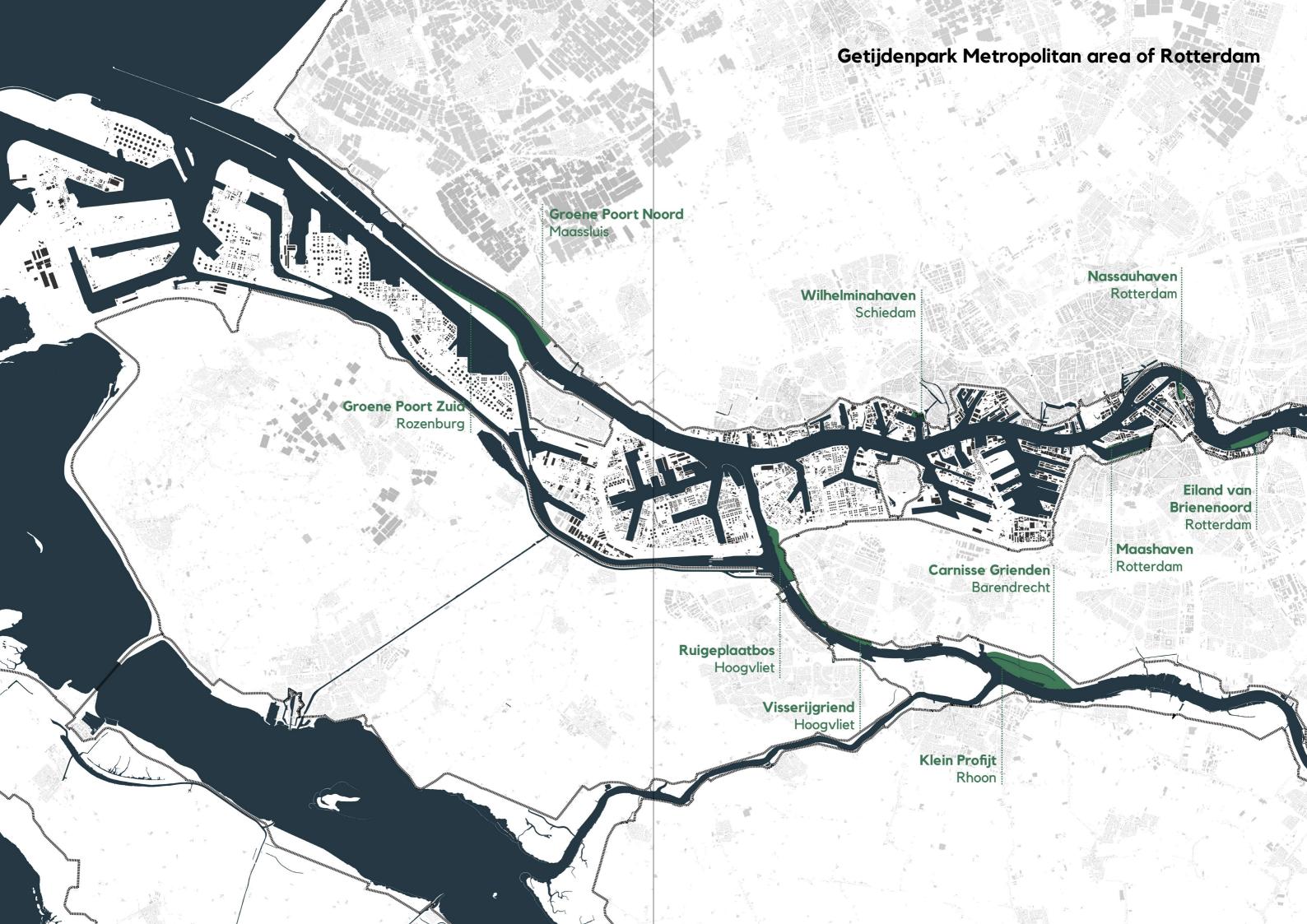
Open up the estuary: Increase tidal influences in the city

Despite the storm surge barrier Rotterdam is still vulnerable for sea level rise and extreme weather events. This vulnerability will be increase by removing the Maeslantkering. The riverfront of the inner city will be in direct connection with the sea without any protection. Within the Metropolitan area, there are a lot of buildings and industries outside the dike.

To be more climate proof and increase the amount of green along the river, Rotterdam introduced the program getijdenpark. This program aims the have more tidal nature in the urbanized estuary. These tidal nature areas provide a buffer for the river and extreme tides. It also provide new nature and recreational area for the citizens.







Agriculture versus nature in Camargue

Closing the delta: Human influences in the Camargue.

The Rhône delta also known as the Camargue is river dominant delta. The delta is created by fluvial sedimentation processes. This resulted in a flat natural area with a high biodiversity. The Rhône connects the Mediterranean Sea with Lyon and Switzerland. The river valley of the Rhône is an important corridor for train and road transport between south and north Europe. The flat land next to this corridor is very suitable location for sea port. A large part of the Camargue between Fos sur Mer and Port Saint Louis has been turned to port and industrial area. The river Rhône plays an important logistic role. Therefore, the river has been canalized to facilitate navigation on this river to Lyon and other upstream cities.

The canalization created a decrease of sedimentation in the delta. A lot of nature areas in the delta are not directly connected to the river anymore. These areas are not able to receive any fluvial sedimentation. Beside a loss of sedimentation, the nature areas are receiving less fresh water. In combination with a rising sea level this results in an increased salinization of natural areas.

The fertile soil of the Camargue is also very suitable for agriculture. The agriculture needs the fertile sedimentation and fresh water of the Rhône.

Therefore, nature along the main river streams have been turned to agricultural land. Due to this agricultural land, nature land has been moved far away from the fresh water streams.

The Rhone river has also be canalized upstream. To facilitate navigation, there are also dams with locks in the river. These dams and the canalization make sure that less sediments reach the delta. A loss of fertile sediments forces the agriculture to use fertilizers. In the last decennia, the use of fertilizers have been increased, also by a growing demand of agricultural products. The use of fertilizers results in a pollution of the delta area.



Legenda

Agriculture
Nature
Water
Urban area

Current sytem

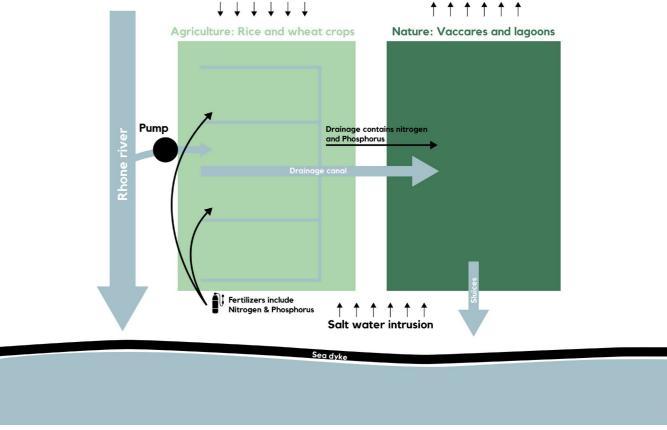
The rice production is the most important source of income for the agriculture in the Camargue. Unfortunately, the production of rice requires a lot of water fresh water. After the Second World War, the production has been increased dramatically. To increase the production, polderization of the delta was required. In most cases this was at the cost of nature. Due to polderization and the demand for a sufficient working agricultural system, the water system became more artificial.

As seen on the previous map, the agriculture is mainly located next to the river and on riverbanks. Nature areas and lagoons have fractured from the natural fluvial system. The Rhône river has been canalized. The freshwater for the rice production goes via a pump from the river to a main canal. This canal distributes the water over the rice fields. Fertilizers are added in the fields. These fertilizers include nitrogen and phosphorus.

The current system explained in section

The outlet of the rice fields leads the water to the Vaccares lake and the lagoon. Attached to these waterbodies are the swamps and salt plains. Nature has not a natural connection with the Rhône river and is dependent on fresh water that derives from agriculture. This water contains, in most cases, nitrogen and phosphorus.

