The Eider

The drama of a river

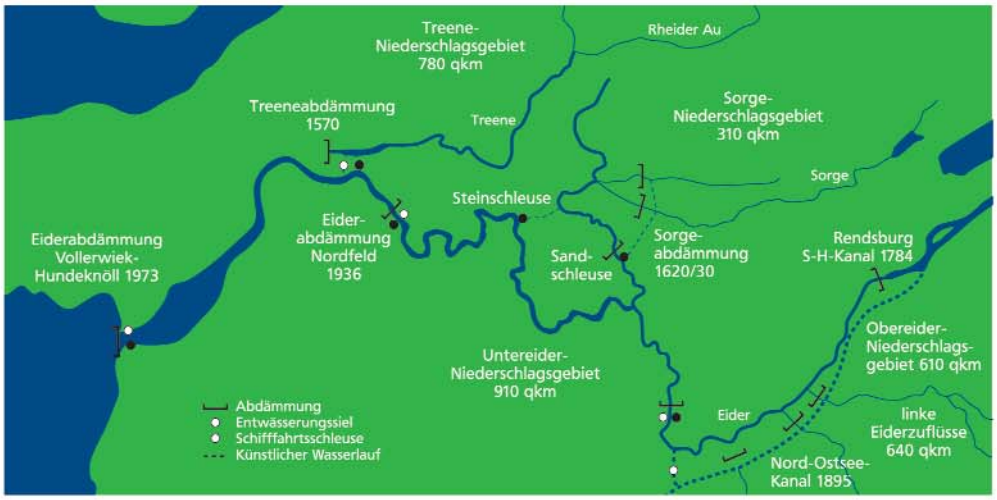
The last 600 years...

Join us on a journey through time!

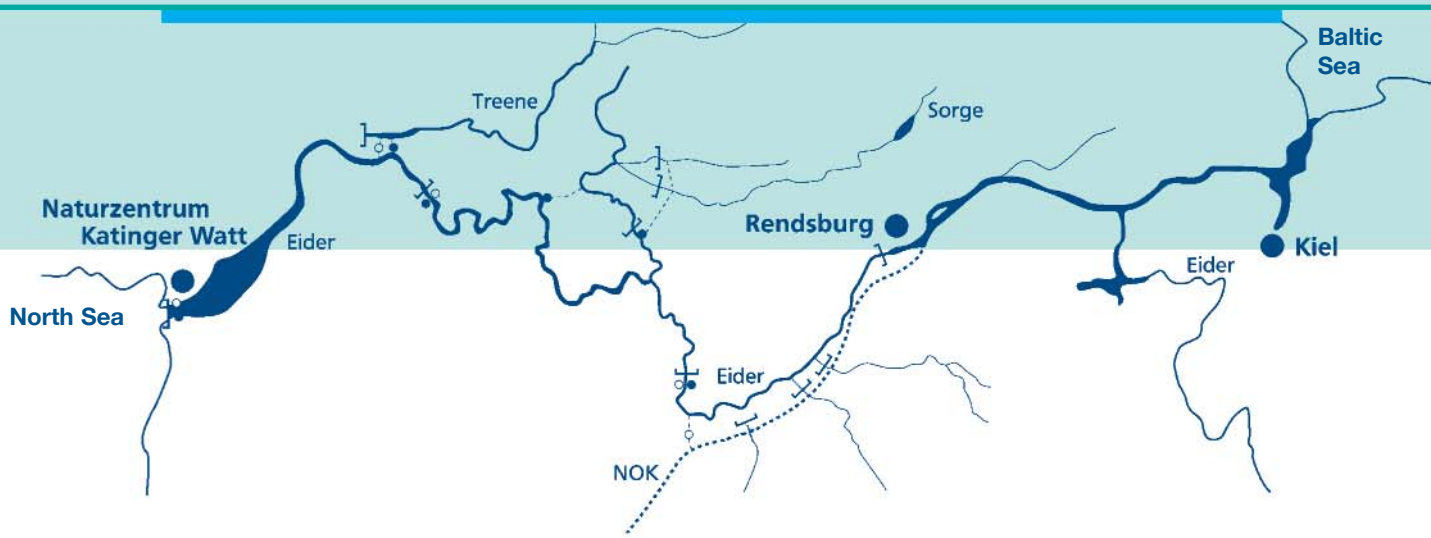
In September 1969 Nis R. Nissen told the story of a river in the magazine "Dithmarschen - Information on local history". At first glance it is a report about the changes in a landscape and about astonishing technical buildings.

At a second view though it is a report about the drama of a river - the change of a living river which is closely connected to its environment to a "flooding-river" Encoded is the illusion that man might learn for the future from the mistakes he made in the past when dealing with nature.

Have a look at this continuous report from September 1969 on the left side of the following pages and you might foresee the drama of a river in eight acts.



Intervention of man in the water balance of the Eider during the last 600 years.



A river between the seas

Long before man started interfering; nature was changing the riverscape all the time. A few centuries ago though, man started to affect these natural occurrences more and more. The people did so because they no longer wanted to use the country the way nature offered it to them, but wanted to protect the cultivated land against the powers of nature. At first these changes seemed to be a big gain, but as time passed unexpected negative consequences occurred. Finally the Eidersperrwerk became necessary because of the intervention in the water balance of the rivers Eider and Treene which started about 600 years ago…

In earlier times man changed the countryside in what ever way he wished by hand and today with modern machines.

