CLIENT: STATOIL STAVANGER

ENVIRONMENTAL IMPACT ASSESSMENT EUROPIPE II IN GERMANY: OFFSHORE AND ONSHORE SECTION

CONSULTANT:
BIOCONSULT SCHUCHARDT & SCHOLLE

JULY 1998 (FINAL, REV. 2)

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1 INTRODUCTION

The Norwegian State Oil Company (STATOIL), originator of the Europipe I project, is currently planning the construction of a second pipeline, Europipe II. The planned structure shall be used for the transportation of natural gas from Kårstø near Stavanger (Norway) to Dornum (Germany). It shall be oriented in a dominantly north-south direction and total 653 km in length, of which approx. 200 km within the German Sector lay.

The time frame for completion of the pipe-laying operations is 1998. By 1.10.1999 Europipe II is expected to be ready for operation.

This environmental impact assessment (EIA) has been appointed by STATOIL on a voluntarly basis, as it is not yet mandated by the German authorities. The report concered with the possible offshore effects of the planned structure as well as the likely impacts on land and is based on existing data.

2 METHODS AND DATA BASIS

2.1 METHODS

The EIA is an instrument of a precautionary environmental policy and assists decision-making within environment-affecting projects.

The aim of this EIA is to describe and to assess the possible impacts of the planned Europipe II project in Germany.

In a first step, the pipeline project is described, in a second step the status-quo of the environment is determined. Both parts are brought together and possible environmental impacts of the planned project are identified and assessed. This assessment is reached by descriptive, qualitative means. Suggestions for possible mitigation measurements are listed.

The report does not include risk assessements concerning leakage or rupture of the pipeline and the possible consequences.

2.2. DATA BASIS

This EIA is mainly based on existing data. A broad range of documentations of the various state authorities and recent publications were available and implemented. Botanic surveys of the status-quo on the land areas were carried out by BIOCONSULT in 1997 as a data basis for the „Landschaftspflegerische Begleitplan“. A numerical simulation which documented the possible impacts during the ready-for-operation (RFO) phase of the Europipe II project has been carried out (ALKYON 1997). In those parts where necessary data is still lacking, it is mentioned in the present report.

3 PROJECT DESCRIPTION

In 1995, after extensive research and political debate, Europipe I was completed by STATOIL. Presently, the company plans to construct a second pipeline, Europipe II (EP II).

The EP II pipeline system will transport dry gas from Kårstø in Norway to Dornum in Germany over a total distance of some 660 km.

The dimension of the EP II will be 42" with an inner diameter of 1.01 m offshore and 40" with an inner diameter of 0,98 m onshore. The pipe is designed for a maximum transport capacity of 65.9 MSM³/d, based on a maximum export pressure of 189 barg and a 89 barg receiving pressure.

3.1. ROUTING

The routing of the Europipe II is designed to start from Kårstø by Stavanger (Norway) to Dornum (Germany) in a north-south orientation (fig. 3.1). It will consist of about 13 km onshore pipeline in Norway from Karstö to Vestre Bokn, and a Landfall Valve Station at Vestre Bokn. This will be followed by 627 km of pipeline offshore through Norwegian, Danish and German sectors of the North Sea. The Landfall area will be between the East Friesian Islands of Baltrum and Langeoog at Dornumersiel. The landfall in Germany will consist of 15 km of landfall section (pre-installed with Europipe I), a maintenance valve, 5 km of onshore pipeline and a Pig Receiving Facility at the Europipe Recieving Facility (ERF) terminal in Dornum. Onshore it is forseen that the new pipeline shall follow the route of the first pipeline to the ERF. The onshore area lays in the Landkreis Aurich, in the German State of Lower Saxony of the Federal Republic of Germany. An extension of the existing ERF is necessary.

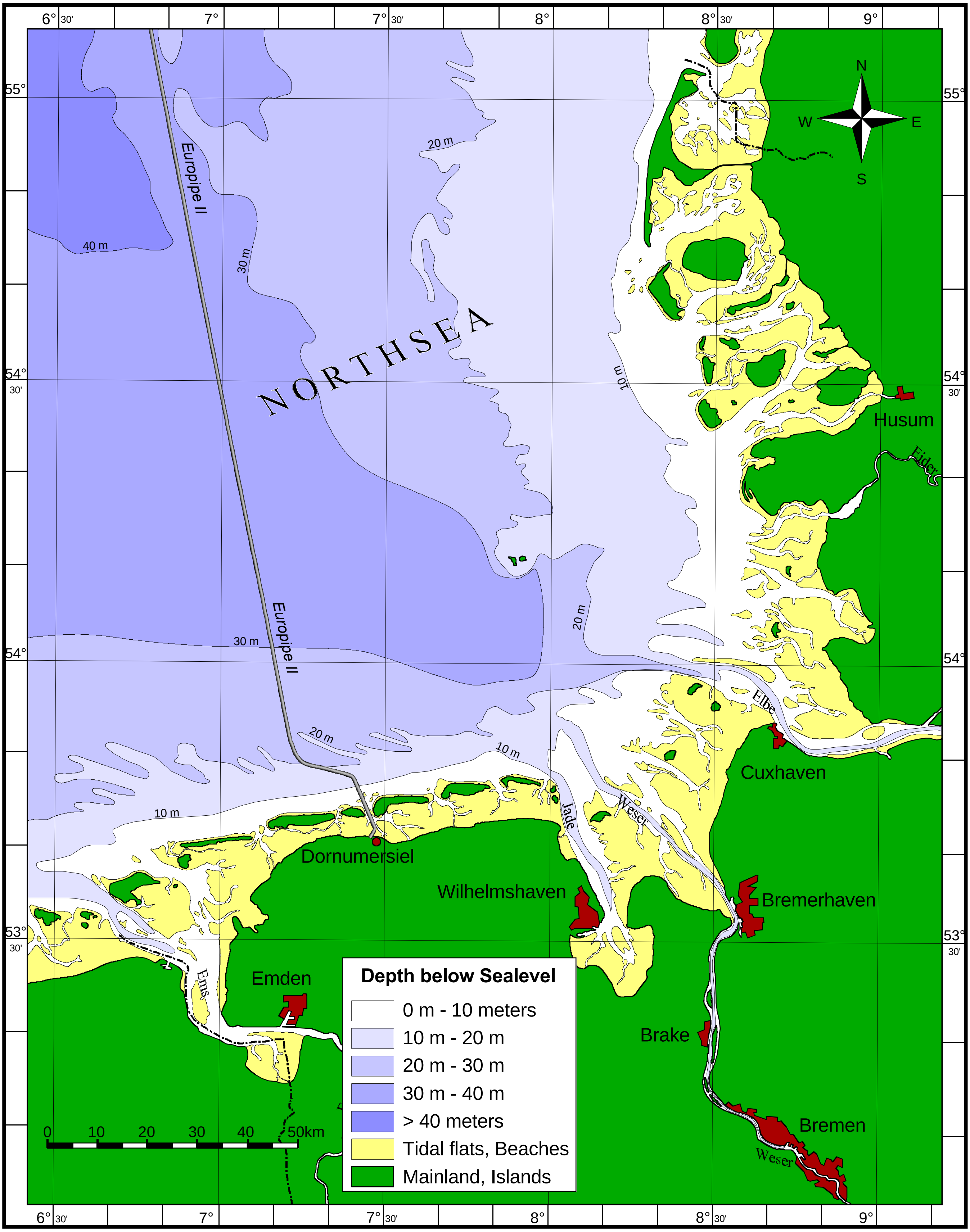

Fig. 3.1: Map of the planned pipeline route offshore and water depth contours.

3.2. PIPE-LAYING

3.2.1. OFFSHORE-SECTION

The total length of the pipeline is 653 km of which roughly 200 km are in the German sector. Crossing of the Danish-German border will be located at KP 455. The tie-in with the preinstalled section will occur at KP 638,9. The maximum water depth in the area of construction within the German sector does not exceed 40 m. Water depth in the landfall area is about 18 m.

In the German sector the pipelaying activities will start at KP 610 in June 1998 laying the pipe up to KP 353, which will be reached in September 1998. Due to the strong likeliness of bad weather conditions, and the shallow water in German landfall (18 m) the large laybarge (Solitaire) presumably will not be able to pick up the preinstalled pipeline at KP 638 directly. After laying the pipe to KP 353 the pipelaying vessel therefore will go back, pick up the pipe at KP 610 and lay it away at KP 638,9 (the tie-in will be performed later). For securing laybarge access to KP 638 prior dredging in the landfall area is required. Approximately 15.000 m³ of sediments will be dredged. Dredging will be performed shortly before pipe-lay activities start.

In the offshore section the pipeline will be laid on the sea-bed. However, intervention works are required along the route for a series of reasons, namely:

- post-lay stabilisation to ensure pipeline stability
- trenching to avoid development of unallowable free spans due to scouring
- free span correction
- to ensure an acceptable safety level, for example with respect to impact or dragging of anchors, of sunken ships etc.
- to meet authority requirements, for example in shipping lanes and military training areas
- to allow access of laybarge in the start-up area in German shallow waters.

On an overall length of about 140 km post-trenching will be required for pipeline stability reasons (s. tab. 3.1). Jetting is the most likely method for the sandy sediments, dominanting in the German sector. However, consideration will be given to the opportunity of exploiting the pipeline`s self-lowering potential, deferring as much as possible trenching where this phenomena is likely. Due to stability reasons the top of pipe should be lowered to 0,5 m below the sea-bed.

Due to authority requirements embedments will be especially necessary on some sections, which are listed in tab. 3.1.

Tab. 3.1: Embedments of EP II in the German sector (S* = due to pipeline stabilization; A* = due to authority requirements).

Section	From KP	To KP	Length (km)	Requirement
	498,5	639,1	140,6	Top of pipe 0,5 m below seabed (S*)
Military Training Area	533	535,2	2,2	Pipe flush with seabed (A*)
West Bound Traffic	582	593,7	11,7	Top of pipe 0,6 m below seabed (A*)
Military Training Area	593,7	607,7	14,0	Pipe flush with seabed (A*)
East Bound Traffic	607,7	619,0	11,3	Top of pipe 0,6 m below seabed (A*)
East Bound Traffic (megaripples area)	619	626,2	7,2	Top of pipe varying between 0,6 m and 1,7 below seabed (A*)
Inshore Traffic Zone	626,2	639,0	12,8	Top of pipe varying between 0,9 m and 1,6 below seabed (A*)

In some areas pre-lay gravel dumping operations will be performed to recover particular seabed features or pipeline free spanning. However, this is mainly necessary outside of the German sector. Additional gravel-dumping in the German sector will be necessary to prepare crossing locations (see below). Post-lay gravel dumping operations will be performed to recover particular free spannings and to protect crossing locations.

In the last section of about 30 km before the pre-installed pipeline the seabed is highly dynamic and special sand bedforms (megarippels) occur. Similar to EP I pipe-laying, the burial of the pipe has been planned on the grounds of a morphological design basis (s. DELFT HYDRAULICS 1993). However, this burial depth has been modified during subsequent discussions with German authorities. Finally, the burial depth on top of the pipe is 0.8 m up to 1.7 m below the seabed estimated „envelope“. No information is available, wether pipe laying in the area shall be performed in a pre-dredged trench or by post-lay trenching.

The Europipe II will cross 12 existing cables in the German sector, of which only 1 is currently in operation. North of the Island Norderney, the pipeline will traverse the Europipe I before connection with the preinstalled section off the coast of Baltrum Island.

The pipeline crossing concept is a bridging solution, including one or more gravel berms placed on the existing pipeline which will guarantee a minimum separation distance between the pipelines throughout the pipeline of 0,3 m. The crossing locations will be protected, after pipelaying, by post-lay gravel dumping.