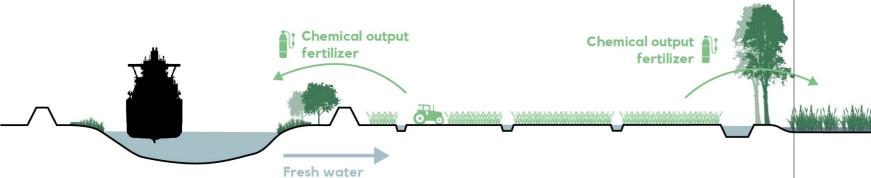
There is hardly a connection with the sea. Marine sedimentation processes are distinguished by a sea dyke. Due to the rising sea level, is the process of salinization increased. For this reason, agriculture needs more fresh water from the river and nature is becoming more saline and polluted.



Evaporation

Precipitations

The current system of the Rhone Delta



for agriculture

Salinization of nature

Salt water intrusion due to sea-level rise

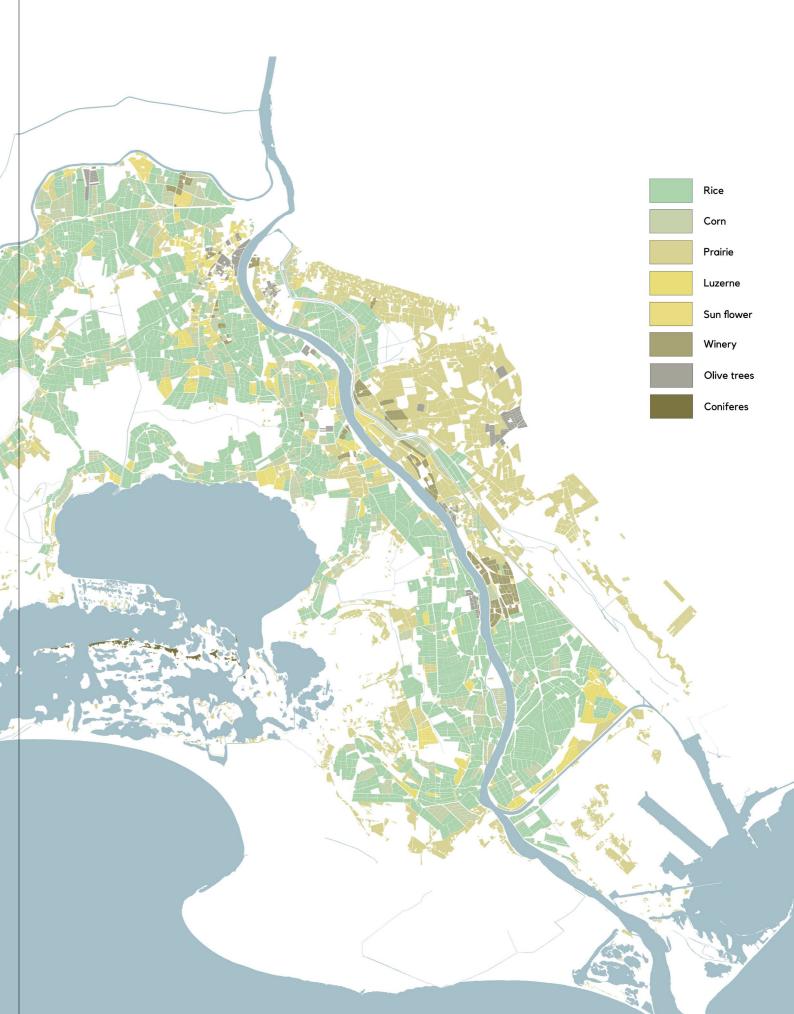
Agriculture in the Camargue

Agriculture in the Camargue

Agriculture is mainly located next to the river Rhône. Agricultural land consists mainly of rice fields. These rice fields are geometric and has a large size. These fields are mostly located in the south. In the north are orchards and other crop fields located.

Crop fields are located on old river banks as well.

These old banks are higher places created by the sedimentation of previous rivers. The banks area recognizable by the curved shapes of the plots.



Nature in the Camargue

Nature in the Camargue

Behind the agricultural plots are nature areas located around the lagoons. In the north consists the nature mainly of swamps. These are swamps are fresh and brackish.

South of the lagoons nature is mainly salt. Saline nature occurs in the form of marshlands and salt plains. East of the saline nature are areas for salt production. Along the coast, coastal nature alternates saline nature.

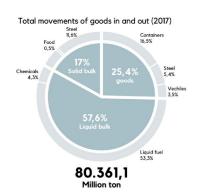


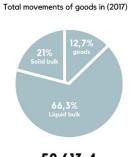
Current economic activities in the port of Fos-sur-Mer.

Large part of the Rhone Delta has been claimed for port activities. This port area is between Fossur-Mer and Port-Saint-Louis-du-Rhone. In the infographic below is shown the stream of goods in and out of the port area in 2017. Based on this port metabolism it is possible to conclude that liquid fuel is by far the biggest ecnomic activity in the port area. Also steel has a substantial share of economic activities. These economic activities are part of a finite and unsustainable production

process. So these are activities are a uncurtainty for the long term future.

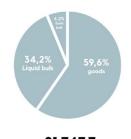
the map on the right shows the strategic location of the port area according to European freigth corridors. Despite this strategic location is container activity not a real big share in the economic activity. This could be a opportunity for a long term sustainable tradings position for the port area in de Rhone Delta.





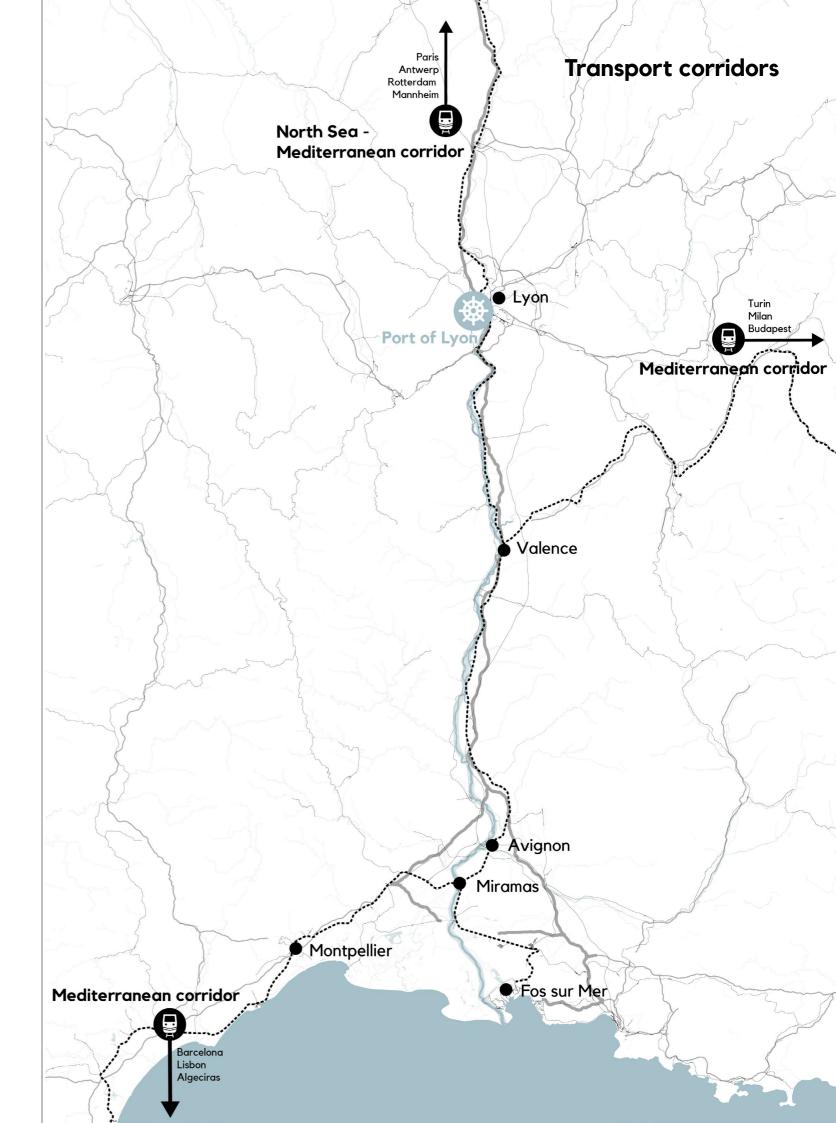


Total movements of goods out (2017)



21.747,7 Million ton





Open up the delta: Increase natural influences in the Camargue

There is a shortage of fresh water and fluvial sedimentation. At the same time, the sea level is rising in the Mediterranean Sea. The canalized river isn't able to deposit fresh sediments in the delta. This results in a lack of fresh water and fertile soil. The soil of the delta is also not able to rise with the sea level due to a lack of sedimentation. The creates a relative land subsidence in the delta.