14th and 15th century

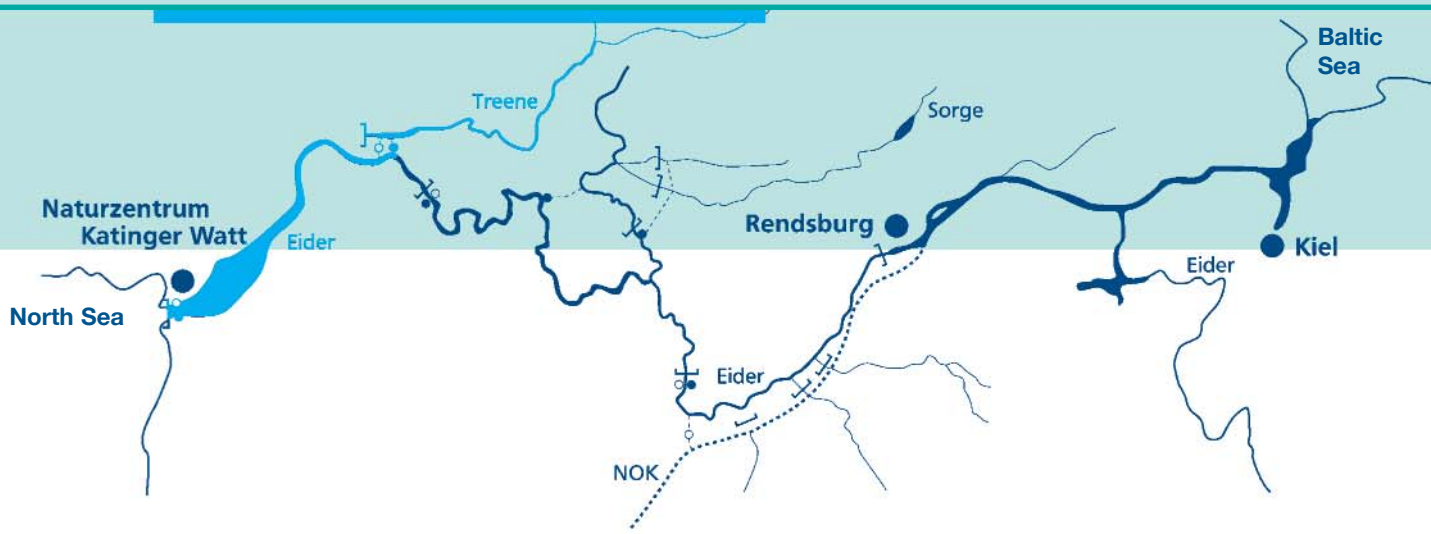
Building dykes along the Eider and the Treene

After the ice ages the landscape of Schleswig-Holstein was moulded by melting ice, the movement of the land's surface, the change in climate, the ascendance of the sea-level and the famous storm-floods. Melted ice from the glaciers made up an intricate branched water system of rivers and creeks. The Eider evolved in this manner. It used to be 185 km long but because of hydraulic engineering its length has shrunk to only about 108 km today. Despite of this, the Eider still remains the longest and most important river in Schleswig-Holstein. Its spring is in the hills in the East of the state near the ***Bothkamper Lake****. At first the water flows towards the* ***Baltic Sea****. Only a few kilometres before the Eider reaches the Kieler Förde, a moraine (a range of hills left behind by the latest ice age) sluices its way to the Baltic Sea, so the Eider has to change directions and now flows towards the* ***North Sea*** *in gentle curves. Because of the rising sea level after the ice age the tides manages to reach the estuary of the river. At first the tide is hardly noticeable in the interior country because the water has enough reservoir-space and can spread into all the side rivers. In case of a big storm-flood though, these side rivers can't take all the incoming water and the surrounding landscape is flooded. Backwater caused big swamps and bogs to form - two kinds of lands that man can't settle on nor can cultivate if they stay in their natural state. The first drastic measurements were made as dykes were built along the rivers. Since the late Middle Age, the 14th and the 15th century, dykes have narrowed down the riverbed of* ***Eider*** *and* ***Treene*** *more and more.*

If a name is printed boldly in this way you can find it on the big map located on the wall behind the aquariums.

Immense glaciers moulded the landscape

Tidal - Eider and Treene River



[MEASURES]

Dykes are built along the rivers **Eider** and **Treene**.

[GOALS]

The dykes are meant to protect the land behind the dykes (back-up area) from the water that gets pushed up the Eider during storm-floods. Furthermore settling and cultivation in these areas is now possible.

Storms churn up the ocean and make the border between sea and land disappear. With dykes man erects new borders.

[EFFECTS]

The dykes protect the back-up area near the estuary. But they also act as a funnel: The incoming water doesn't have enough space to spread and so the flood-wave develops even more power. The water rises higher and reaches deeper into the country. It hits the areas further up the Eider with a bigger force than before. The momentarily gain for the estuary area brings unexpected problems to the interior country.

1569 until 1570

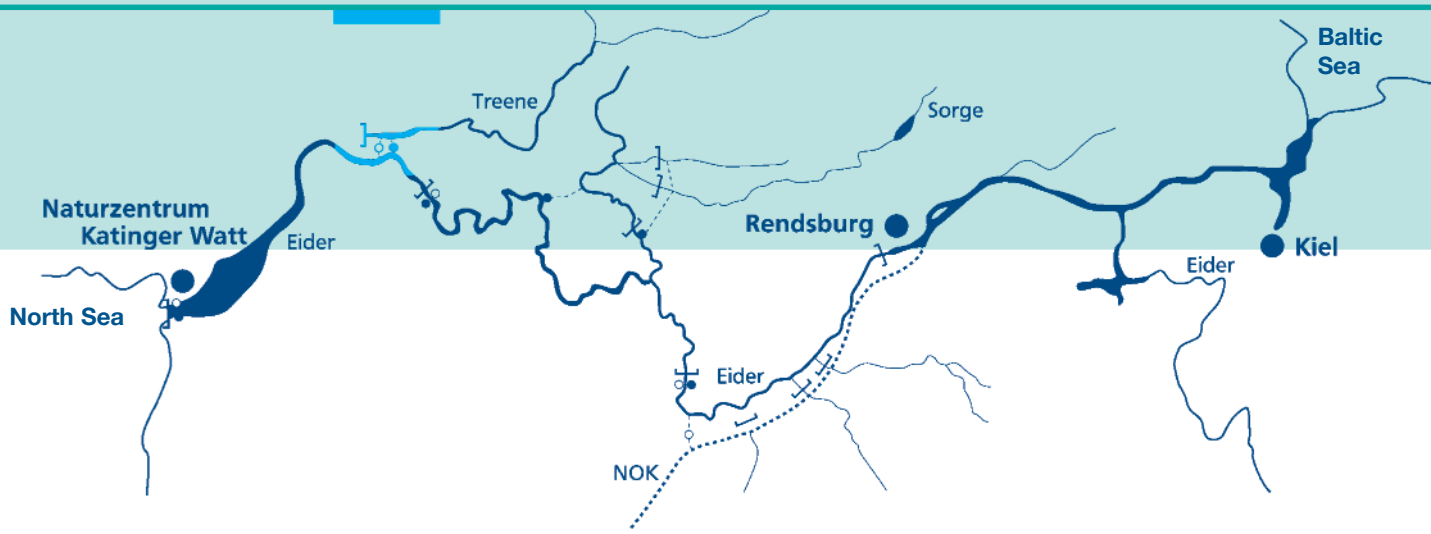
Damming of the Treene near Friedrichstadt