The crossing of the existing cable in use also will be achieved by separation with the means of gravel berms which are dumped on top of the section in question. The only potential requirement for cable remedial work is the lowering of the cable to ensure that minimum cover requirements are met. After completion of the laying process, the cable crossing will be covered by gravel.

Regarding disused cables, they will normally be laid over where no trenching is required. In areas where the pipeline is to be post-trenched the normally required operation consist of cable splitting and repositioning of the cable ends at about 20 m aside the pipeline route.

3.2.2. PRE-INSTALLED SECTION

In order to satisfy the increasing demand for natural gas in Western Europe the 640 km Europipe I from the Norwegian North Sea to Emden in Germany had been built. Landfall of the offshore pipeline took place 1994 in the German Wadden Sea, which has declared National Park (NLP) in 1986. The pipeline landfall section is about 12 km long, extending from the former 3-mile zone seaward of the East Frisian islands Baltrum and Langeoog, crossing a very dynamic, shallow sandbank area (reef bars), following the Accumer Ee tidal inlet between the islands, continuing into the shallow Accumersieler Balje before reaching the tidal flats. For the purpose of burying the pipeline permanently in the sea bed, a trench of varying depth and with a trench bottom width of 12 m was dredged seaward of the tidal flats. In addition, a 100 m wide vessel access channel had to be cut through the above mentioned sanbank area. In total some 3.4 10^6 m³ of mainly sand was removed to be used for beach nourishment or to be brought to an interim storage area off-shore for later backfilling of the trench. Pipelaying into the open trench was performed by a large pipelaying vessel in the tidal inlet and seaward and using a smaller one in the Accumersieler Balje. The large pipelaying vessel could not be used with its normal anchor pattern when operating in the shallow and narrow tidal channel. Instead 34 anchor piles were pre-installed and used as anchors during pipelaying.

The tidal flats, the foreland and the dike have been crossed using a sub-surface tunnel at 8 m depth below mean sea level (length about 2.600 m). The tunnel start shaft was located behind the main dike. The physical connection of the offshore-pipeline in the trench and the land pipeline in the tunnel has been performed in a sub-sea floor tie-in chamber located in the Accumersieler Balje.

In this landfall-section the EP II section has been preinstalled in parallel to the pipe-laying of the EP I.

3.2.3. ONSHORE-SECTION

The onshore segment of the survey area ranges 4600 m from the landfall point of Europipe II to the Europipe Recieving Facility (ERF). The pipeline will be constructed using conventional onshore pipe laying methods. A trench will be excavated, the pipe will be placed parallel to the excavated trench, welded and later placed into the trench. The trench will then be refilled with the excavated soil. The new pipeline shall be lowered 10 m from the existing Europipe I. The working strip which will be needed for this method is approx. 42 m wide, from which about 10 m for interim soil storage are above EP I.

About 20 ha of mostly agricultural land will be used during construction. The cover layer of soil will be 1 m in average. The trench will be backfilled with the original soil except of a sand layer of approximately 0.3 m around the pipe to improve soil stability during negative temperatures of the incoming gas. Minimum temperature of the gas will be - 5^{o}C.

Crossing of ditches will be done by the open cut method except for these ditches running in parallel to roads or the main dyke. Roads and the dyke crossings will be done by sub-surface crossing including the adjacent ditches. The pipeline will cross in total 32 drainage ditches on the way to the ERF.

Statoil has no requirement for a landfall valve station, however, the German authorities have required a line valve station at the same location as for EP I (close to the old winter dyke). This facility will have a height of about 5 m above the bottom, an access road and a fence. The area covered will be about 1.650 m².

3.3. ERF AND EMS

The Europipe Recieving Facility (ERF) is located in Dornum, the Europipe Metering Station (EMS) in Rysum/Emden. The latter is concerned with the distribution of the natural gas to the collectors of Ruhrgas, Gas Uni and BEB. Here the amount of sold gas is recorded.
The ERF is mainly concerned with the reheating of the incoming natural gas. As the natural gas cools off considerably during the offshore passage from Norway to Germany, the ERF plays an important role in reheating the incoming gas before further transportation to the EMS in Emden to avoid negative temperatures.

The ERF was erected during the Europipe I project and covers an area of 8,05 ha. In order to minimize the visual impact, a maritime design was implemented in the architecture of the ERF and some vegetation planting in the surrounding had been carried out. The EMS near Rysum/Emden was also constructed as part of the Europipe I project and was build next to an already existing Phillips-Petroleum Facility.

In the framework of the Europipe II project, an extension of capacity of the ERF is necessary. It is planned to erect:

- two new process trains for gas pressure regulation,
- a new pig receiving facility,
- a new metering station due to change of delivery point,
- a new analyser building,
- a new boiler (8 m high), and
- a new vent stack.

The locations and areas are depicted in fig. 4. 1. For all permanent measures the area inside the existing fence will be used. About 2 ha will be used inside the fence, from which 0,5 ha will be permanently covered with buildings, roads and other facilities.

During construction an area on about 0,5 ha outside of the existing fence will be used as a temporary construction site. The complete removal of these facilities will take place in 1999.
During construction noise emissions similar to a normal construction site are expected. A separate noise prediction study is not planned. Construction time will approximately be over a period of one year (March 1998 - March 1999; main activity in the summer). During the construction time there will be a considerably increase of large vehicle in the surrounding of the ERF. About 10.000 m³ of soil will be excavated and transported.
Within the construction site of some of the above mentioned facilities the groundwater has to be lowered temporary by pumping. The pumped water will be dumped into existing deep wells, which have to be reactivated.

On the EMS no special activities in the phase 2 of the EP II project are foreseen. Up to now the facilities have been upgraded by a new coal-filter and an additional measuring device.

3.4. RFO-ACTIVITIES

Hydrotesting, cleaning and gauging of the pipeline have to be carried out before Europipe II will be ready for operation (RFO). This operation has a duration of 4-6 months. The time period for the beginning of this operation shall be in Autumn 1998.
Thereby, seawater will be filled in at the Norwegian end of the pipeline and discharged at the landfall area of the Europipe II in Germany. By this time, the pipe has not yet been attached to the pre-installed section at the former 3 mile limit offshore. The water used for this flushing operation will be inhibited with oxygen scavenger (to reduce the oxygen concentration in the tube) and caustic. Caustic will increase the pH to a value of approximately 10.2 which will help to prevent internal corrosion caused by the growth of anaerobic bacteria.

Fig. 4.1: Illustration of the existing ERF at Dornum and the planned extension.

After hydrotesting, the inhibited water will be discharged in the area of the tie-in point off the Island of Baltrum. At the discharge point, a 1 m long tube with vertical upper orientation will be added at the end of the pipeline. This tube has an inner diameter of only 0.394 m (cross-section 0.073 m²) compared to the main pipeline which has a diameter of 1.06 m. This has the effect, that the little vertical tube outlet functions as jet stream device during the water discharge operation. The outflow velocity reached during the jet phase is approx. 13 m/s in the vertical orientation with a mean flow of 0.75 m³/s.
The exact location of the discharge point will be at UTM 5970469N, 789222E. The water depth of the discharge point is 18 m below the mean sea level and will occur 2m above the seabed. The discharge volume of the effluent will be approx. 520.000 m³, including 34 m³ oxygen scavenger (sodium bisulphite) and 50-100 m³ caustic (NaOH). During the ensuing flushing operation, 260.000 m³ water will be required. Here, 17 m³ oxygen scavenger will be added.
The oxygen scavenger is a 30% sodium bisulphite ($NaHSO_3$) solution, the caustic agent is a solution of 30% caustic soda (NaOH). A 30% solution translates to 300 g/kg, or approximately 300 g/l agent in the water.
The discharge of the inhibited sea water will take place in March 1999 over about 14 days.

3.5. OPERATION

Offshore

A maintenance programme for the pipeline will be implemented, which will carry out all inspections through the inner part of the pipeline itself. Morphological changes of the offshore sea bed are controlled by an echo sounder on a yearly basis.

During the pipeline operation, the gas might have a temperature of -5 °C at the landfall section.

On parts of the total pipeline length the pipeline will be not be burried under the sea-bed but will be on the sea floor as a permanent structure. This will be on a length of about 40 km close to the Danish-German border.

Onshore-noise

Operation of the extended ERF will create permanent emissions of noise and air pollutants. This is described in detail in chap. 5.4.4.

Onshore-air emissions

Possible air emission and immission impacts during the operation of the extended ERF have been described and assessed by the TÜV Hannover/Sachsen-Anhalt (TÜV 1997).
Presently there are 5 boilers on the ERF with 10 MW each. 4 of them are allowed to be used in parallel. The planned extension of the ERF includes the permission to use all 5 boilers in parallel an the additional construction of another boiler with a capacity of 27 MW. Some data on the emission of the existing and the planned boilers are compiled in tab. 3.2.

Tab. 3.2: Selected emission data from the existing and planned boilers at the ERF station Dornum (from TÜV 1997).

		Boiler A	Boiler B	Boiler C	Boiler D	Boiler E	Boiler F
Volume (dry)	m³/h	10,1	10,1	10,1	10,1	10,1	26,9
dust	kg/h	0,05	0,05	0,05	0,05	0,05	0,13
CO	kg/h	0,20	0,20	0,20	0,20	0,20	2,70
NOx	kg/h	0,28	0,28	0,28	0,28	0,28	2,0
SO_2	kg/h	0,35	0,35	0,35	0,35	0,35	0,94
Temp.	^{o}C	70	70	70	70	70	110

In comparing the present situation (max. 4 boilers inparallel) with the planned situation (max. all 6 boilers in parallel; this is, however, worst case) dust will increase from 0,2 kg/h to 0,38 kg/h (+ 90%); CO from 0,8 kg/h to 3,7 kg/h (+ 360%); NOx from 1,12 kg/h to 3,4 kg/h (+ 200%) and SO_2 from 4,76 kg/h to 6,05 kg/h (+ 27%).
To reduce the emissions below the German standard values, the TÜV Hannover has calculated a minimum chimmey height of 19,7 m above the earth´s surface. As the given and the planned additional chimmey are all 20 m high, the directives of the TALuft (air standards) will be fullfilled.

3.6 FACTORS OF INFLUENCE

The possible impact on the environment due to the construction activities will be mediated by the so-called „factors of influence“ which are listed below.

ACTIVITY OFFSHORE	FACTOR OF INFLUENCE	POSSIBLE IMPACT ON:
pipeline and cable-crossings	gravel dumping	sediment structure, benthos
dredging for laybarge access	sediment removal and disposal	sedimentstructure, plankton, benthos, fish
post-trenching	resuspension, sediment removal	sedimentstructure, plankton, benthos, fish
pipe-laying	sediment compaction, -overlay	sediment structure, benthos
RFO-activities	discharge of inhibited sea-water	water-quality, plankton, fish
construction-activities	combustion of fuel	air quality
operation	gas-temperature of about -5°C	biological activity, benthos

ACTIVITY ONSHORE	FACTOR OF INFLUENCE	POSSIBLE IMPACT ON:
construction activities	noise emissions, general disturbance	avifauna, humans, tourism
construction activities	combustion of fuels	air quality, human health, tourism
construction activities	lowering of groundwater	vegetation, fauna
construction activities	accidental release of chemicals and fuels	water quality, soil quality
trenching	removal and storing of soil	soil, vegetation, fauna, agriculture
operation	combustion for re-heating of the gas	air quality, human health, tourism
operation	noise emissions	human health, tourism
operation	gas-temperature of about -5°C	biological activity, soil structure and -fauna, vegetation
operation	erection of permanent facilities	landscape view, tourism

Possible accidents during construction or operation will not be taken into account in the present EIA.