To deal with these problems, nature needs to get more control over the Rhône delta. The river should be able to increase the diversification of sediments. By an increase of diversification also more nature areas will be able to receive fluvial sediments and fresh water. This will reduce the salinization and land subsidence within the vulnerable nature areas.

This can be done by open up delta to the cultivated land. Lowering dikes around the agricultural plots and use sediments as flood protection instead of a monofunctional dike. These sediments can be use as fertile soil in the agriculture. This can reduce the use of chemical fertilizers. The stream of the Rhône can be diversified as well by using old streams of make new streams through the vulnerable areas. One of these areas is the nature around the port of Fos. The nature is completely cut of from the delta. Due to the rising sea level, the nature is transforming to a saline nature area. This results in a decrease of biodiversity. By reconnecting this area to the Rhône, it is able to maintain the delta nature and deal with the rising sea level.

Agriculture: Rice and wheat crops

Nature: Vaccares and lagoons

Use old river for natural freshwater supply

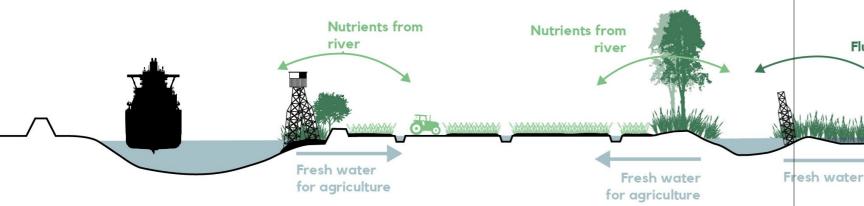
Use old river for natural freshwater supply

Salt water intrusion

The proposed strategy for the Rhone Delta

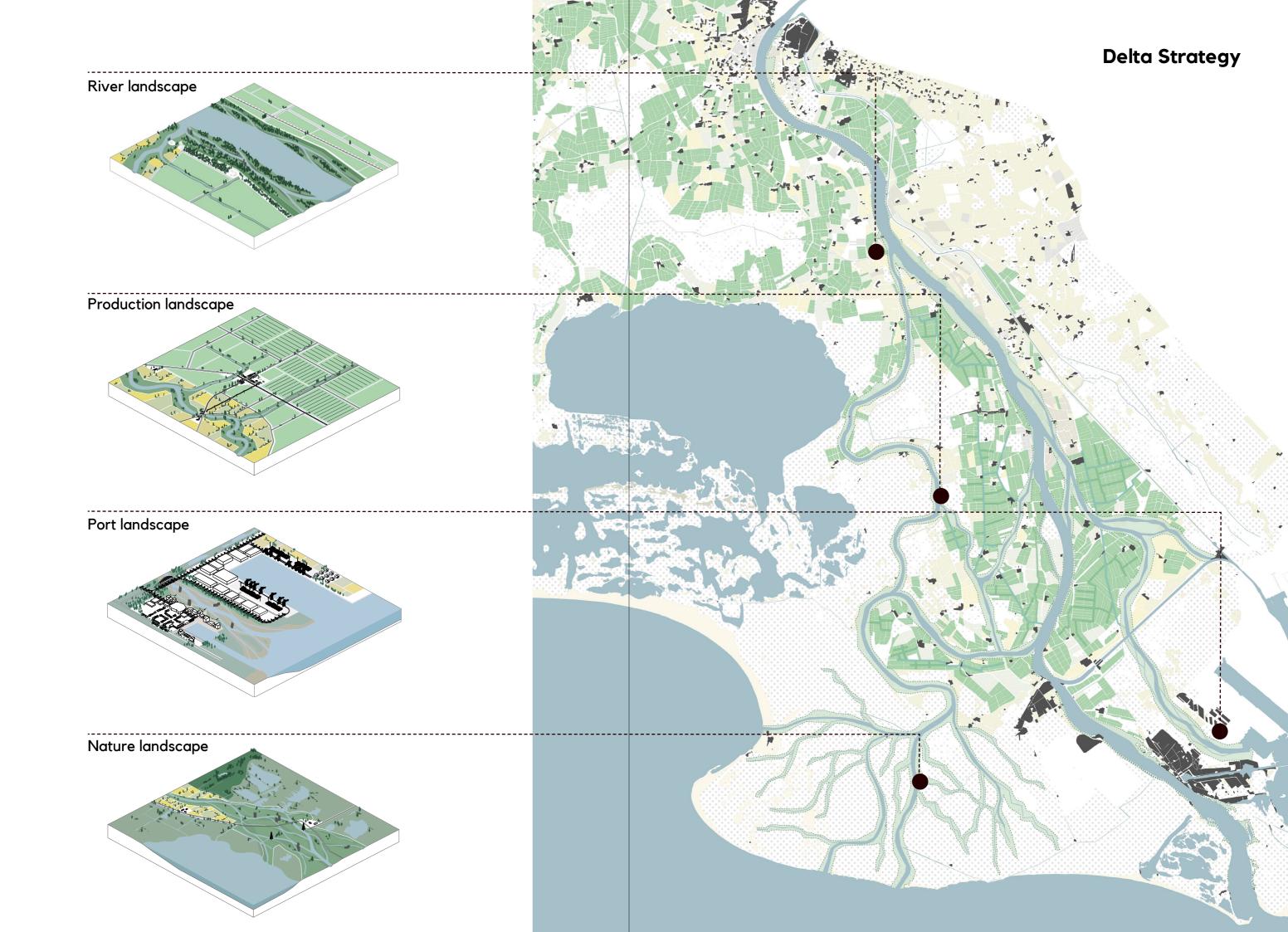
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The proposed strategy explained in section



Fluvial sediments

Salt water intrusion due to sea-level rise



Water pumps to provide rice fields with fresh water Settlements on higher riverbanks Old river flow Main irrigation conds Rice fields

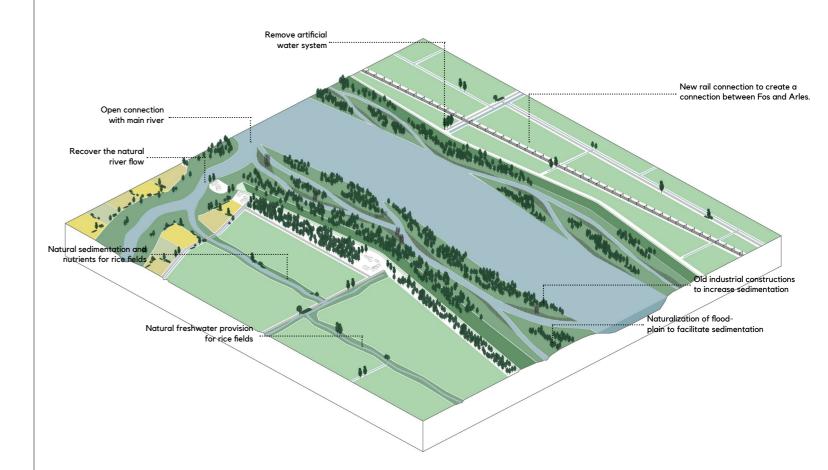


Agriculture on the river bank of the Rhone



The river at Port-Saint-Louis were riverbanks make place for salt production and saline nature.