In the narrowed riverbed the flood-wave didn't have enough reservoir-space and grew even higher.

During 1569 and 1570 the confluence of the Treene into the Eider was dammed up. The whole catchment area of the Treene was now suddenly no longer affected by storm-floods. The flood-wave was kept in the riverbed of the Eider. Because of the dykes though, it didn't have enough space to spread and the water grew higher and higher and more and more powerful.

Large parts of Schleswig-Holstein belong to the catchment area of the Eider.

Tidal - Eider and Treene River



[MEASURES]

Near today's **Friedrichstadt** the confluence of the **Treene** into the Eider is dammed with a sluice. In 1588 the sluice is enlarged to a sluice so ships can pass.

[GOALS]

In case of a storm-flood the water is supposed to be prevented from flowing into the catchment area of the Treene. This will provide a better protection against flooding in this area.

[EFFECTS]

The loss of reservoir-space because of the new Treene Sluice leads to an even higher flood-wave along the dyked in estuary. The pressure that the water develops grows.
As a result of the new sluice, floods resulting from a storm are not possible anymore. But now the sweet water from the flats of the Treene doesn't have any possibility to flow into the Eider and to the sea anymore. Therefore it's the sweet water that now causes severe flooding in the catchement area of the Treene. Nowadays 18 expensive pump-systems have to drain the Eider-Trenne-Sorge flat constantly.

The rainwater is collected in the rivers which bring it to the ocean. A complete area which is drained by one river is called catchment area. The size of this area determines how much water is brought into the river. Finally this area, and all the water coming from it, make a river to what it is - a stretch of running water. The speed and the volume determine certain living conditions in a river that are suitable for various kinds of plants and animals. Every change has consequences for this habitat. The Eider lost about 780 square-km of natural catchment area because of the Treene Sluice. Because of the reduction of water inflow, the riverbed of the Eider shrinks.

1620 until 1630

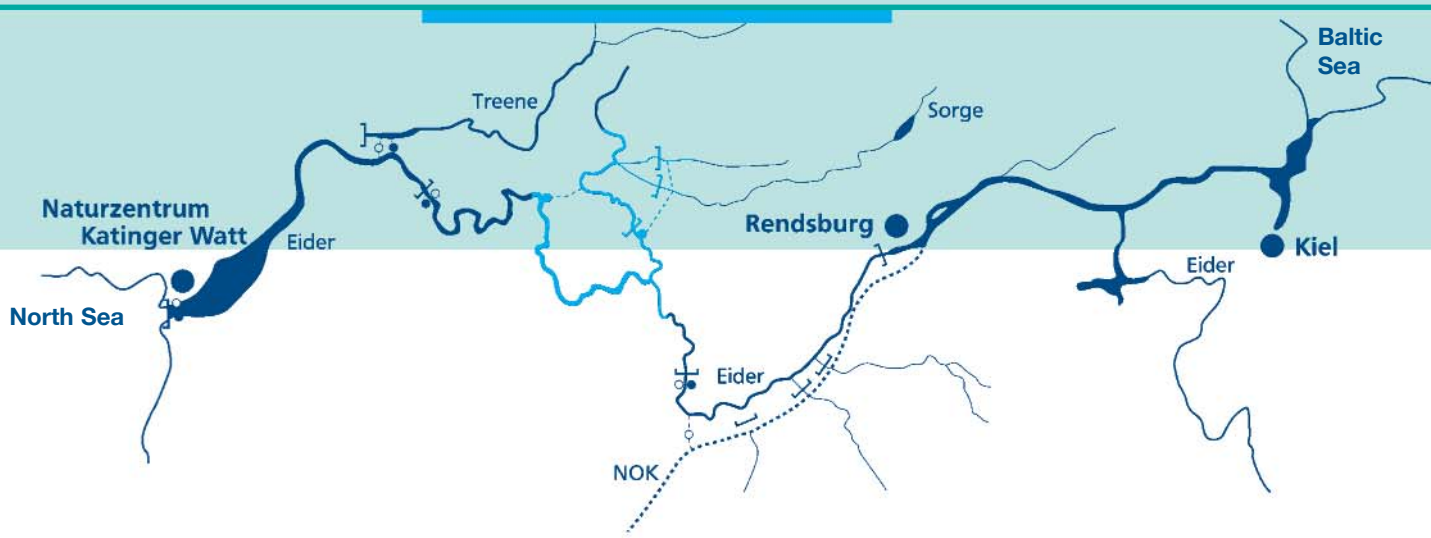
Damming of the Old Sorge and building of the Stein Sluice and the Sand Sluice

From swamp to farmland. Man manages to form the land as he wishes.

As a result of the sluice near Friedrichsstadt, the Eider became a threat to its dykes because the water rose even higher. The tides reached far upstream of the Eider, and so new dykes had to be built after the confluence of the Sorge. The danger of a flood coming from the North Sea was now more or less banished but new problems occurred. The sweet water from the river flats was not able to flow into the Eider. During heavy rainfall the interior country was flooded by this immense reservoir of sweet water.

Water is the characteristic element in the flats of the rivers Eider, Treene and Sorge.