4 DESCRIPTION OF THE IMPACT AREA

The Impact Area stretches from the northern border of the German-Danish territorial Seas in a southern extension to the East Friesian Islands between Langeoog and Baltrum. It continues on the mainland at Dornumersiel to the ERF at Dornum. Here the incoming natural gas is reheated before further transportation to the EMS in Emden, using the already installed Europipe I tube; or to a gas storage in Etzel via a pipeline, which is under construction.

4.1. OFFSHORE SECTION

The post-glacial development of the North Sea has been influenced through variations of the currents of the north-atlantic system, climatic changes and geological eustatic and isostatic movements of the coastal areas. Anthropogentic activities have modified the present coastlines to a great extent.

As mentioned above, the planned Europipe II will be tied in at a pre-installed section in the Wadden Sea outside the 3-mile-zone. Thus, the offshore EIA covers the area north of the tie-in point to the German-Danish sectoral border.

4.1.1. HYDRODYNAMICS AND MORPHOLOGY

The North Sea can be classified as a shallow continental shelf basin. It has a volume of 41.000 km^3 and covers an area more than 575.000 km^2. The derived mean water depth is 70 m. The morphology of the North Sea can be described as a quadrangle, which has a open side to the North Atlantic ocean. A regular slope continues from the southern part of the basin into the deeper regions of the northwest. The Doggerbank and the Norwegian trough are the two major features. The coastline of the North Sea varies to a great extent - in the southern basin, marshes and dunes are predominant; at the Scottish and Norwegian coastline, rocky cliffs and fjords are widespread. The bathymetry of the investigated area displays a relatively planar slope which moves into a deep sedimentation zone (North of 54°50') in more than 40 m depth.

In this basin the tides are a vital component of hydrodynamics, producing considerable currents and sediment movements, as well as influencing the zonation of coastal organisms, landforms and weathering processes.

The tidal range in the North Sea varies from mesotidal (2-4 m) to macrotidal (> 4 m). Tidal range is an important determining factor for coastal ecology and geomorphology, controlling the width of coasts subjected to alternate wetting and drying and the impact of waves.

The water column at the German East-Friesian Islands contain a predominantly easterly momentum during flooding which reverses on ebb tides. In the pre-installed region of Baltrum, the tidal range is roughly 2.4 m. Here the tide creates a characteristic current pattern, which is overlayed by a coastal current which runs parallel to the coast in a west to east direction. During flood tide, the west-east currents can reach velocities up to 0.8 m/s. At low tide, this current reverses to the west direction and attains speeds up to 0.4 m/s. At high tide, the current flows at 0.1 m/s in a northern orientation (BSH, 1992). During storm events, especially with northwestern gales, storm flood levels can reach up to 8-9 m above the mean sea level (compared to the 1.2 m rise during ordinary high tides).

However, present calculations show, that the likelyhood of an accelerated sea level rise over the next decades has increased. Estimations indicate an increase of 60-70 cm above the mean sea level over the next 100 years. Together with an expected increase in the storm weather conditions, this presumably will shape the North Sea morphology in the future.

4.1.2. SEDIMENT DEPOSITION AND SPATIAL DISTRIBUTION

The North Sea basin is covered to a vast extend with post-glacial sediments which can be distinguished by their grain size. In the southern part of the basin there has been a general submergent trend over the last 10000 years. Sediment sources, such as glacially derived sands and gravels available in the early stages of the post-glacial transgression, are now below the wave base.

Traversing the German Bight, the pipeline will cross three distinctive sediment areas of different composition and origin (DHI 1981, s. fig. 4.2). In the northern part, a section of rather poorly sorted sands (250-500 µm) with interlaying deposits of gravel and soild rock can be found. Most likely these deposits have been established during the Holocene era, although the occurence of local gravel accumulations are presumably of Pleistocene origin (DHI 1981). These deposits are suceeded, to the south, by an area of well-sorted silt and clay sediments which contain more than a 5-10% proportion of grain sizes less than 63 µm. Locally, this fraction increases from11-20%. This almost planar layer, in approx. 40 m depth, is thought to consist of glaciofluvial relicts of the Elbe meltwater stream of the Pleistocene ice-age during the Quaternary era.

Subsequent in southern orientation to the tie-in point at Baltrum, the latter is adjoined by very well-sorted fine-sands and silts with grain sizes ranging between 63-250 µm. This area lays east of the Borkum-Riffgrund, a plattform which consists of coarse sand and gravel deposits.

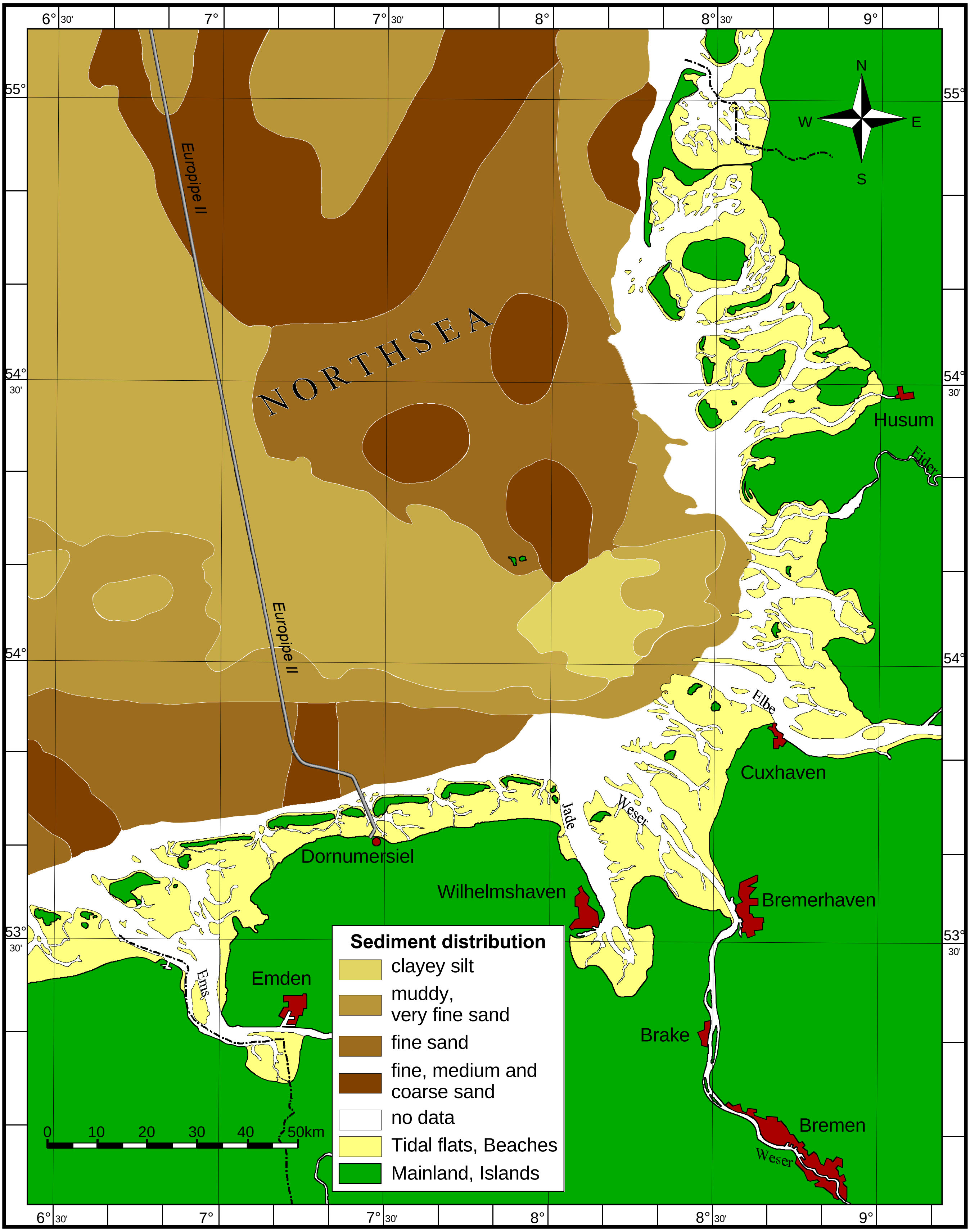

Fig. 4.2: Map of the offshore pipeline route and the sediment distribution (data DHI 1981).

However, coarser material of 250-500 µm have only a very local distribution in the impact area. Destinctive morphologic features such as underwater dunes, sandwaves and ripple marks can be found here.

The sediments contiguous the pre-installed area at the Island of Baltrum are fine, well-sorted sands with small allocations of clay (FIGGE, 1981). Sampling carried out by KRÖGEL & FLEMMING (1993) documented for the pre-installed area coarse fine-sands with higher local fractions of silt and clays (10-15%).

4.1.3. WATER QUALITY

The water quality of the German North Sea is monitored mainly by the joint observation programme of the various states and the federal state authorities (Bund/Länder Meßprogramm für die Nordsee). Analysis of data indicates that over the last decades, the water quality of the North Sea has declined. This has been caused by the increased introduction of chemicals, which react toxic at a certain concentration level (RACHOR & RÜHL 1990). Sources of these human induced chemicals are miscellaneous. Examples are: the direct dumping of industrial waste, waste water and burning of waste. However, these impacts have been stopped during the last years. One major concern is the distribution of heavy metalls which have been monitored by the DHI (Deutsche Hydrographisches Institut) since the early seventies. Interpretations of the obtained data revealed, that the German Bight is one major area of Cd and Pb loads (SCHMIDT & DICKE 1990). Temporal trends analyses for heavy metals in sediments in the German Bight do up to now not generally indicate that the load of the bight has been reduced during the last years, as has been shown for seawater with special reference to cadmium (QSR 1994).

In some areas in the North Sea, temporary oxygen depletion in bottom waters could be found (RACHOR 1983, QSR 1994). This is mainly caused by the decomposition of algae. This algae came to exist because of the increased nutrient load of the surface layers, while settling down at the bed reverses the oxygen concentration to very low levels (RADACH et al. 1990). This situation has occured in some deeper water layers. Another phenomenon of oxygen depletion (black spots and black areas) has been recently recorded in parts of the Wadden Sea (UBA 1996). However, this situation has not been relevant for the coastal waters off the East Friesland Islands so far. Here the tides and the coastal currents have a strong influence on the water quality.

Another item of interest is the input of petroleum hydrocarbons. Among others the impact to seabirds is a field of concern, not only due to catastrophic accidents but also due to chronic, non-point source oil pollution (WWF 1993). Aerial detections of floating oil films indicate the main source of this chronic pollution: most of oil slicks were observed along the main shipping routes due to illegal discharges of bilge or sludge tank residues. However, in the northern regions of the North Sea there is an increasing proportion due to tanker washing and offshore installations (QSR 1993).

Concerning the RFO-Activities of the Europipe II, the pH-factor and the oxygen-concentration are the water quality parameters which are of particular interest. The available data is compiled in tab. 4.1. For 1995, the pH-factor, derived from 8 samples, varied around 8.2 and 8.5 and shows the typical, light alkaline conditions of seawater. The oxygen level in these samples were between 7.4 and 10.7 mg/l. This indicates a saturation rate between 81 and 105% (relatively well-balanced).

Tab. 4.1: Parameters on water quality 1995 at the station No. N1.2, roughly 3 sm north of Norderney (BLMP 1994).