River landscape



River landscape

Restored nature on the river banks will be used for sedimentation. The old historic side channel will have a new natural connection with the river as part of the soil diversification strategy.

Next to Rhone river, a new rail road will be established to create a better rail connection from the port the the European freigth corridors.

Large scale rice production Large scale rice production Large cond for freshwater supply. Small scale agriculture on the higher riverbanks



Rice field in the Camargue



Endless rice cultivation close to the river.

Production landscape



Production Landscape

The restored side channel will provide the rice field on a natural way with fertile soil and sediments. This wil reduce the amount of chemical fertilizers.

The riverbank of the old side channel gets a more natural character.

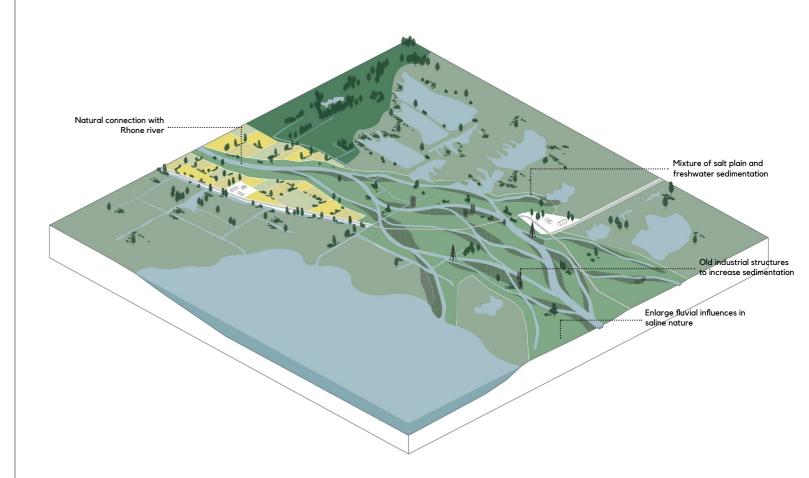


Swamps with the typical horses of the Camargue



The lagoons and salt marshes are a habitat for the Flamingo.

Nature landscape

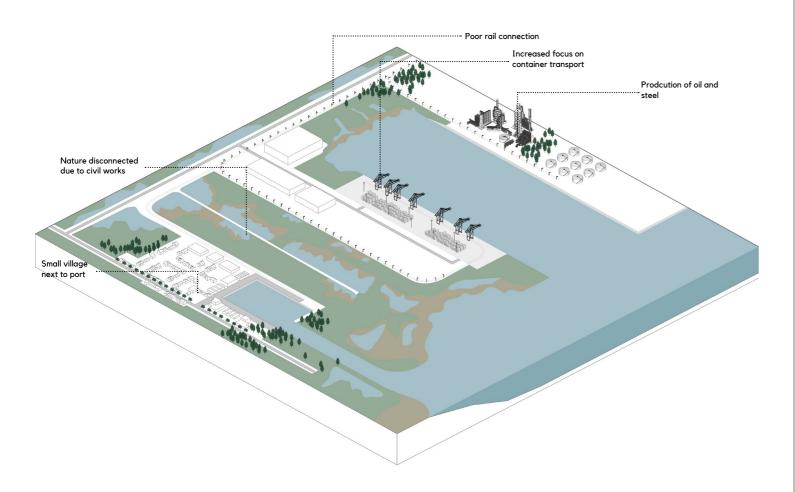


Nature landscape

The nature landscape and the lagoons will get a nature fresh water supply by the restored side channel.

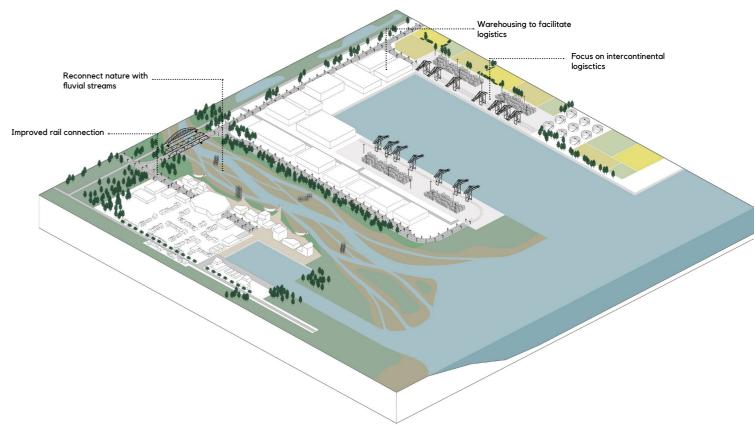
This fresh water supply will bring beside fresh water, new sediments as well. This is needed to prevent the delta from sinking in the sea.

Port Landscape









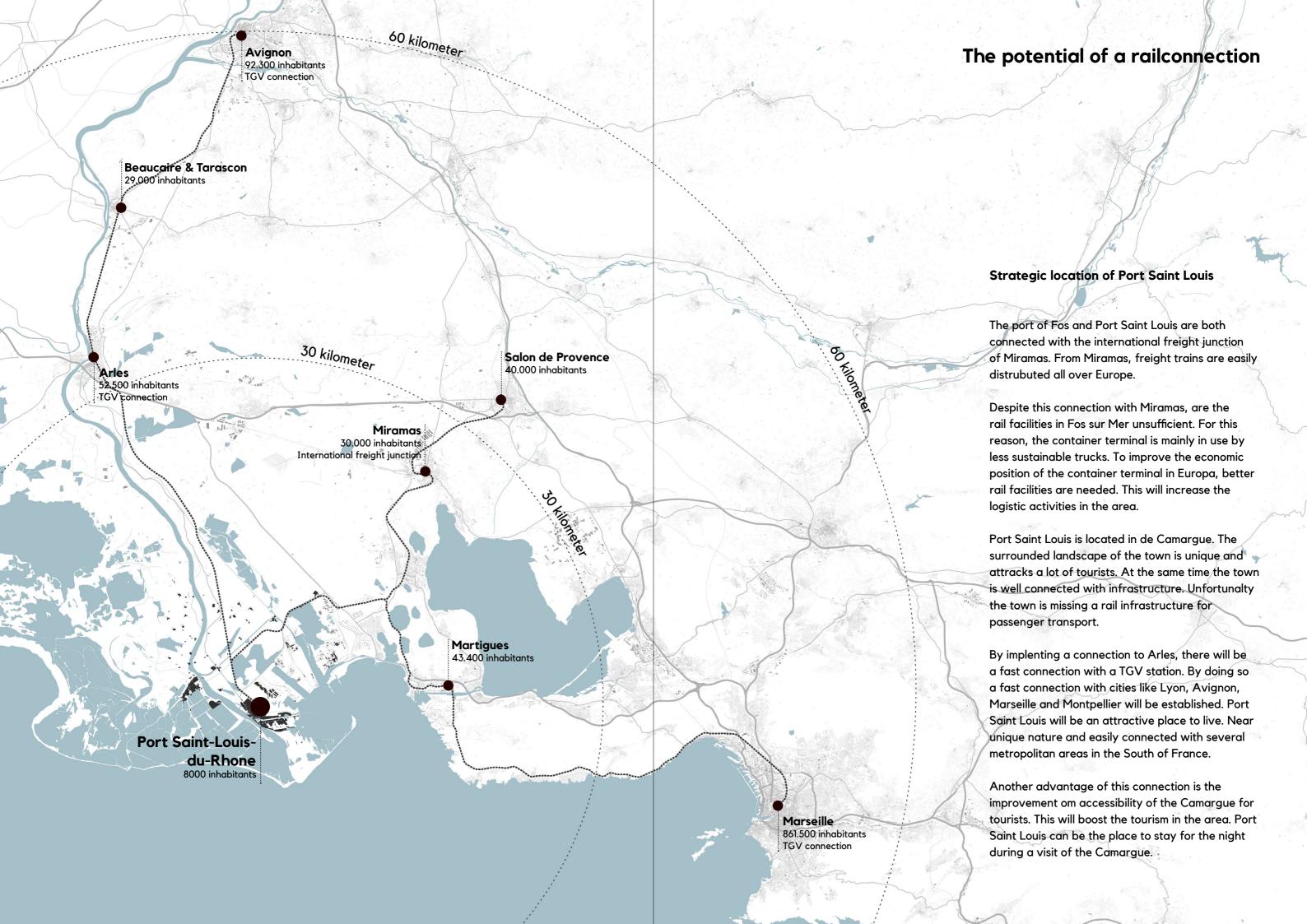
Port landscape

The port has a very poor rail connection despite the strategic location on freight corridors. The economic activities are mainly about oil and steel production. Those industries are finite and have no perspective on the long term.