Former Tidal Eider, now Interior Eider



[MEASURES]

By building dykes, dams and new channels and by draining lakes, the water balance is supposed to be made controllable.

The Erfter Dam closes the confluence of the **Alte Sorge** into the Eider. The water from the Old Sorge flows into a channel called **Großer Schlot**. This channel opens into the Eider further downstream.

The confluences of the **Sorge** and the **Bennebek** into the Meger Lake are dammed and the lake is drained. Again the water from the two rivers flows into a new channel which opens into the Eider further downstream. The water level is controlled by the **Stein Schleuse** and the **Sand Schleuse**.

Even though the ground is swampy new dykes are built.

[GOALS]

The flats of the Sorge are supposed to be made cultivatable by a better draining system. A better protection against floods is supposed to be achieved.

[EFFECTS]

The continuing loss of reservoir-space lets the water level of the Eider rise even higher. The tides reach all the way to **Rendsburg** where levels increase by up to 75 cm.

As a result of this the **Tidal Eider** again has to be protected against storm floods and backwater. Because the Erfter Dam is too low and the dykes begin to fall apart on the swampy ground, the protection against storm floods in the Eider-Treene-Sorge-flats is hardly worth mentioning.

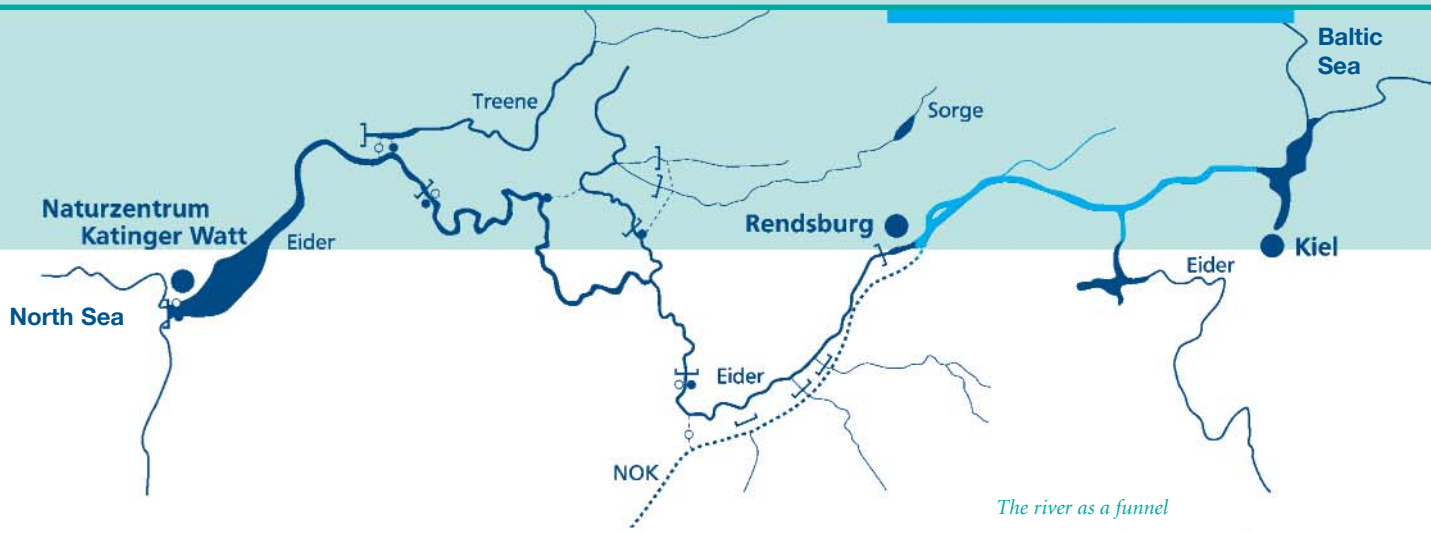
Again the Eider looses about 310 square-km of natural catchment area.

1777 until 1784

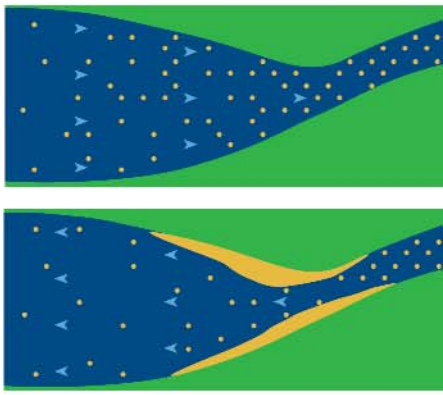
*About 200 years later the building of the **Old Eider Channel** from 1777 until 1784 marks the next big intervention in the water balance of the Eider. The river is made deeper in the upper reaches and the new channel was built connecting the Eider with the Kieler Förde. One of the most obvious consequences was that the tides were noticeable in **Rendsburg** more than ever before.*

*Due to the narrowing of the Eider riverbed and the continuous rising of the water level of the North Sea (the so called secular = timeless rising) the tides have affected Rendsburg since the 17th century. Because the Eider was dug deeper for the channel and because most of the gentle curves were straightened, the differences of the tides suddenly increased very much. Furthermore the natural water movement of the Eider changed and the sand from the riverbed was no longer washed downstream sufficiently. This meant that in case of a storm flood, the storm-wave would wash all the sand upstream and the Eider no longer would be suitable for ships. Additional to all this it became more and more difficult to drain the flats of the **Eider** and the **Treene**. The secular rising of the North-Sea water level caused a higher water level in the Eider, too.*

The prognosis for the rising of the water level of the Eider in the 18th and 19th century was about 25 cm per century. Looking at this long period of time it's clear that this was quite a noticeable effect which often resulted into massive floods in the whole area of the Eider.



The river as a funnel
During high tide the narrowed riverbed increases the speed of the incoming water. Proportional to the water speed, sand and other sediments are washed up the river. The faster the water, the more sand is transported a further distance.