		03.03.92	11.06.92	11.08.92	10.11.92	22.03.93	17.05.93	16.08.93	28.10.93
pH		8.4	8.5	8.5	8.3	8.2	8.4	8.3	8.2
dissolved oxygen	mg/l	10.7	8.4	7.4	9.6	10.1	8.9	7.8	9.0
oxygen-saturation	%	105	104	98	104	100	83	81	96
water-temperature	^{o}C.	5.5	15.8	19.8	9.1	5.8	12.3	17.3	9.4

4.1.4. ZOOBENTHOS

In general, coastal zones are fertile, nutrient-rich environments, with the nutrients brought in from rivers and the upwelling of coastal waters. Most kinds of soft-bottom sediments as well as hard bottom substrates are populated by a diverse fauna (makrozoobenthos, meaning invertebrates larger than 1 mm), which is of some importance for secondary production in marine environments and forms an important nutrional basis for fish.

Surveys covering the whole impact area of EP II are scarce. In October 1975 a survey of the macrozoobenthos of the sublittoral of the German Bight (seaward of the 10 m deth contour) and adjacent areas had been made (SALZWEDEL et al. 1985). Using different classification methods five clusters have been optained from the 66 stations by the authors, which have been regarded as bottom communities or associations. Their distribution is depicted in fig. 4.3.

The distribution of the associations in the investigated area reflects especially the distribution of the sediments.

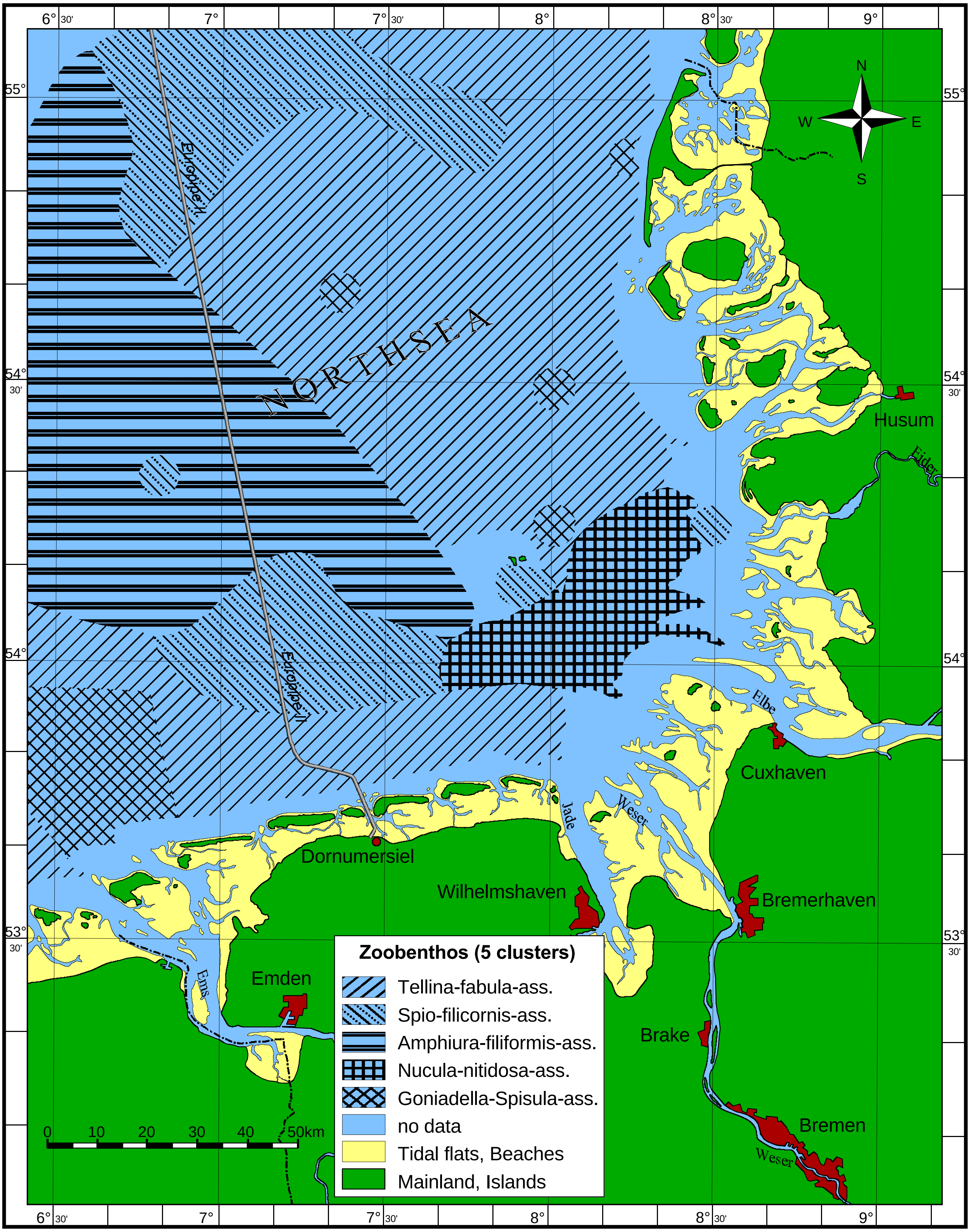

Fig. 4.3: Distribution of macrozoobenthos associations in the German Bight (data from SALZWEDEL et al. 1985).

In the German sector Europipe II will cross 3 of these 5 bottom communities. North of Baltrum seaward of the - 10m contour the pipeline will be laid in the area of the *Tellina fabula*-association. In northern direction the area of the *Spio filicornis*- association will follow and further northward the *Amphiura filiformis*- association will be crossed, followed by crossings of the the *Tellina fabula*- and the *Spio filicornis*- association.

The *Tellina fabula*-association is the spatially dominating association in the German Bight and has been found mainly between 13 and 31 m on fine and medium sands. Characterizing species are the polychaete *Magelona papillicornis*, the bivalve *Tellina fabula*, and the amphipod *Urothoe grimaldii*. The total number of species is relatively high in this association (121 species), whereas the mean number of 34 derived from all samples in the area is below the average figure of 40 for the whole area investigated. Abundance and biomass are close to the mean values for the total German Bight.

The *Spio filicornis*- association was found in 5 areas within the German Bight. Regarding water depth and sediment structure the *Spio filicornis*- association is the most heterogeneous one, which encompasses the shallowest (7 m) and the deepest (52 m) locations. They have been found mostly on fine and very fine sand, but also on medium and coarse sand as well as on muddy sediments. In the *Spio filicornis*- association the highest overall number of species (148) and a very high mean number of species (49) has been identified. Also the mean abuandance is high, whereas the biomass is close to the average of the German Bight.

The *Amphiura filiformis*- association has been found mainly north of Helgoland predominantly on muddy very fine sands or muddy fine sands between 34 and 45 m depth. The ophiuroid *Amphiura filiformis* (brittle star) is the characterizing species dominating in abundance and numerical dominance. Other species characteristic for this association are the polychaete *Pectinaria auricoma* and the gastropod *Cylichna cylindracea*. Both the total and the mean number of species are high in this association (133 and 50 species), whereas the abundance and biomass figures equals the means for the total German Bight.

The boundaries of the five associations were very similar to those described by earlier investigators, indicating no drastical permanent changes during the last 50 years regarding the boundaries of these associations (SALZWEDEL et al. 1985). However, abundance and biomass have been increased, indicating a long-term trend, which has been recently indicated by several authors.

Zoobenthos can be regarded as indicator of the well-being of the marine ecosystem of the North Sea and of the water quality. In the region of the German Bight a large number of zoobenthos species are thought to be endangered (RACHOR et al. 1995). In different types of sediments the zoobenthos generally has increased in total numbers and biomass during the last decades and long-living species seem to have declined (e.g. *Amphiura filiformis*).

Generally, a dominance of small, fast-growing species is to be noted, which is mainly attributed to euthrophication processes especially in coastal waters of the North Sea (RACHOR 1990, QSR 1994).

4.1.5. FISHFAUNA

The North Sea is home to more than 200 fish species, from which only a small number is of commercial importance. Commercial species whose adults occur in large numbers on the continental shelf are Sprat, Cod, Whiting, Grey Gurnard, Scad, Mackerel, Dab and Plaice. For the commercially important species of ICES (International Council for the Exploration of the Sea) show that the spawning stocks for most of the fish species in the German Bight were above the „safe biological minimum“ during the last ten years. Exceptions are the stocks of Herring and Cod. However, stock sizes nowadays strongly depend on the reproductive success a few years earlier because the age structure of the exploited populations is not well balanced anymore, because fisheries take most of the older individuals. For most of the species under considerations the size of the stocks has been decreased considerably during the last decades (WEBER et al. 1990)

Most of the commercially important species migrate during the course of a year. The pelagic species, such as Sprat, Scad, Mackerel, and Herring migrate the most, because their spawning and foraging areas are often far apart. Demersal species, such as the Grey Gurnard, Cod, Plaice and Sole live near or on the bottom of the Sea and migrate only over relatively short distances. In winter, for example, when Cod and Plaice are ready to spawn, they migrate into the center of the southern part of the North Sea to spawn in January / February. The Grey Gurnard, for example, stays at the north-western side of the Doggerbank in the winter and migrates slowly to the direction of the German Bight in the summer. Differences in the spatial distribution occur also between the different age-groups of the same species. Older animals generally live in deeper water than young specimens of the same species. However, the distribution of most species in the North Sea can vary significantly between years and also between seasons.

Except of the Herring all species mentioned above spawn on the continental shelf, mainly south of 54^{o}N. The earliest spawners are Cod and Plaice (January - March); Dab, Whiting and Sprat follow between February and June and later on Sole and Gurnard (March - June), and Mackerel and Scad (May - July). All of these commercially important species spawn pelagic eggs, the spawning grounds of these species are not strictly defined. Only the Herring deposits their eggs on the bottom consisting of coarse sand and gravel, as it is hardly found in the German Bight.

The larves of Sole, Plaice, Dab, Cod and Herring are passively carried by the currents into the shallow coastal waters and the Wadden Sea during early larval stages. These areas are referred to as nursery areas. After about two years they gradually migrate into deeper waters.

The Wadden Sea itself, as a transition zone between the deep North Sea basin and the mainlands, is a unique nursing region for some commercially important fish species. Vast stretches of shallow waters and high biologic activity add positively to this effect.

4.1.6. MAMMALS

Sea mammals are the top predators in the food chain of the North Sea. Therefore they are vulnerable to persistant contaminants accumulating in the food chain. Due to this and due to impact of fishery, densities have been reduced. Among other in coastal areas mainly the seal (*Phoca vitulina*) is important, whereas in the German Bight species like the common porpoise (*Phocoena phocoena*) have their habitat. Except for the seal all other sea mammals in the German Bight have been recently classified as strongly endangered in the Red List (BENKE & HEIDEMANN 1995)

4.1.7. SOCIO-ECONOMIC ACTIVITIES

Main economic activities in the German sector of the North Sea are fishery and shipping. However, using the sea floor for cables, pipelines and other is of increasing importance. Exploration of oil and gas do not take place along the planned route.

Fishery

Fishery is a important economic activitiy in the German Sector of the North Sea. Whereas in the 12 mile limit only German ships are allowed to fish, outside of the corridor also vessels from other countries (mainly Dutch and Danish vessels) are active.

The international fish catches in the North Sea has been strongly increased within this century: from about $1x10^6$ tons in 1910 to about 3.5×10^6 tons in 1975. In the seventies there was an break down of the Herring population and as a consequence fish catches decreased to about 2.5×10^6 tons. However, the overall fish catches is still very high in relation to the area: it is about 3.4 t/km² and therefore one of the highest of the world (WEBER et al. 1990).

The German fishery fleet is relatively small compared to other European countries: only 14 vessels for the far-field fishery and about 40 vessels for the offshore fishery. Much higher is the number of local cutters, fishing mainly only in coastal waters (about 1500) (Statistisches Bundesamt 1995). Due to this small fishing fleet, Germany has to import relatively large amounts of fish.