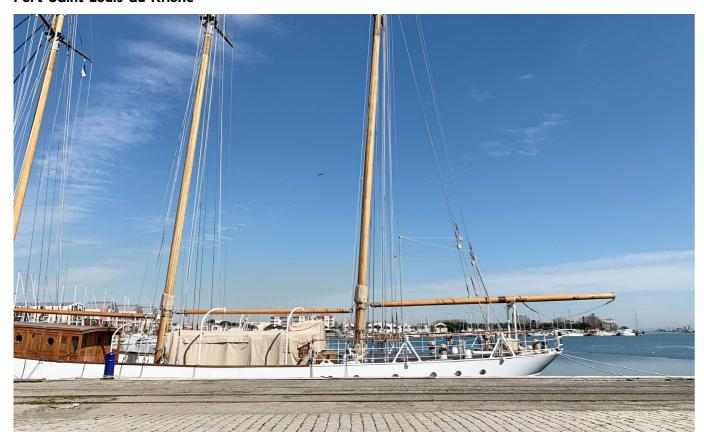
Nature in the port has been cut off by civil structures and has no ecological connection with the rest of the delta.

The new port will focus more on global logistics and warehousing. An improved rail connection will facilitate this ambition.

The nature in the port will be part of the delta wide sedimentation strategy. It will have a new connection with the rest of the delta.



Port-Saint-Louis-du-Rhone





Container terminal Fos-sur-Mer







Ancient town of Port Saint Louis



The old harbour



Public housing for the labours of the port area.



Abonded industry at the east side of the village



Recent developments at the old harbour



Masterplan Port Area of Port-Saint-Louis-du-Rhone **Global Logistic Port** The port area of Fos-sur-Mer will be specialized in logistic activities on the global scale. Since the port area is located along two important European Freight corridors and strategic located for a intercontinental connection with Asia. Beside transshipment the area is also perfect for warehousing global trade products. Large scale warehousing will fit perfect in the large scale industrial landscape. Warehousing This small scale warehous area can facilitate the trade of the local food production of the Camargue. From this location it will be possible to store and distribute the special red rice over the rest of france, Europe and the world. **Expansion of Port-Saint-**Louis-du-Rhone. The port of Port-Saint-The new logistic activities will bring Louis-du-Rhone new businesses to this area. The town, which is located a unique Warehousing and trading and nature area will be the perfect distribution of local food is an location for the offices and doing opportunity for the old port of Portbusiness. Saint-Louis. The port will focus on small ships and short distance sea-The focus on logistic comes with a connection. good railconnection. Therefore, it will be possible to add a train station to By improving the railconnection, the the town and improve the connection port will also be able to redistribute with the metropole area of Marseille. the goods from the Global logistic port. A train connection facilitates tourism

in the Camargue nature area.

Masterplan Port-Saint-Louis-du-Rhone



Green space during dry periods

The town of Port-Saint-Louis will be located between two nature areas. The green structure wil facilitate a green connection between these nature areas. The green center of the town will be used for this connection.

beside ecological connection provide the green center a public function. Located between important public buildings. Via a former rail track is the park connecting public parts of the town with each other.

The green center will have an open character and a robuust materialization. By having these characters, this space will be able to adapt to different weather events.





Residential Green



Green space to infiltrate water



Dense and informal plantation plan



Use of mediterrenean grasses



Use of mediterrenean plants



Urban green



Hight the openess of the space. Paths follow old rail track



Use of robust materials like contrete



Plants and trees with a little mediterrenean accent.

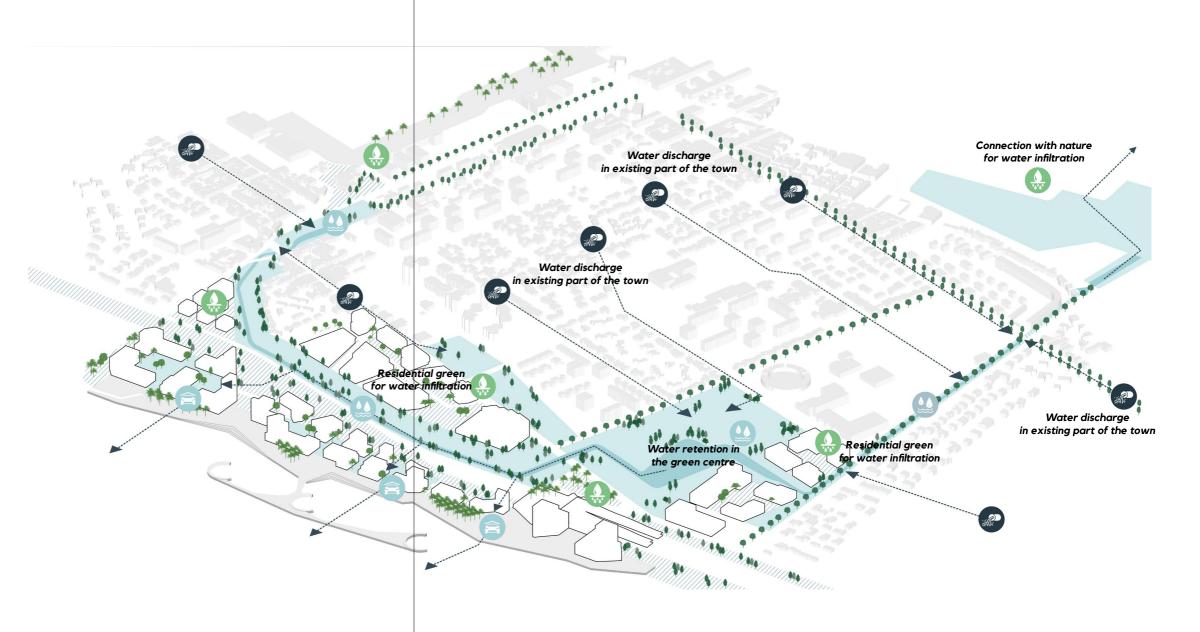
Green space during wet periods

The town of Port-Saint-Louis is located between two channels of the Rhone River. This location makes the town very vulnerable for flooding and extreme weather events.

This masterplan propeses a climate adaptive strategy which is based on the green space as discussed before.

Lower parts of the central green facilitate retention. Other parts of the central green space facilitate an overflow. Also the parking beneath the elevated part can functionate as overflow for the retention area.

Retention zones will bring the water during dry periods back to the nature areas around the town.