During low tide the water speed decreases because the riverbed suddenly becomes wider again as it opens to the ocean. All the sediments and the sand fall to the ground of the river and stay there. The sediments that were brought in during high tide aren't washed back into the ocean - the Eider becomes shallower and shallower. This progress is supported by the loss of water from the catchment area due to the dams.

[MEASURE]

A channel with a depth of 3,5 m is built from **Rendsburg** to Kiel-Holtenau. This channel flows in the riverbed of the Eider until to the **Flemhuder Lake**. Gentle curves in the riverbed are straightened. At the Flemhuder Lake the channel leaves the riverbed of the Eider and flows into a brand new channel that leads through the moraine hills directly to the Baltic Sea.

[GOALS]

The channel is supposed to enable ships to travel from the Baltic to the North Sea without having to go around Denmark.

[EFFECTS]

Due to the **Old Eider Channel** the water of the upper reaches of the Eider changes its direction and flows into the Baltic Sea now. The main river is no longer closely connected to its spring - another 610 square-km catchment area is lost. The Eider grows smaller because the upper reaches and their tributaries no longer provide the river with water. Consequences are that the power of the water to wash sand downstream decreases which makes the Eider continuously shallower. The difference in tide in Rendsburg increases to be 100 cm.

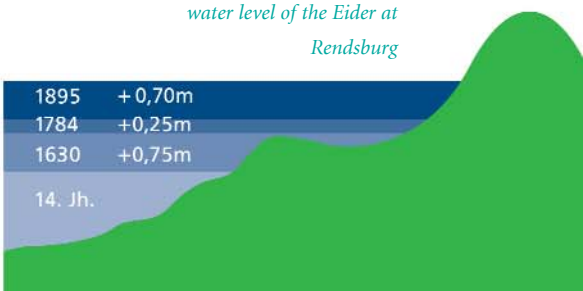
1888 until 1895

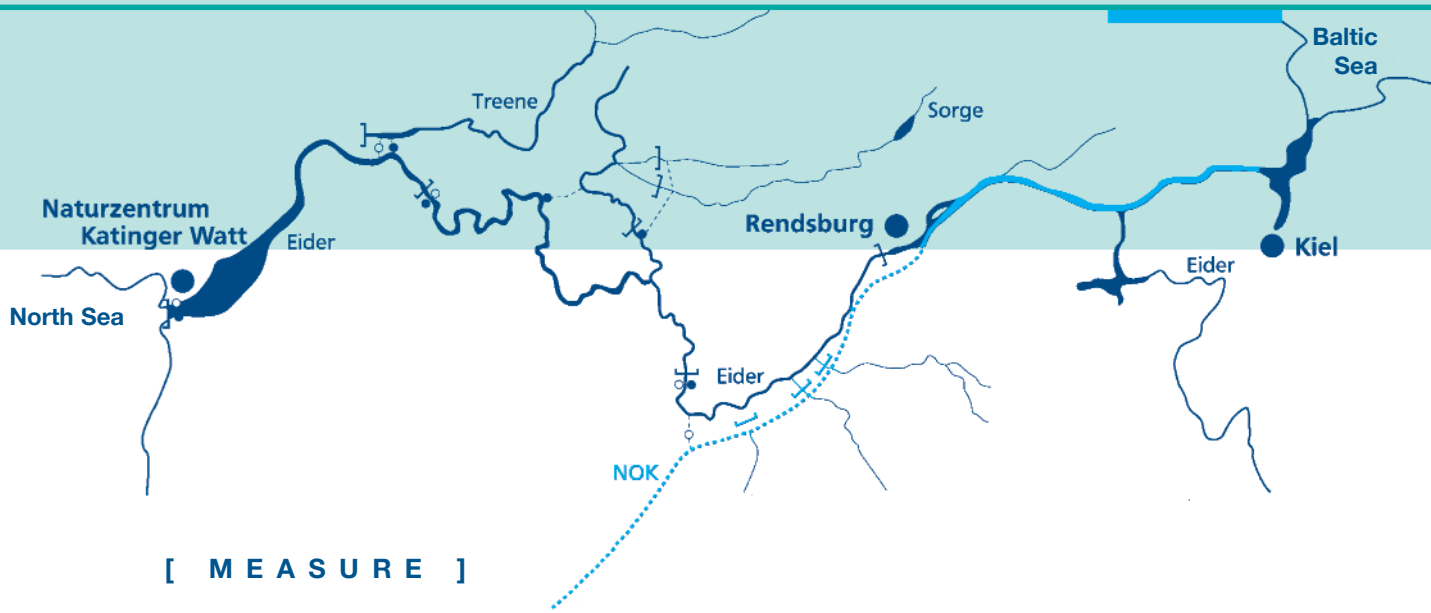
Source: Walter Schulz; Der Nord-Ostsee-Kanal. Mit freundlicher Genehmigung des Verlages Boyens und Co.

For the fourth time man intervenes in the water balance of the Eider. From 1888 to 1895 the ***Nord-Ostsee-Channel*** *was built. This channel connects the Baltic Sea with the North Sea and enables bigger ships to cross through Schleswig-Holstein. The* ***Eider*** *was cut off from the new channel by a sluice in* ***Rendsburg****. The result was that the water coming from the catchment area further upstream from Rendsburg, including the region between* ***Kiel*** *and Neumünster, now flowed through the Nord-Ostsee-Channel to the North Sea and no longer used the riverbed of the Eider. In addition to that all the confluences south of the new channel were also cut off from the Eider. This of course meant that not enough water flowed through the original riverbed of the Eider and the former most important river completely turned into a tidal river which experienced low and high tide twice a day. In the area of the estuary new summer-dykes were built which made the riverbed even narrower than it was before. The funnel-effect became bigger and because of that the silting up of the riverbed increased continuously. The tides became higher and higher, the average water level grew decade by decade. It became more and more difficult to drain the flats of Eider and Treene, therefore the layer of sediments grew and grew, and floods became more frequent and caused severe damage.*

In only seven years 43.612 men created an almost 100 km long, 11 m deep and 110 m wide channel between the North Sea and the Baltic Sea - the Nord-Ostsee-Channel. Spades, wheelbarrows and suction dredgers were the most important tools. On the 20th of June 1895 the first ship left Brunsbüttel and arrived in Holtenau at 12.35 pm - after a trip of almost eight hours.