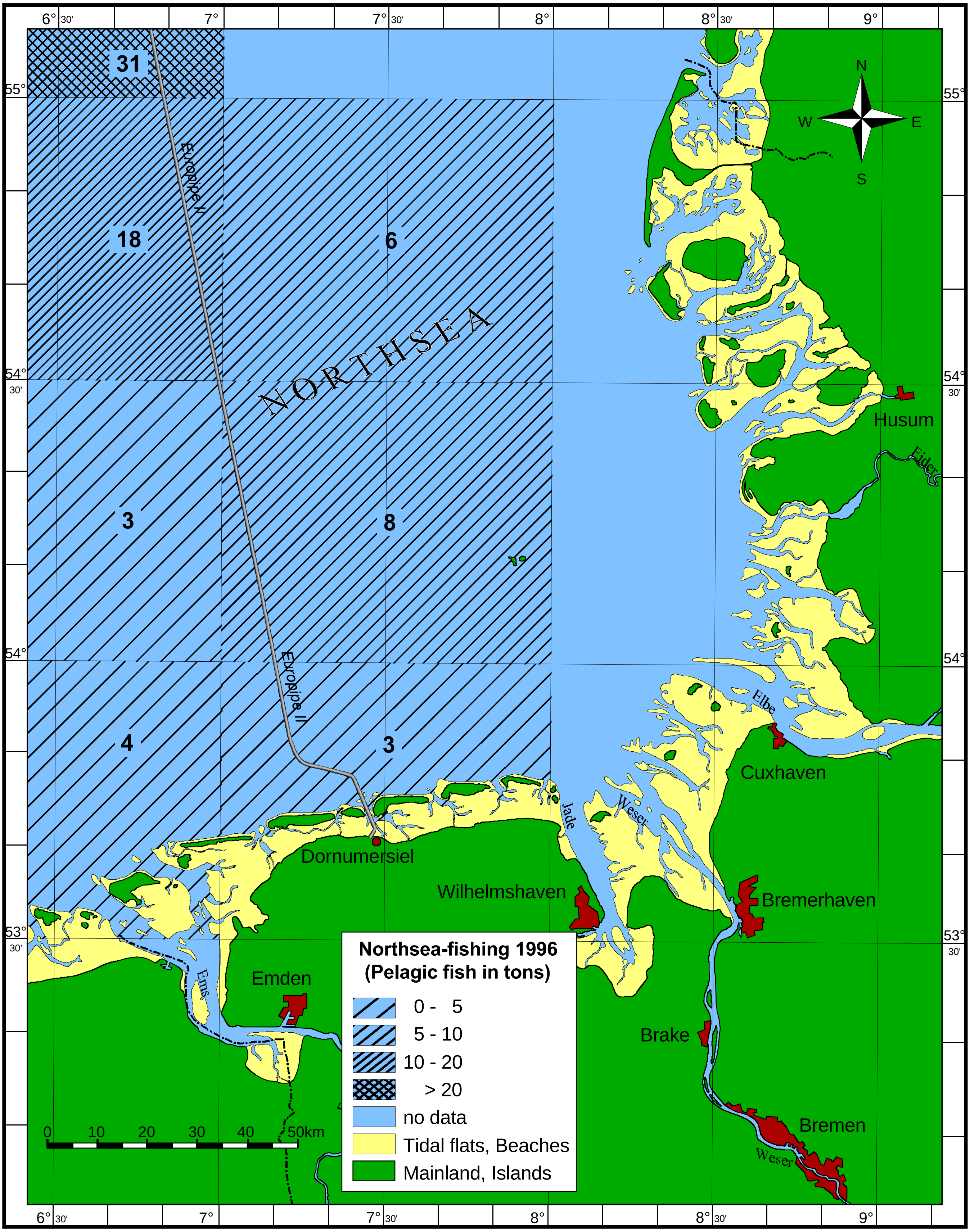

Fig. 4.4: Spatial distribution of pelagic fish caught in the Europipe II route in 1996 (data from BLE 1997).

Two main types of fishery can be distinguished in the open North Sea: pelagic and demersal fishery. For the pelagic fishery large floating trawls are used to catch pelagic species such as Herring, Mackerel and Scad. For the latter the targets species (such as Plaice and Cod) living at or near the bottom. Mostly a beamtrawl is used for demersal fishery, whereas bottom trawls are relatively seldom used.

In the pipeline area the importance of pelagic fisheries done by the German fleet is very low: only about 1.3% of the catches done by the demersal fishery (calculate from data for 1996 from BLE, see also figs. 4.4 and 4.5).

At 90 % of the total catch, the following 11 species are the most important fishery resources: herring, cod, Norway-pout, Greater sand-eel, mackerel, sprat, whiting, haddock, plaice and Sole.

The spatial distribution of the demersal fish catches differs strongly in different areas along the pipeline (s. fig. 4.5). It is relatively low along the coast and increases strongly in the center of the German Bight whereas it is decreasing northward. The situation of the pelagic fishery is similar on a much lower level (s. fig. 4.4).

Nowadays the area under consideration is being fished during the whole year.

In the Wadden Sea and the coastal region, the most frequently used fishing vessel is the shrimp cutter. They predominantly catch the common or brown shrimp (*Crangon crangon*) and also flat fish (mainly sole) with their trawling nets. Most of these fishing activities are conducted from small local fishing ports - e.g. regarding the Accumersieler Balje and Accumer Ee area, most vessels originate from Dornumersiel and Bensersiel. From October till April, the trawling vessels trawl in as little as 5-10 m mean water depth in the vicinity of the East Friesian Islands. During this time, roughly 30 vessels from Cuxhaven, Bremerhaven and Brake carry out trawling activites. In addition, a few cutters from Greetsiel (2), Norddeich (2), Accumersiel (3-4) and Fedderwardersiel (no data available) are also active in the area (Staatliches Fischereiamt, Aufsichtstelle Norddeich). In these winter months, the Cod is the main object of the fishing efforts.

From March till December local small fisheries predominatly catch the shrimp resources. Because of the strong competition of the local habours along the coast, the fishing areas are spatially limited. Presently, in the Wadden Sea region of Baltrum and Langeoog, approx. 15 cutter vessels from Accumersiel and Bensersiel carry out fishing activites during these months. In 1988, 7.700 t of mussels, 750 t of fresh fish, 2.300 t of edible crabs and 1.300 t of fodder crabs were landed and realized a market value of 15.4 mio DM. This underlines the economic importance of the local coastal fishing activities (EIA for Europipe I 1991).

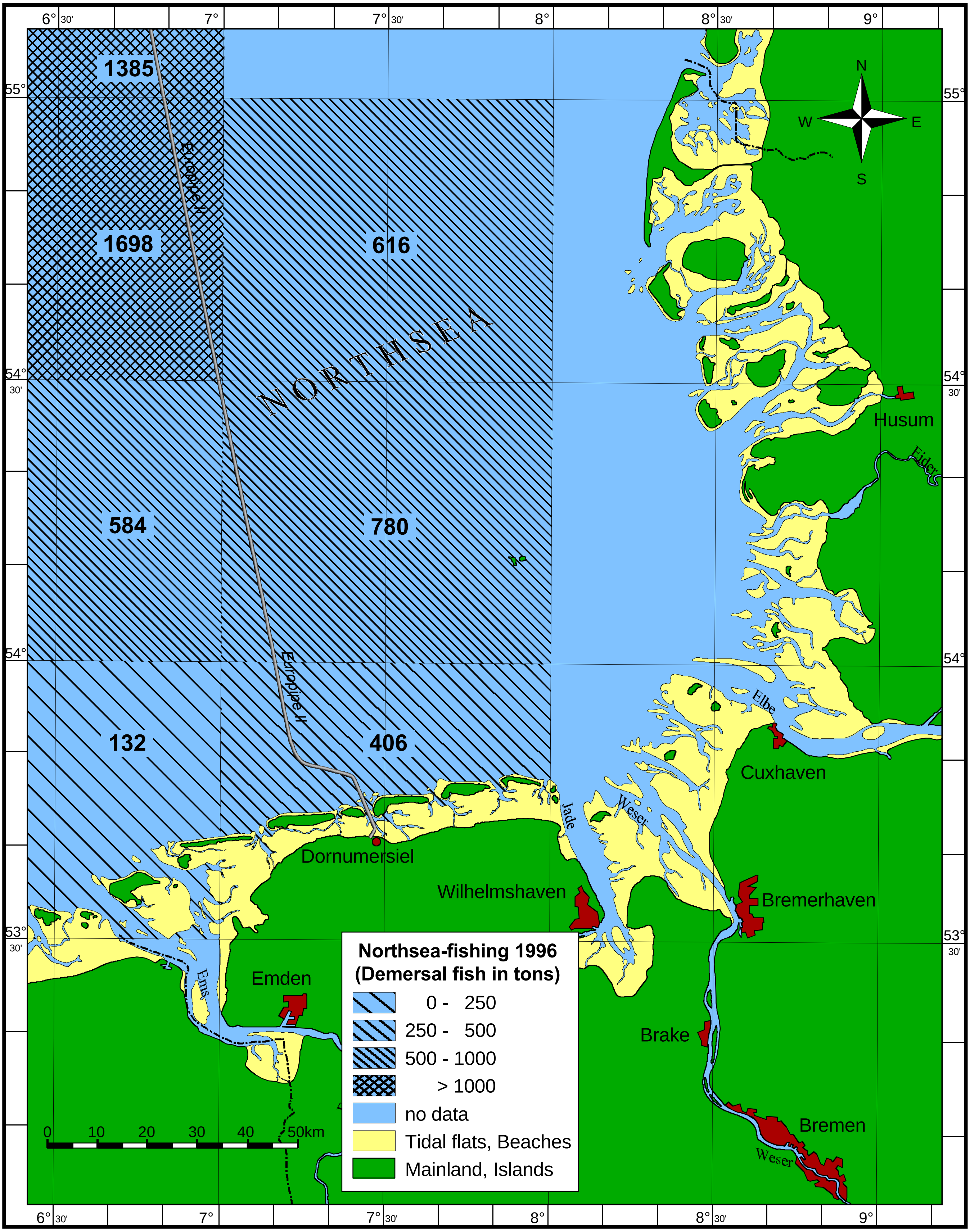

Fig. 4.5: **Spatial distribution of demersal fish catches in the Europipe II route (data from BLE 1997).**

<u>Shipping traffic</u>

The proposed pipeline route will cross two main shipping lanes in the German sector (both including a separation zone), which are very important and frequently used by international vessels (s. fig. 4.6).

The southern TSS Terschelling-German Bight traffic route has been used in 1996 by 13.305 ships in west-east direction (towards the Jade, Weser, Elbe) and 16.560 ships in east-west direction (s. tab. 4.2). This means an average of 81 ship passages the day!

The northern offshore traffic lane is the TSS German Bight Western Approach which was used by 1194 incoming ships (travelling to the east) and 1283 outgoing ships (travelling to the west) during the same time period (s. tab. 4.2). This means an average of 6 ship passages the day.

At a third passage, which is along 54° N and not labled as special traffic zone in the marine charts, the amount of ships travelling into the German Bight totaled 1.488 in 1996. In the opposite direction 1.538 ships used this route which connects the Humber estuary (Great Britain) with the German Bight. This means an average of 8 ship passages the day.

An Inshore Traffic Zone near the East Friesian coast is also used. In 1996 it has been used by 107 ships travelling to the east and 211 ships travelling to the west. This means an average of about 1 ship passage the day.

Tab. 4.2: Shipping (number of ships) across the Europipe II route (data from WSD 1997). For the location of the accounting points s. fig. 4.6.