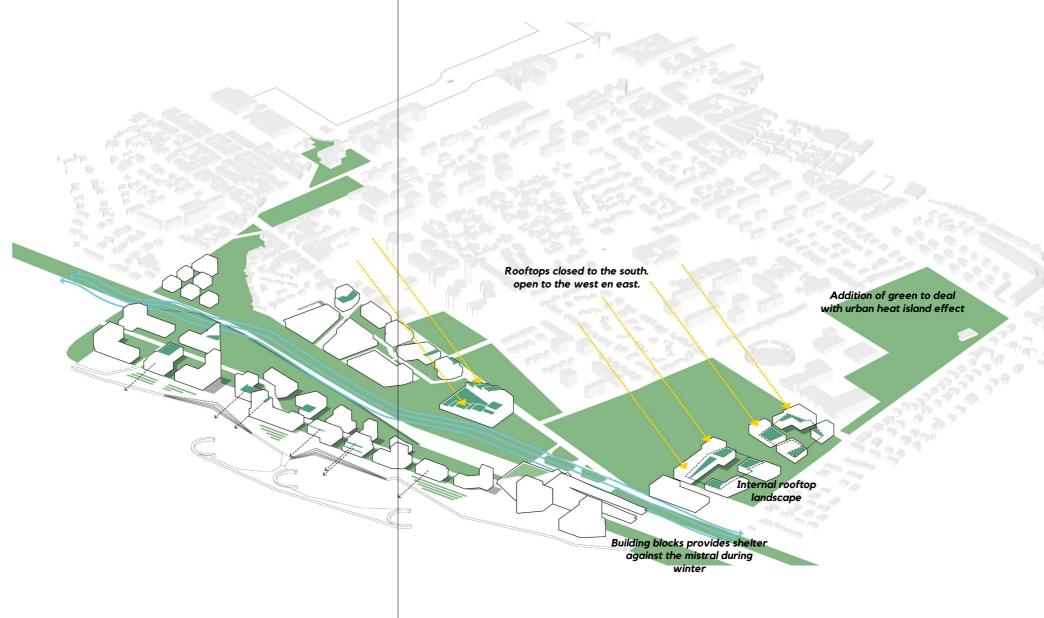


Adapting to the local climate

The masterplan uses the natural dynamics of the delta to create a livable city. Open spaces around the buildings blocks are oriented north to south to create a sea breeze in the summer. At the same are the buildings blocks providing shalter in the winter against the mistral.

By using semi-building blocks shady and sunny places are created by positioning buildings strategically.

Higher parts are mostly facing to the south and north. This creates a rooftop landscape which provides shade during hot hours and sun in the evening hours.



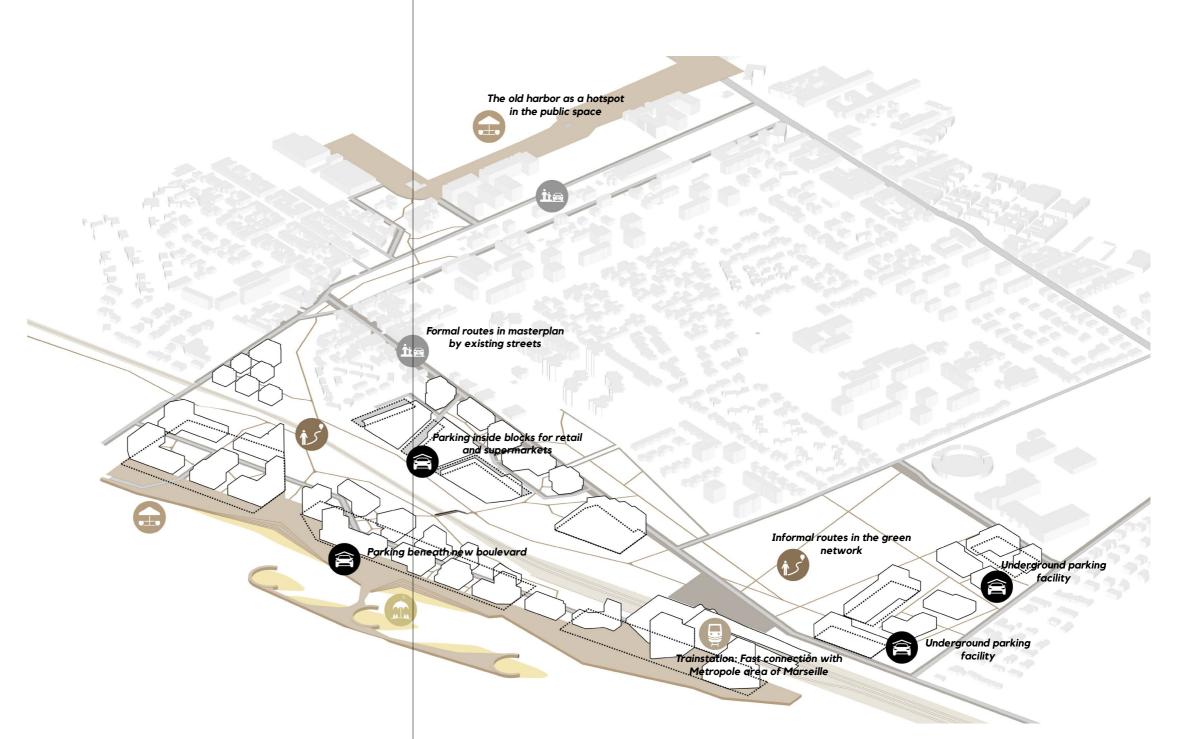
Routing in the masterplan

This masterplan will use as much as possible the existing infrastructure. Especially when for the formal routes to the old center of the town.

Informal routes are located in the green parts of the masterplan and a partly following the old rail track. These informal routes will bring the old harbour and the new boulevard togethers with a park.

The new boulevard includes a sedimentation island with a beach that is a result of the delta wide sedimentation stratetegy.

Parking space are beneath the elevated part of the plan that fuctionate as a flood defences and water overflow.



Functions of the masterplan

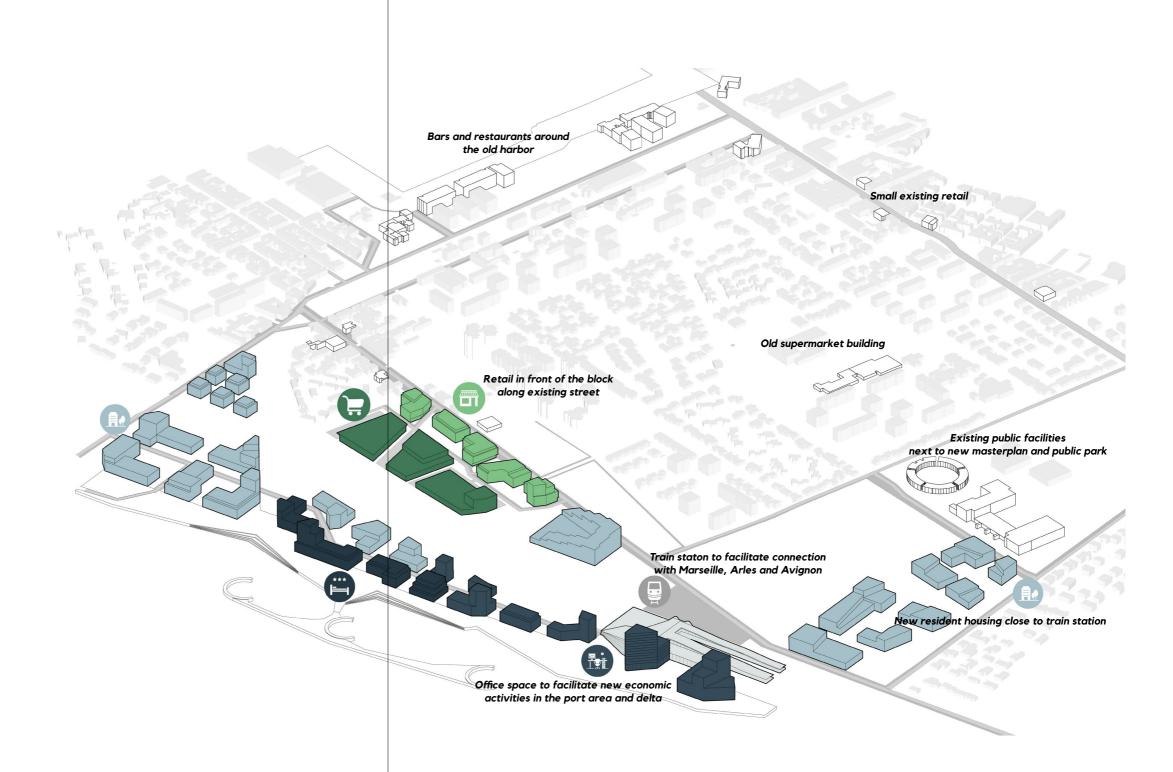
The new train station will be the engine of this masterplan. A fast connection with the Marseille metropole and Arles- Avginon provides opportunities for this strategic located town.