Man's intervention changed the water level of the Eider at Rendsburg





[MEASURE]

The Nord-Ostsee-Channel is built from Brunsbüttel, which is a city on the river Elbe, and Holtenau near Kiel. Between **Rendsburg** and the **Flemhuder Lake** the channel and the Eider share the same riverbed, after the Flemhuder Lake the new channel partially flows in the bed of the **Old Eider-Channel**.

The original riverbed is shortened, dug out, widened and straightened. On each end of the channel a sluice is built so the channel is not dependant on the tides. A sluice in Rendsburg is the last connection to the Eider.

[GOALS]

A connection between the two German seas is supposed to be achieved so bigger ships can pass through, especially the fleet of emperor Wilhelm.

[EFFECTS]

Due to the new channel the Eider is separated into two parts: The upper reaches and all the southern confluences flow into the channel. The original Eider once again looses 1250 square kilometres (!) of catchment area. The rest of the Eider from Rendsburg to the estuary becomes a tidal river. The drastic loss of water changes the depth and the water speed of the river during low tide. Silting up increases and the complete river gets even narrower. In Rendsburg for example the river is now only about 2/3 of its original width. The water level rises which leads to growing problem of draining the interior flats. Continuous digging in the Eider is necessary to prevent the water from ruining these cultivated areas.

Because of the higher water level new dykes are necessary. But these new dykes again increase the power of the water and the water level itself. Many dykes start getting soft, crumble and break. Because of the swampy ground it is not possible to build them any higher. Especially during the first half of the 20th century big storm floods wash away important dykes. In Rendsburg the highest water level ever was recorded: 2, 57 m above sea level.

Resulting from the location between two seas, the Nord-Ostsee-Channel carries brakkish water which is a mixture of sweet water from the river and salt water from the ocean. With a few exceptions most organisms can only survive in sweet or salt water. As a result all organisms from the upper reaches of the Eider die as soon as they reach the Nord-Ostsee-Channel. The typical habitat of the upper reaches of a river is drastically shortened by the channel.

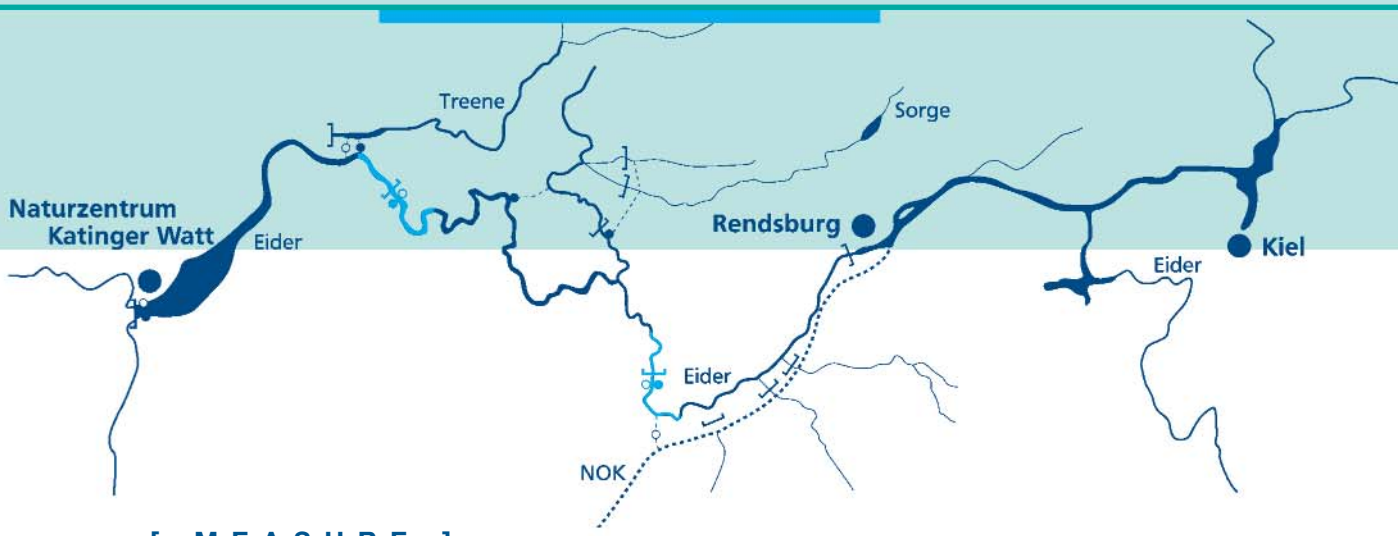
1934 *until* 1936

Building a sluice in Nordfeld and a dam in Lexfähre

Source: Walter Raabe; Eiderstedt. Mit freundlicher Genehmigung des Verlages Boyens und Co.

At the end of the 19th century sturgeon fishing was a well developed branch along the Eider. Only a few years after building the dam at Nordfeld the last sturgeon was caught.

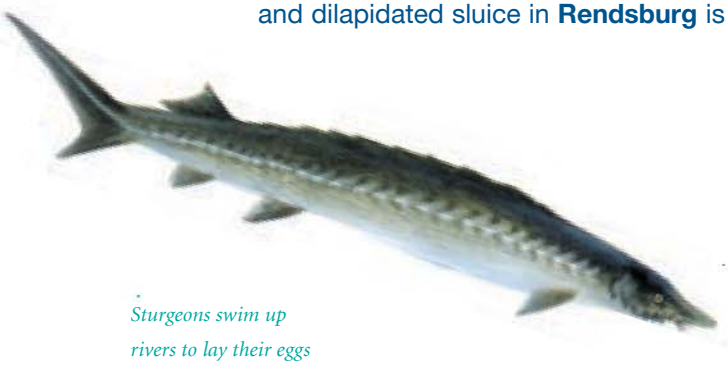
*After long investigations a decision was made from which improvement was expected: In the year 1936 a dam with a sluice was built straight across the Eider in **Nordfeld** near Friedrichsstadt. A second little dam at **Lexfähre** was supposed to keep the water level constantly high between Nordfeld and **Rendsburg**. And a new shipping channel, the **Giselau-Channel**, which was controlled by a sluice, connected the Eider to the **Nord-Ostsee-Channel** (confluence near Offenbüttel). The dam in Nordfeld prevented flood-waves from reaching the Eider higher up and so only the part from Nordfeld to the estuary remained influenced by the tides. The main goals of these measurements were the same as all the damming before. The protection from storm floods of the area from Nordfeld to Rendsburg was completely fulfilled. But the hopes of being able to drain the flats of Eider and Treene more effectively, were not fulfilled. On the contrary the problem of standing water on the cultivated land increased.*



[MEASURE]

The Eider is dammed at **Nordfeld** and at **Lexfähre**. Sluices are built in the dams.