Length class	TSS Terschelling - German Bight		TSS German Bight Western Approach		Link Humber/Wash - German Bight	
Length class	point 1	point 2	point 8	point 7	Direction GB - D	Direction D - GB
<90	5.984	6.396	197	229	822	914
<120	2.897	3.594	231	258	343	334
<150	1316	1.702	141	168	106	133
<250	2505	3.940	545	517	215	154
<300	543	873	74	104	2	3
>300	60	55	6	7		
sum	13.305	16.560	1.194	1.283	1.488	1.538

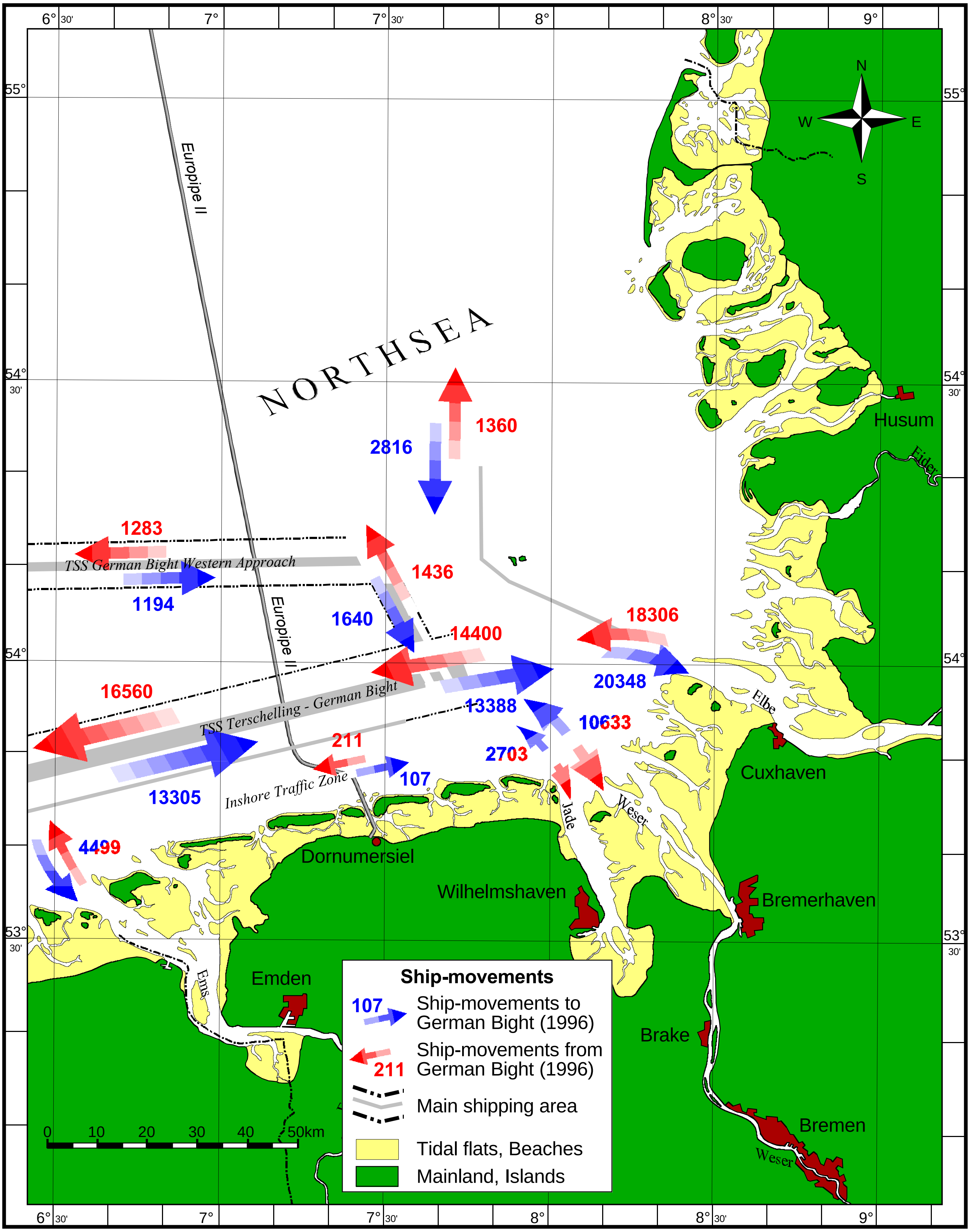

Fig. 4.6: Main shipping lanes crossing the Europipe II route (data from WSD 1997).

4.2. LANDFALL-SECTION (WADDEN SEA)

The Wadden Sea is one of the last remaining large natural landscapes in Europe which is strongly influence by the tides. It extends from Esbjerg (Denmark) in the north to Den Helder (Netherland) in the south. During the 1980's, a joint agreement on conservation and managment of this area was developed by the three neighbouring countries Denmark, Germany and The Netherlands.

In Germany, major parts of the Wadden Sea were declared as national parks and further subdivided in several protection zones in which different stages of restriction were deployed. However, residential areas and harbours as well as the navigable rivers Ems, Jade, Elbe and Weser are explicitly exempted of these regulations.

The East Frisian Wadden Sea area is a unique ecological area and home to a multitude of plants and animals which are well adapted to the extreme variations of the environmental conditions. Details can be found in the EIA for Europipe I.

4.3 ONSHORE- SECTION, ERF AND EMS

The landward survey area is located in East Friesland of the State of Lower Saxony (Germany). The region is dominated by a maritime climate, very moderate elevations of the topography and holocene sedimentary deposits of marine orgin. The climate is moderate with cool summers and mild winters. The mean temperature thoughout the year is + 8,5°C, the average temperature difference is about + 15,4 °C. The average rainfall amounts to 750 mm/year and the humidity is about 80%. The climate water stock shows an anual surplus of 300-400 mm, the water deficit during the summer is below 50 mm. The vegetation period is approximately 225 days/year.

The area is mainly used as agricultural pastures and farmlands. The population density varies from 80 P/km² in the coastal marsh regions to 130 P/km² in the inward following East Friesian uplands, the "Geest". The towns of Emden, Aurich, Leer and Wittmund play key roles as economic centres of the region.

4.3.1. IMMISSIONS

In conjunction with the construction of the Europipe I, the Europipe Recieving Facility (ERF) was built by STATOIL, which reheats the incoming gas before it is interlocked into the mainland supply network and distributed further to the Europipe Meter Station (EMS) at Rysum/Emden.

4.3.1.1 AIR IMMISSIONS

The immissions within an area are not only caused by the emission activities of the region, but also have a large spatial component. Hence immissions are affected by transport of air immissions in the atmosphere and the local climate. The climate of an area is created by meteorological parameters, such as temperature, duration of sunlight, precipitation, wind direction and wind speed.

Next to the mild and moderate climate of the impact area, a second noteworthy feature is the open structure of the countryside which allows the occurrence of high wind velocities predominately of west and southwest direction.

As a result of the low level of industrialization, the proximity to the sea and the wind pattern air pollution is relatively low in East Friesland. Tab. 4.3 summarizes some characteristic values from Wilhelmahaven and Emden as well as from some cities outside or comparison. In the Dornum area STATOIL has agreed to carry out detailed long-term surveys of possible air immission effects of the ERF. A permanent station which collected air immission data from the 19. January 1996 until 31. January 1997 had been erected. NO, NO_2, SO_2, O_3, CO and suspendend particle data were collected. In addition, meteorological parameters, such as wind direction, wind speed, air moisture, temperature, air pressure and solar radiation were obtained and implemented in the interpretation of the data. The results are listed in Tab. 4.3.

The survey displayed only low immission rates for all the major parameters of concern compared with the limits given in the „TA Luft“ as well as compared with other areas (tab. 4.3).

Tab. 4.3: Air-immissions in the sourrounding of the ERF station (from TÜV Hannover 1997) I1V/I2V means short- and longterm values.

	NO µg/m³		NO_2 µg/m³		SO_2 µg/m³		CO mg /m³		Dust µg/m³	
	I1V	I2V	I1V	I2V	I1V	I2V	I1V	I2V	I1V	I2V
TA Luft - limit			80	200	140	400	10	30	150	300
Dornum 1996	<5	26	13	57	<8	29	<0.5	1,0	30	97
Dornum 94/95	<5	22	13	41	5	23	<0.5	1,0	31	97
Dornum 1993	<5	9-10	9	20-23			<0.5	<0.5		
Wilhelmsh.	4	30	17	50	12	56	<0.5	0,9	28	96
Emden	5	43	23	58	12	50	0,5	1,7	37	118
Cloppenburg	6	46	27	74	8	27	<0,5	1,7	31	99
Hannover	12	81	34	77	17	82	0,6	1,6	40	123
Bremerhaven	9	54	9	65	17	96	0,5	1,2	26	59
Bremen	9-23	66-138	31-37	65-79	8-12	44-55	0,5-0,7	1,2-2,0	18-35	43-94

The NO levels display daily mean levels between < 5 to 50 µg/m³. Measurements prior to the installation of the ERF (from only part of the year) suggest a NO_2 level of 9 µg/m³. Recent measurements indicate a daily level of 13 µg/m³. It has been concluded, that the higher levels were created by the local automobile traffic, thus cannot be connected with the operation of the ERF (TÜV HANNOVER 1997). For SO_2 levels, the limit is 15 µg/m³. The long-term measurements retrieved with < 8 µg/m³ only very low daily levels of SO_2. The Ozon concentration was also include in the long term surveys; the results show a monthly variation of O_3 between <5 to 47 µg/m³. The levels are below the EC-level of 189 µg/m³ (level by which the public needs to be informed) and below the 240 µg/m³ of the German Immission Standards (§40 a-e BImSchG). These rather low levels for O_3 can be explained by the rather cool summer months of 1996.
The ERF building was designed to meet the current air immission standards of the Federal Republic of Germany. As shown in the results of the above long-term survey no measureable alternations in the immission impact due to the operation of the ERF at Dornum has taken place. The standards for these assumptions were derived from the TA Luft (German immission standards). However, in relation to the limit of immission levels for being approved as a health resort area only the NO_2 immission of 13 µg/m³ exceed the limit level of 12 µg/m³.

4.3.1.2 NOISE IMMISSIONS

Noise immissions are of relevance as one important field of impact to human well-being. Also during the Europipe I approval procedure noise immissions during construction as well as due to operation have been a major item of concern. Due to this relevance the German authorities have produced a relatively detailed framework of standards and limitations.
During construction the activities will be evaluated using the AVV (Allg. Verwaltungsvorschrift zum Schutz gegen Baulärm - Geräuschemissionen). The standards are compiled in tab. 4.4.

Tab. 4.4: Noise immission standards during construction activities according to AVV.

Characterization of the area	Noise Immission standards	
	during the day (dB (A))	during night (dB (A))
areas, in which commercial activities are dominating	65	50
areas, in which house-holding is dominating	55	40
areas, in which only house-holding is allowed	50	35

hospitals, health resorts etc.	45	35

At the existing facilities of ERF and EMS STATOIL conducted noise immission monitoring during operation (GENEST 1997a, b).

ERF

The ERF is near the village Dornum and the standard of the noise immissions during night-time operation should not exceed 35 dB (TA-Lärm, § 66 BImSchG). The closest buildings next to the ERF are in the vicinity of 600 m. The measurements were carried out on the 11.3.97 from 10:00-12:00 pm. The results, 30 to 33 dB display immission rates lower than the given standards during day-time as well as during night-time operation (GENEST 1997a).

EMS

Noise immissions were also assessed at the Europipe Meter Station (GENEST 1997b). Here the present standards of allowed night-time noise immissions (TA-Lärm) are:

- 45 dB at the Hammrich farm,
- 35 dB at the edge of the village Rysum,
- 40 dB at the camping facility in the south-east.

All of the above localities are within 1100-2200 m of the EMS.