Nearby big cities within a nature area and a lot of employment provided by the port.

The global logistc businesses will find its head quarters next to the train station. Next to the office buildings are hotels and short stay apartments to partly facilitate the 2-3 million tourist yearly of the Camargue.

Dark green buildings provide room for fresh markets for the local products from the camargue and the large supermarkets.

Light green buildings provide room for new retail and small foodstores.



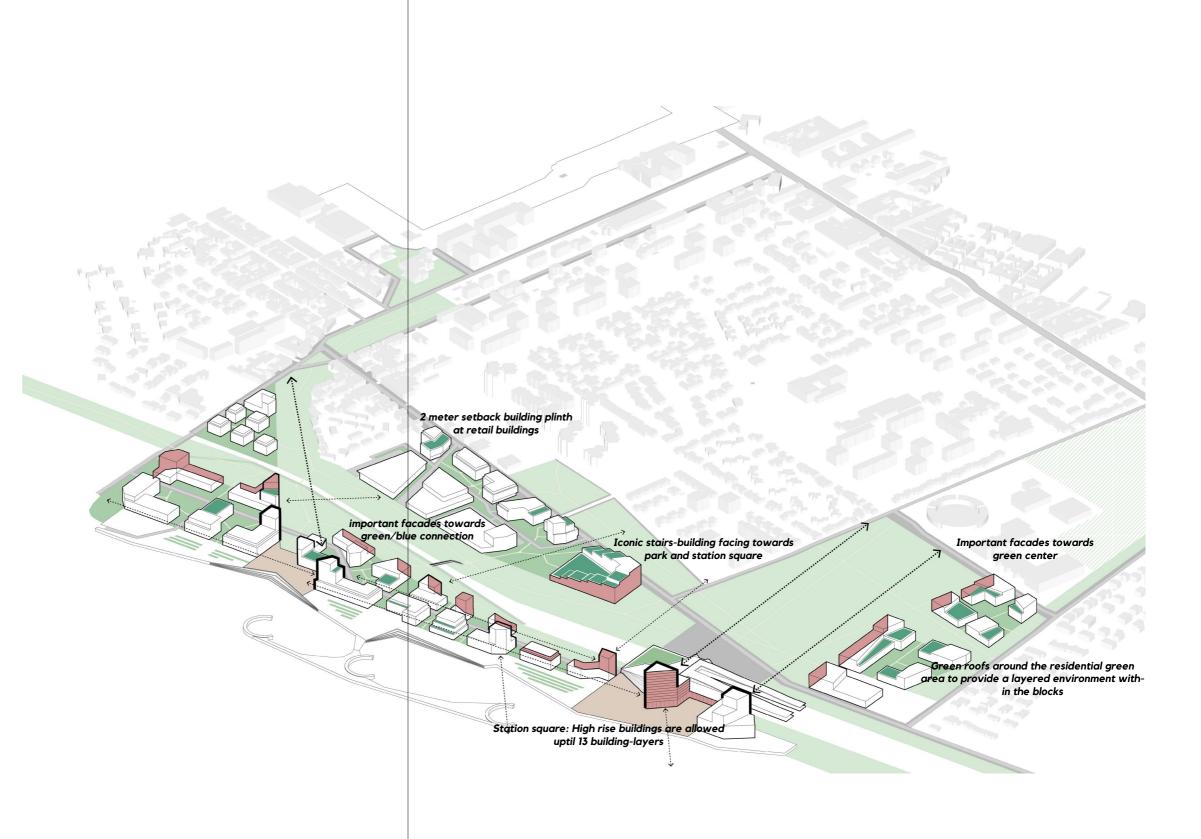
Building rules of the masterplan

Building rules are based on the spatial set up of the masterplan.

View axes will be finished with high rise buildings. Also to places on the boulevard are allocated as a high-rise location up to 13 building layers.

the front towards the new green space will be filled up with important facades. These facades requires more attention of the architect.

The building base along the boulevard will be at least 4 layers to provide a face to the wide boulevard end nature area.





Section Park and building blocks During dry period









Section Park and building blocks During wet period

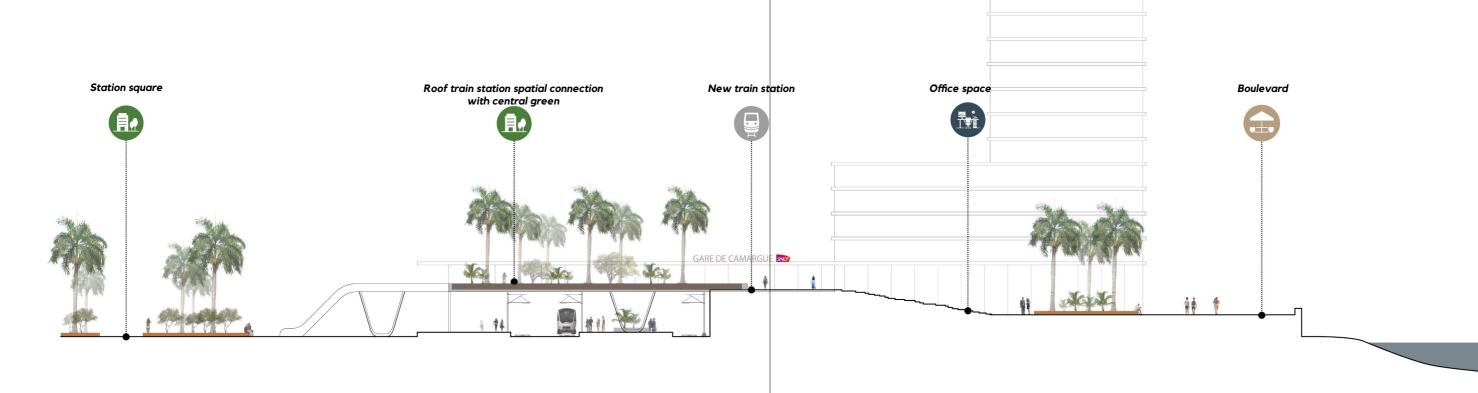








Section train station and public space









Cross principle to connect worlds at both sides of the station

Connection with the platforms

Natural and green charactar. Wooden construction at the roof of the train station

Rice production Camargue

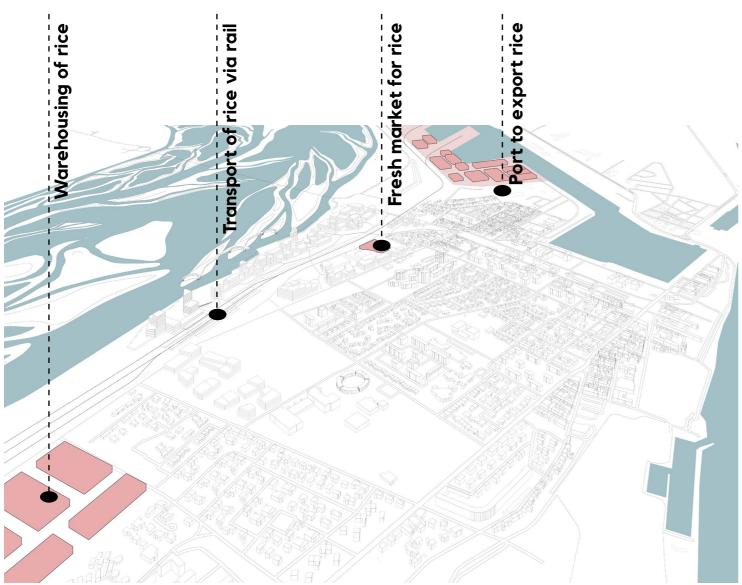
Economic driver of rice production

Port Saint Louis provides an efficient system for the export of rice. It starts with fresh warehousing in the north. From there it can be transported to the port. From there it can be transported to other mediterrenean regions.