The **Gieselau-Channel** (3 km) is built which connects the Eider and the **Nord-Ostsee-Channel**. This channel is also regulated by sluices. The old and dilapidated sluice in **Rendsburg** is filled with soil (1784).



Sturgeons swim up rivers to lay their eggs

[GOALS]

The flats between Nordfeld and Rendsburg are supposed to be completely protected from storm floods.

In addition all flats along the Eider are supposed to be better drainable.

Shipping is supposed to be improved by the Gieselau-Channel.

[EFFECTS]

This part of the Tidal Eider is now dammed at two ends; the middle part is no longer affected by the tides. The dams are also insuperable barriers for many migrating animals. The Sturgeon is a good example. This fish can reach a length of 6 m and can grow to be a hundred years old. Due to the new dams it can no longer reach its spawning grounds and is extinct in the Eider. With its disappearance also the sturgeon fishing vanishes from the Eider.

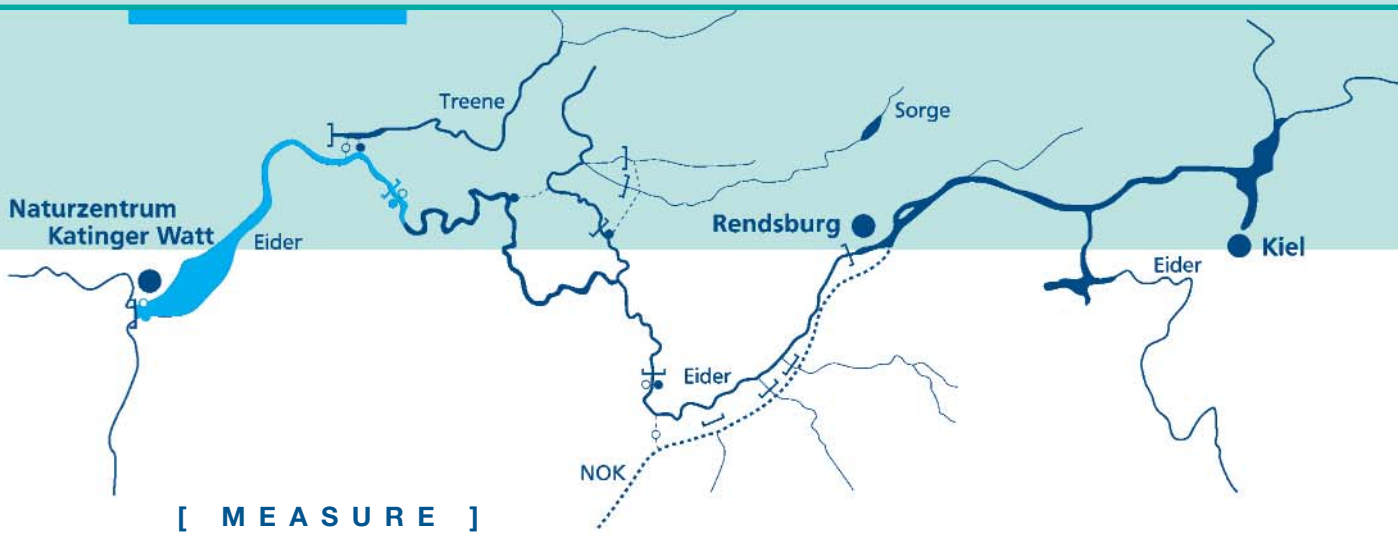
In Rendsburg the Eider leaves the Nord-Ostsee-Kanal as a little creek. Without the influence of the tides the river hardly has any water at all in its wide riverbed. Almost 12 million cubic metres of water are lost because of the missing influence of the tides. The groundwater level decreased dangerously and threatened not only the agriculture in the interior land but also the possibility of shipping goods on the river. To prevent this, the additional dam at Lexfähre was built. It divides the stretch between Nordfeld and Rendsburg and therefore can regulate the water level of the Eider at a constant level.

1950 until 1967

Sediment-washing program at the sluice in Nordfeld

The new dam at Nordfeld shortened the way of the tides drastically. At the beginning the differences between the tides grew, but after a while the tides changed: Unexpectedly high tide carried more sediment into the Eider. During low tide the water flowing towards the North Sea was never able to wash out all the sediments back into the ocean. The well-known funnel-effect increased even more and soon the Eider was silted up to 80 or even 90 %. A sand barrier developed which made it almost impossible for the water coming out of the ***Treene*** *and the* ***Eider*** *to flow all the way to the ocean. In the year 1947 a big flood occurred and a big area along the Interior Eider was under water. During this year it became clear, that something had to be done. The difficult economic situation in general, and then difficulties of the people living there, delayed any serious attempt to cope with the problem.*

The first attempt to do something was in 1950. A sediment-washing program started in ***Nordfeld****. During high tide when the water reached all the way to the dam, the sluice was opened and the water flowed further up the Eider than usual. Before the tides changed, the sluice was closed again and the water in the Interior Eider was kept back while the water on the tidal side started flowing back to the sea. After a while the sluice was opened, the water came rushing out in a powerful wave and washed lots of sand and sediment away. The program was successful, but not as much as had been hoped. The impact of the wave soon got lost in all the sand and the wave then didn't have enough power to clear the estuary from the sediments. Unfortunately the program couldn't be expanded because of the size of the sluice and because the amount of water stored behind the dam in Nordfeld was also limited. Installations concerning the security of the dam would not have been able to cope with too much water. Barriers which narrowed down the Eider and therefore were supposed to increase the power of the wave were not as effective as they were thought to be.*



[MEASURE]

Starting in 1950 the water from the Eider and the water flowing in during high tide is stored at the **Nordfeld** dam. During low tide it is released into the **Tidal Eider**.