The measurements were carried out at the 12.5.97 from 9:30-11:00 pm. The obtained results concerning the EMS are below the guidelines for night-time noise immissions (GENEST 1997):

- 37 dB at the Hammrich farm
- 32 dB at the edge of the village Rysum
- 31 dB at the camping facility in the south-east

The results show that the EMS is below the given German noise immission standards.

4.3.2 TOPOGRAPHY, GEOLOGY AND SOILS

Most of present East Friesland and the adjacent offshore regions of the North Sea were forged during the Quaternary ice ages. The almost flat topography of the current coastal areas show the strong marine influence. These lowlaying marine induced marshes are followed inland by the uplands of the Geest. The latter region is dominated by pleistocene glacial sands, glacial clays and drift sands.

The marsh landscape has been deployed by the shifting sequences of transgression and regression of the Sea during the present Holocene era. Since the early times of the Holocene, the soils of the marsh regions have undergone a characteristic progression in their way to a maturity stage. The soil genetic processes originate in a sequence, starting from desalination, stabilisation of the soil structure, decalcification, acidification and clay displacement. These phases of soil development are still present today and have to be seen in close connection to the spatial geographical position; the mud flat sea marshes with high salinity close to the North Sea are followed by transitional marshes with the above mentioned progression. However, these distinctive soil sequences have been strongly modified by mankind and his cultivation efforts of the heavy nutrient rich soils.

Futher inland the marine influence eases gradually, so that marine, limnetic, semi-terrestrial and terrestrial sediment layers overlap, which cause an alternation in the soil typs.

According to the German soil taxonomy, the soils in the landfall area of Dornum can be classified as sea marsh soils which contain a significant high percentage of organic matter in the upmost layer of 30-40cm. High oxygen values and good drainage qualities are characteristic. By an increase of decalcification, the stabilisation of the soil structure and the good drainage quality declines gradually.

During the construction of the trench for the Europipe I, the soil structure of the sea marsh from the landfall area to the ERF have been locally significantly affected.

Groundwater layers are predominately found in the Pleistocene sands of the region. Because of the strong influence of the salt waters of the North Sea, the groundwater has a high saline component of > 250 mg Cl/l. The level of the groundwater averages by 1 m below the mean sea level. In some parts this level rises up to 0.5 m below the mean sea water level. The groundwater level is the result of a water management, which is adjusted at agricultural needs. With the help of artificial ditches and drainage tubes the water flow is directed seaward. Caused by the heavy drainage and the high transpiration rate of the pastures, the replenishment rate of the groundwater is low (< 100 mm/a). Therefore the groundwater flow is weak, resulting in the occurence of inflow of salt water and the presence of salt water in the drainage ditches during low water table levels.

The usage for human consumption can thus be neglegted. Most of the water is used for agricultural purposes and serves as drinking water for livestock.

4.3.3 BIOTOPE-TYPES AND VEGETATION

In order to characterise the biotype-types which will be affected from the planned land-crossing of the Europipe II, a botanical survey along the proposed land-section has been carried out in June 1997 (BIOCONSULT 1997a).

The onshore impact area, ranging from the landfall point at Dornumersiel to the ERF is dominated by agriculture.

The biotope-types „intensive pastures“ and „agricultural fields“ fields are strongly dominating. Intensive pasture is used as meadow and grazing land. Compare to moist and mesophilic pasture these stocks are considerably impoverished both from a floristic as well as from a faunistic standpoint. This is documented in the literature e.g. for butterflies and grasshoppers but also for birds. On agricultural fields the species spectrum is even more reduced due to frequent disturbances and use of fertilizers and biocides.

Presently this has been documented along the Europipe I route for the carabids, which have been monitored in connection with the regeneration of the landroute of Europipe I (BIOCONSULT 1997b). A very reduced spectrum of species has been found also on the reference areas outside of the impact area.

Next to the arable fields and pastures, only a couple of natural woods can be found. Along the planned route there are no biotopes existent which are common for the natural landscape of the survey area; expecption being a small natural water. During the construction of the ERF, a circle of young woods have been planted around the facility. However, various of these trees were found to need replacement.

According to the results of the present mapping, the proposed route of Europipe II will cross:

- 61 % agricultural fields,
- 25 % intensive pastures (Lolio-Cynosuretum-Fragments),
- 11 % temporary very intensive pastures (coparable to agricultural fields),
- 3 % woods, ditches etc.

The obtained results were compared with the findings of a previous mapping, which was carried out in 1993 within the framework of the Europipe I project (GALAPLAN 1993). It can be concluded, that the acquisition of agricultural fields has increased significantly from 1993 - 1997. In 69 areas which were directly comparable, the number of areas which are used as agricultural fields has been increased from 35 to 42 and the number of pasture areas has been declined from 33 to 25. This means an increase of agricultural fields from 51 to 61% and an decrease of pasture land from 48 to 37 %. This transition from pasture to fields is a general trend in Northern Germany: between 1960 and 1994 the pasture land in Lower Saxony has been reduced about 29 % (DRACHENFELS 1996). However, there are some indications, that the construction of the Europipe I has played a role in the local framework of this general transition. Exact statements on this transitions can only be given if additional surveys of neighbouring areas would be carried out which were not effected by the construction of the pipeline.

In respect of the protection of species and biotopes, the most important biotype of the survey area are the broad marsh ditches. Here various species belonging to the natural vegetation find an area for retreat. However, these areas have only a very limited spatial distribution within the onshore impact area.

In the red list of biotypes (DRACHENFELS 1996) statements are given regarding the jeopardy of biotypes but also on their ability to regenerate. The list predicts high regeneration abilities (less than 15 years) for all occuring biotypes in the survey area. Therefore, none of the exsiting biotypes can be ranked high in rarity.

4.3.4 BIRDS

The Wadden Sea region function as an extremly important environment for breeding and resting birds. There is a crucial importance of the region for many migrating species as a “recharge point” on their partly far distanceway in the South. This implies the ecological importance of the Wadden Sea, as birds are commonly used as indicator for the well-being and diversity of an ecosystem. For details see the EIA for the Europipe I project.

The Wadden Sea close to the onshore section of the EP II impact area is the Münstersommerpolder, a foreland which is protected against the sea by a summer dyke and used as pasture land. The present situation concerning the avifauna has been intensively monitored within the framework of the Europipe I monitoring (FRANK & GRÜNKORN 1996). It is regarded as an area of regional importance for resting birds (HECKENROTH 1994a) mainly due to the occurence of brent goose, golden plover, curlew, redshank and others. It is also of regional importance for breeding birds (HECKENROTH 1994b), mainly due to redshank, oystercatcher, and other. However, there is some local disturbance due to tourism, coastal protection and agricultural activities.

The onshore route between the tunnel and the ERF is not evaluated as breeding or resting place of even local importance (HECKENROTH 1994a, b). However, there are some more detailed informations available: along the onshore-section breeding and resting birds have been mapped during the Europipe I approval procedure (GALAPLAN 1993). According to these results the northern part of the 5 km section has been evaluated as of low importance for breeding birds (only a few breeding pairs of lapwing, blue-headed wagtail skylark and reed buting have been recorded). The southern section up to the ERF has been evaluated as of moderate importance (especially due to the occurrence of the blue-headed wagtail). A mapping of resting birds showed relatively low overall numbers, which is in accordance with the evaluation by HECKENROTH (1994). However, some numbers of lapwing and especially golden plover, which seem to prefer freshly reworked agricultural fields, have been counted here. Concentrations of these species have been recorded between the new and the old winter dyke and north of the ERF station (GALAPLAN 1993).

4.3.5 SOCIO-ECONOMIC ACTIVITIES

Presently 103.000 people are registered as employed and liable for social security contributions in East Friesland. The unemployment rate is about 19%, which exceeds the mean unemployment rate of 11,5% of the state of Lower Saxony and the average rate of 8.7% for the Federal State of Germany (Statistisches Jahrbuch).

Agriculture is the dominant factor of the regional economic income of the East Friesian county, which implies futher ecological, rural and social aspects. More than 17% of the population of the local communities are employed in agriculture. The productivity output of the farms meet the general average of the Federal State, the average size of the farms varying between 2-20 ha. As a result of EEC guidelines on structural change in rural areas, the importance of the agriculture productivity in the country will decline. Presumably this will not pertain the high number of small farms and their pattern of land tenure.

Of minor importance is the forestry sector as economic income for the East Friesian county. With only *2%* of the entire economic income, the commercial timber production is rather peripheral. However, in regard to their function as ecological buffer zones, biotope, landscape and recreation, the forests achieve a high ecological value.

The characteristics of the rural East Friesian landscape, the Wadden Sea, the marshes, the uplands and many canals and scattered forests have been recognized as of expanding recreational value over the past decades. This landscape, next to the low population density compared to Germany as a whole, are the main reasons for the growing income out of the tourism branch. Thus it gains increasing economical importance for the local economy. Particularly the East Friesian Islands can be regarded as main tourist centers, the Islands being strongly dependend on the tourist sector. The mainland adjacent to the coastal zone also achieves economic profit from the tourist branch. Over 380.000 visitors each year spend a total of *3,8* million nights on the mainland. The inland regions off the coast hardly benefit from tourism.

4.4 EVALUATION OF THE STATUS QUO

An evaluation of the impact area will be achieved by means of ranking the ecological status in high, mean or low categories. The high category is used, when the area obtains characteristic structures, high densities of certain species or other destinctive particularities. In addition, an estimation of the sensitivity of the area in terms of reactions to possible impacts and stress is given.

The North Sea basin is dominated by the influence from the tides, waves and currents and the resulting sediment movements. So far, this offshore region still seems to be within the natural balance and dynamics. Hence the environment of the offshore impact area can be ranked as being of high ecological importance.

Concerning the water quality, the entire basin is affected by the input of nutritients into the system. This has a local effect on the offshore ecosystem, e.g. the German Bight, were high levels of oxygen depletion at the sea bed can be found. Therefore, the status quo of the offshore region is, regarding the water quality, of lower value and exposed to stress.

The Wadden Sea represents one of the last remaining natural landscapes of Western Europe. Despite the influence of man induced changes (e.g. water quality, sedimentology, etc.) this ecosystem still can be regarded as being intact to a large extent. Thus the protection and preservation of the natural dynamics of this ecosystems are of fundamental importance. For the local fishery, the Wadden Sea is of major importance as it forms their basis of subsistence.

The onshore area of the pipeline project, the marshes and the ERF, are of relatively low ecological value caused by the intensified agricultural utilization of the landscape. However, the area has to be seen as sensitive with respect to the adjacent vacation resorts. This concerns mainly noise immissions. The climatic situation of the impact area is characteristic for the German North Sea coast. It is the principal reason for the high recreational value of the area. Air immissions are very low, especially on the East Friesian Islands, but also on the adjacent mainland coastal areas. Therefore the value of the onshore area concerning human well-being and the sensitivity can be classified as high.

5 ENVIRONMENTAL IMPACT ASSESSMENT

5.1 OFFSHORE-SECTION

Impact along the offshore section will be mainly a result of:

- Dredging of approximately 50.000 m³ before pipelaying for securing laybarge access
- About 140 km of post-trenching along the pipeline by jetting
- Additional gravel- dumping to prepare crossing locations
- Increased burial depth along the last 30 km prior to the preinstalled section (no information available on the method)

5.1.1 ABIOTIC SITUATION

HYDROLOGY AND MORPHODYNAMICS

Dredging of approximately 15.000 m³ before pipelaying in order to secure laybarge access to km 638 (in March/April 1998) might influence the local hydro- and morphodynamics. However, the expected alterations of the flow regime will be negligable due to the relatively small amount of dredged material and natural backfilling is probable. This can be concluded from the findings of the limited impact of a large temporary access channel in the Accumer Ee tidal inlet, where no influence on the long-term natural dynamics in the area were assessed. Also mobile sediment structures (sublittoral dunes) affected by the construction work regenerated to a large extent within the following year (KRÖGEL 1996).