The warehousing includes a railterminal to distribute the red rice over France and the rest of europe.

In Port Saint Louis is a fresh market were local business shops sell red rice to local inhabitants and restaurants in the region.

This infrastructure and facilities create a financial certinty for new sustainble rice production in the Camargue.





Impression of the rice production in the Camargue



Wet rice fields



Wet rice fields



Harvesting the rice



Small scale agriculture near the river flow, large scale rice agriculture away from the river

Agricultural production Camargue

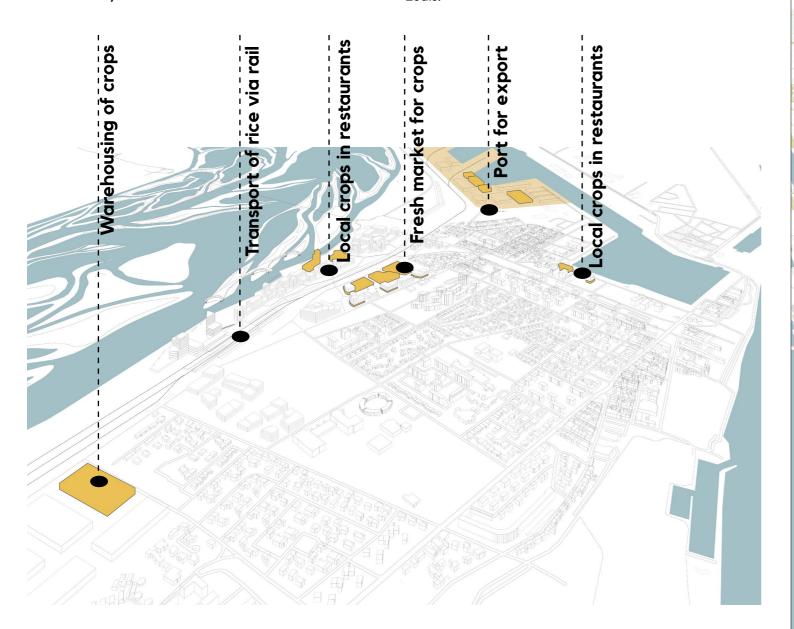
Economic driver of agriculture

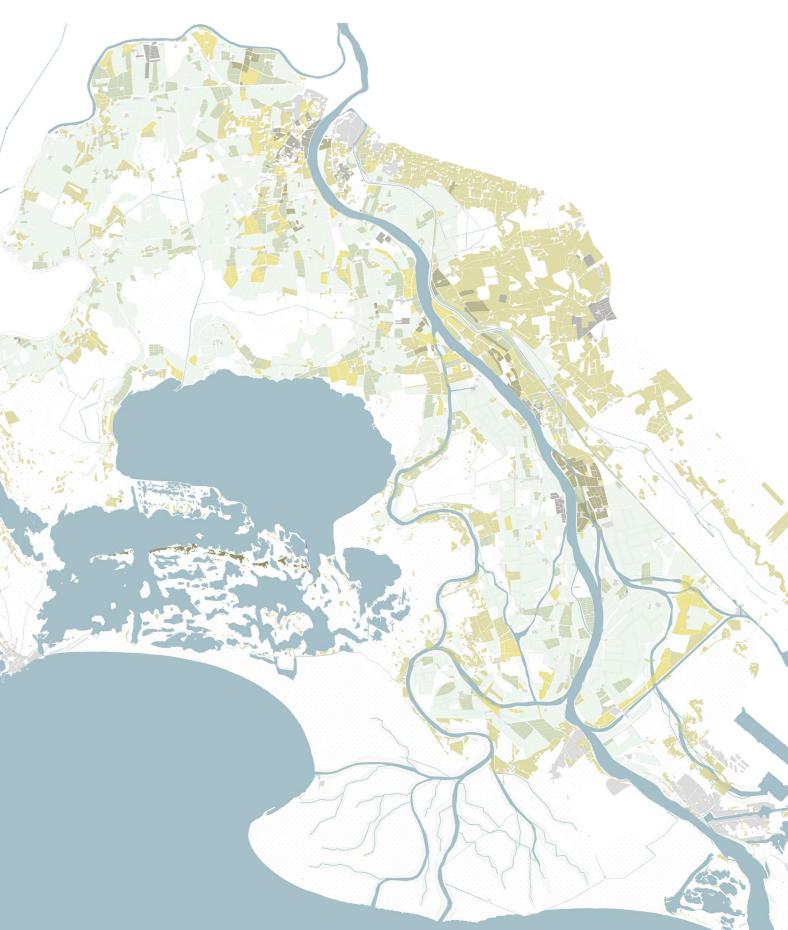
In the Camargue are a lot of different farmers with a wide scope of agricultural products. Within the new delta economy this wide scope of products offers a local food economy for supermarkets, fresh markets and restaurants.

Thanks to the improved rail infrastructure products can easily distrubute over the south of France from

Port Sant Louis. In this town are also large scale freshmarkets to sell the products to restaurants en local in habitants.

Yearly, millions of tourists are visiting the Camargue, the will enjoy local fresh products in restaurants and bars during their stay in Port Saint Louis.





Impression of agriculture in the Camargue



Cattle management



Wine production near deltaic nature



Wine production north in the Camargue



Salt production near Saline-de-Giraud.

Agricultural production Camargue

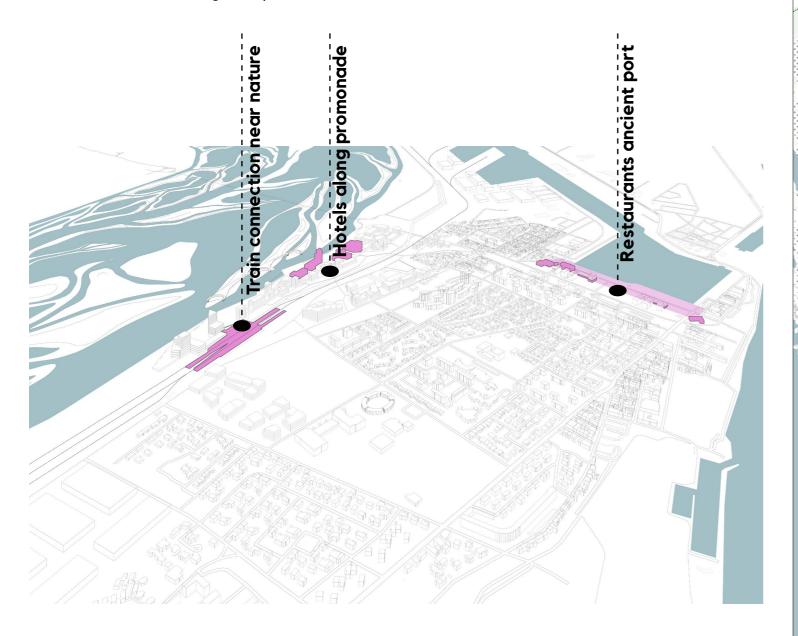
Economic driver of nature development

The unique nature of the Camargue attracts yearly million tourist. Due to a lack of sleep facilities, nearly of all visiting tourists spending the night outside the camargue.

Port Saint Louis provides facilities to spend the night in the Camargue. The train station makes the town and the Camargue easy accessible. The

hotels at the promanade are located in next to new delta nature and next to the ancient port. From Port Saint Louis are several nature reservers easy to reach.

This strategy makes sure that the tourist economy will be more local and enforce also other local economic sectors.







Saline lagoons along the coast



Wild white camargue horses



Flamingo's living along the coast of the Camargue



Brackish nature half way the camargue

The New Delta Economy

A new deltaic strategy for the Rhone Delta and Port Saint Louis du Rhone.

Luuk van Zwam

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