In front of the dam at Nordfeld the silting of the river can be seen very clearly - it has only about one fourth the width it used to have.

[GOALS]

The powerful wave coming out of the open sluice of the dam at Nordfeld is supposed to wash sand and sediments downstream and out into the North Sea.

[EFFECTS]

Due to the dams in Nordfeld and Lexfähre the Eider once again looses catchment area. This time it is 910 square kilometres. The water flowing downstream looses more power and the silting up of the Eider continues. The tides change and high tide brings in more sediments than low tide can wash back into the North Sea. The width of the Eider diminishes rapidly. Up to 90% of the original riverbed is silted up near Friedrichsstadt. This of course makes the Eider no longer shippable. The riverbed grows higher and higher which results in growing problems of how to drain the flats along the river. Expensive pumps have to be installed. The sediment-washing program is not as successful as expected and so the silting continues. Because of the higher riverbed the dykes slowly but surely get too small to protect the interior land from storm floods.

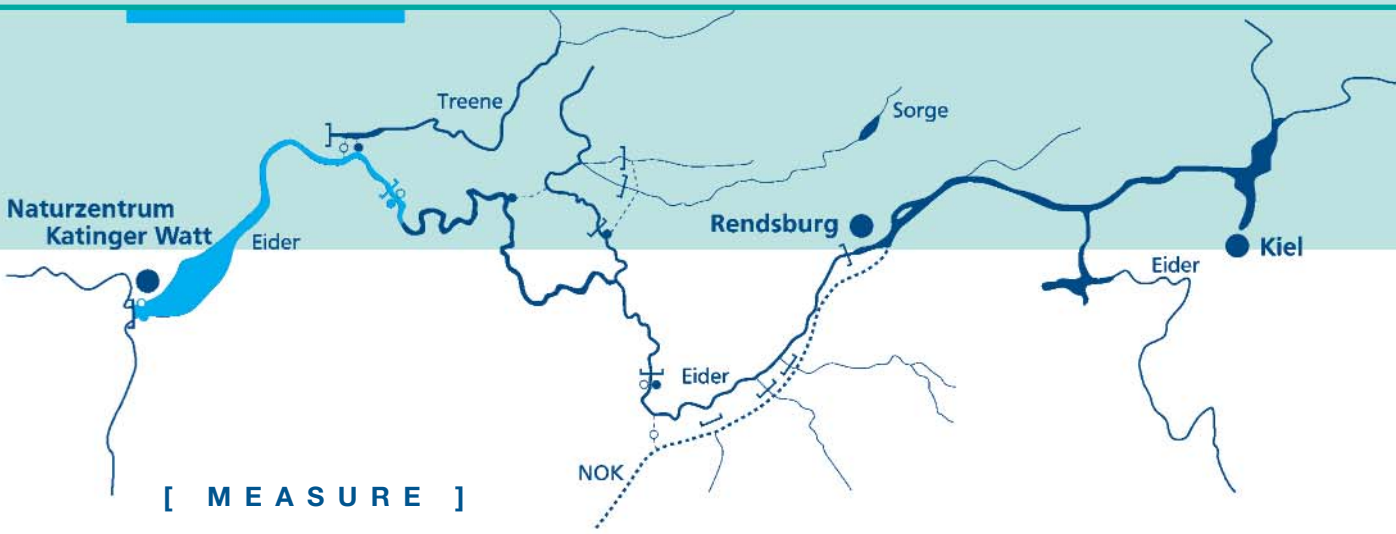
1967 *until* 1973

Building of the Eiderspeerwerk and damming the rest of the estuary

To guarantee the drainage of the flats along the Eider and its confluences expensive pumps had to be installed. They made it possible to drain the water in the meanwhile so much higher water level of the Eider. If even bigger problems and any further catastrophes were to be prevented, something fundamental had to change ...

... the Eidersperrwerk was built into the middle of the Eider-estuary.

Source: Friedrich Cordes, Eiderdamm - Natur und Technik, Hans Christians Verlag, Hamburg



[MEASURE]

A 5 km long dam was built through the complete estuary of the Eider between Vollerwiek and Hundeknöll. A sluice for ships and a gigantic SPERRWERK is built into the dam.

A second dam was built, which separates and drains half of the expanse of the estuary (1.200 ha).

The Katinger Watt then and now

[GOALS]

Most important: Protection from storm-floods.

The length of the dykes is shortened from two times 30 km to only 5 km. These dykes along the remaining 5 km are enlarged and built higher.

During high tide the water can be stopped from flowing upstream now, the flats can be drained more effectively because reservoir-space is provided in the Eider riverbed.

Shipping remains possible on the Eider.

Additional to all this a second road connection between Eiderstedt and Dithmarschen is created.

[EFFECTS]

During storm floods the Eidersperrwerk closes its gates and therefore protects the interior from the flood.

Because the water level of the Eider is now better controllable silting can be coped with effectively.

The mixture of sweet and salt water changes, the Eider becomes "sweeter" and marine organisms retreat. The salt marsh of the estuary is no longer seriously affected by the tides and the river mud flats are drained. This big interference destroys the rare habitat of a tidal influenced estuary. On the former riverbed 1.200 ha of forest, fields, marsh land and sweet water is created.

Human intervention changed the natural conditions. In many cases an immediatly advantage for the moment was followed by a unexpected, disadvantaged aspect.

At least the damming of the Eider has been neccessary because of the human intervention in the water supply of the rivers Eider and Treene, initalized 600 years ago.

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