Some dumping of gravel will be necessary to prepare crossing locations (with cables and other pipelines). This will be done below the existing sea-bed and the areas will be backfilled with sand. Thus no impact on the local morphodynamics is to be expected. Rocks dumped at the tie-in point will be removed after construction.

On a length of about 140 km the pipe will be buried. Thus no impact on hydro- and morphodynamics is foreseeable. Even if the top of the pipe should become exposed above the sediment due to erosion processes, impact will be very local.

SEDIMENT DISTRIBUTION AND QUALITY

A somewhat increased sedimentation rate along the pipeline during dredging and jetting can be expected. This will mainly occur in the close vicinity of the pipeline. This might alter the sediment composition due to differential settling of different sediment fractions. However, the amount of resuspended material will be small, due to the limited extent of dredging/jetting activities. Long-distance transportation of reworked fine particles (< 63 µm) and sedimentation in low-energy environments will also occur only to a very limited extent. This may result in an increase of the natural sedimentation rates, resp. higher proportions of fines within the sediment. However, this probably will be neglectable as shown by data of the monitoring investigations of Europipe I where no clear increase of fines in eulittoral sediments has been found (KRÖGEL 1997), although a significantly higher amount of sediments had been dredged.

Thus the impact on the sedimentological situation will reveal only minor and temporary consequences which probably will not be distinguishable from the natural dynamics.

RELEASE OF PEAT

During dredging as well as during jetting peat containing sediments may be released. During Europipe I peat has been dumped onshore near Emden to prevent possible impingement on the fishery, tourism or the benthos communities as well. However, soil surveys gave no evidence for peat layers which might become suspended.

WATER QUALITY

As the major possible impact factor on the water quality the turbidity caused by dredging and jetting can be identified. A distinction between small- and large-scale effects should be made: in the immediate vicinity of dredging and jetting activities the concentrations of suspended resp. sinking matter will strongly increase. This is a short-term impact due to high settling velocities of the major part of the material. An increase of very fine suspended matter, which will be carried over larger distances and then deposited, will occur as well. However, this will be a relatively small amount, because sand with small content of fine material is the predominant sediment type along the route (for jetting) as well as north of the preinstalled section (for dredging).
Measurements of turbidity during the Europipe I construction in the framework of the Monitoring Programme showed only relatively weak increase. The increase was not strong enough (the mean suspended matter concentrations had been increased for about 5-10 % during construction) to overlap the natural pattern of intratidal turbidity variability, although about $3.2x10^{-6}$ m³ of material had been dredged and backfilled. However, natural background turbidity in the Wadden Sea is clearly higher, thus making a direct comparison somewhat difficult.

Nevertheless, small-scale as well as large-scale increase of turbidity will be a temporary impact and will not result in any longterm impact.

During the construction activities no extra contaminants will be added to the water, apart from possible small quantities which may occur through spilling. However, existing contaminants in the sediments might be resuspended or mixed with other sediments. Although concentrations of persistent contaminants are clearly elevated above natural background values in the sediments of the German Bight, only neglectable mobilization of such contaminants must be expected due to the low content of very fine particles in the sediments along the route (they act as „contaminant traps“).

EMISSIONS TO AIR

During the construction phase, impact on air quality may occur resulting from the combustion of fuel and gasoil. Generally, NO_x emission levels from ships are relatively high compared to many other emission sources. However, the emission levels for the Europipe II project will not deviate in comparison to emission levels from similar pipelaying projects.

NOISE-EMISSIONS

Noise-emissions will occur during construction activities mainly due to the laybarge. In the offshore section no special authority requirements are formulated and areas of special sensitivity do not exist. Thus, special noise reduction measures are not necessary.

5.1.2 BIOTIC SITUATION

Impact on the biotic situation might be expected mainly for benthic communities and fish, whereas others such as plankton or destruents will be negligible. The assessment is based on existing data. Especially for the macrozoobenthos the available data basis is relatively old and very scattered. Thus potential occurrence of endangered species or specific biotops (s. RACHOR et al. 1996; RIECKEN et al . 1996) can not be excluded.

MACROZOOBENTHOS

In the area of the tie-in point north of the preinstalled pipeline where some material will be dredged and along the major part of the route itself (due to jetting) the endobenthic community will be partly destroyed. Another part of the individuals may survive the activity (e.g. mobile polychaetes). The results of the Europipe I monitoring programme have shown a clear temporary reduction of the number of species (from 50 in spring 1994 [status quo ante] to 30 in summer 1994 as could be expected due to intensive dredging works). Reduction of species number during construction (compared to the situation in spring 1994) was strongest in the outer tidal inlet (from 28 to 12) and relatively weak in the area of the reef bar (from 29 to 26). Especially amphipods and mussels were reduced during construction. In spring 1995 the number already increased to 41 which could be explained as recovery. However, a further increase as could be expected for the summer 1995 did not take place. These preliminary results indicate some impact due to dredging activities. However, the data available concerning the endobenthos reveal no "decolonization" of the route area caused by the sediment removal as it was expected in the EIA for Europipe I. Already several weeks after the refilling of the trench the area of the trench has been recolonized with a limited species range. This is in accordance to recent results on sand removal from the outer Weser Estuary (GOSSELCK et al. 1996). Also the results on the recovery of the benthic fauna in sandy sediments of an intermediate dumping area north of the Eastfrisian Islands indicated that already one year after dumping and dredging no clear differences (concerning number of species and densities) between this area and a reference area without any construction activities could be found (VAN BERNEM 1996).

Taking into account, that dredging volumes are clearly lower than those of Europipe I and the area directly affected by the construction of Europipe II is also clearly smaller, there is a high probability for only local and temporary reduction of benthic communities. Relatively quick recovery (within 1 to 3 years) can be assumed.

Concerning the status quo situation of the meiofauna no data is available. A reduction of species numbers and abundance in the direct impact area is probable, as has been shown for sublitoral meiofauna (copepods) during Europipe I construction as well (VAN BERNEM 1996). There the monitoring investigations revealed a massive loss of the stock of sublittoral copepods after the construction works. However, already the following summer the number of species as well as abundance did partly recover.

Outside of the direct impact area (the trench) only minor and temporary impact to the zoobenthos must be expected mainly due to an only weak and short-term increase of suspended matter concentrations and thus increased sedimentation rates. An impingement of filtering organisms and a shift of the species composition towards opportunistic species is unlikely. Such far-field impact has been argued for the eulittoral benthos in the Accumer Ee tidal inlet due to increased suspended matter concentrations and sedimentation as a result of the Europipe I construction activities. The results of the Europipe I monitoring programme do not give any clear evidence for such effects: in the impact area the investigated eulittoral areas were characterized by very similar benthos communities between 1988/89 and 1996. Strong changes in its composition did not occur.

In evaluating these interim results it must be taken into consideration, that about 3.2 mio. m³ of sediment had been dredged and dumped in the area. This means a considerably higher amount of resuspended material as during Europipe II construction. Thus only minor impact during EP II must be assumed.

The laybarge which will be used for Europipe II pipelaying is equiped with a self-positioning system. Thus no anchoring will be nessary during pipe laying, and damage due to the use of anchors (anchor mounds) can be avoided.

Summarizing the possible impact on the benthic communities, some reduction in species numbers as well as in densitiy and biomass can be expected for the direct impact area. Recovery process will lead to a relatively fast recolonization with opportunistic species within one year also due to the restricted area which will be affected. A complete regeneration may take somewhat longer, depending also on the local structure of the sediments and the communities.

FISH FAUNA

Impact on fish can be foreseen as a result of mechanical disturbance due to the removal of sediments by dredging and the mixing of bottom layers due to jetting. Indirect impacts may be possible due to alterations of food availability.

A direct impact due to the dredging and jetting will is possible for small resident species and young demersal fish like plaice (*Pleuronectes platessa*) as well as demersal eggs, whereas adult species will probably be able to avoid the construction area. The results of the monitoring investigations for Europipe I reveal impingements for a small resident species (the small diminutive goby *Pomatoschistus microps*) as well as for juvenile plaice, whereas number and densitiy of adult, mobile species did not change (KNUST & ULLEWEIT 1996). The numbers of the brown shrimp (*Crangon crangon*) stocks during the year of construction showed a clear decrease of about 50 %.

Such effects may also be expected during Europipe II construction. However, these effects can be expected to be, if at all, very local and short term effects. Any long lasting effects can not be expected.

Concerning the indirect effects a shift of the food range of the indicative species eel-pout (*Zoarces viviparus*) compared to reference areas and a bad nutritional condition was recognizable as a result of Europipe I construction. However, such a reduction of the nutrient base will be unlikely as an effect of Europipe II construction due to the minor width of the trench / the area disturbed by jetting.

5.1.3 SOCIOECONOMIC ACTIVITIES

Main economic activities which may be affected by the construction works are navigation and fishery. Some impact may be possible on existing pipelines and cables. This will require special measures in most cases as described in chap. 3. This will not be detailed here.

NAVIGATION

The proposed pipeline route will cross two main shipping lanes in the German sector (both including a separation zone), which are very important and frequently used by international vessels. Thus some interference with the construction activities is possible. Special measures will be required. In implementing such measures it should be possible to avoid any direct impact on navigation. These measures will be worked out with the relevant authorities.

FISHERY

Some impact on fishery due to the Europipe II construction activities may be expected. The presence of a lay barge and other construction vessels may temporarily hinder fishery activities along a pipeline route (loss of access) and the number of fish might be reduced due to direct mortality of adults, juvenile or eggs.

However, the lay barge which will be used for laying EPII is equipped with a self-positiong system. Thus no anchoring systems are required. This will narrow down the area where hinderance of fishing vessels mainly could occur. Due to this and due to the high speed of more than 3 km/day hinderance of fishing vessels during the offshore operation is neglectable.

Also direct loss of fish ressources due to construction activities will only be temporary and very local as has been detailed in chap. 5.1.2.

5.1.4 IMPACT DURING OPERATION

During operation of the offshore pipeline impact on benthic communities or fish is unlikely. The pipeline will be burried on the major part of the German sector. Thus no new type of substrate (secondary hard bottom) for benthic species will be introduced resulting in a shift in species composition.

Negative gas temperature (up to minus 5 degree) will not lead to an impact on benthic communities due to ahigh temperature exchange rate with the sourrounding water body.

No regular emissions to air or water will take place during operation. Under accidental conditions, e.g. an external impact damaging the pipeline, a gas release could occur. The probability of occurrence of such an event is very low. However, such a risk analysis of accidental conditions is not part of this EIA.

FISHERY

Europipe II will cross areas which are intensively used by fishermen. Especially in the area around Europipe II km500 catches of demersal fishery are very high (s. fig. 4.6). For demersal fisheries using beam trawls or bottom trawls an interference with obstacles on the sea bottom might be a problem causing damage or loss of the fishing gear or even loss of the vessel.

However, along about ¾ of the pipeline length in German waters the pipe will be covered with at least 0,5 m of sediment. This will strongly reduce the risk of any interference with fishing gear. About 50 km close to the Danish border the pipe will be laid on top of the sediments without any burial. In this area as well as in areas of free spans occuring due to erosion some impact might be possible. However, research carried out in Norway, the Netherlands and Germany gave strong evidence that pipelines laying on the sediment surface as well as pipelines with a free span up to 80 cm high do not interfere with the trawling nets of the demersal fishery. This has been documented for beam trawls as well as for bottom trawls (s. summary in the Norfra EIA for the Dutch sector). However, there are few examples of accidents caused by hooking of trawlboards and beam trawls under a pipeline or rock dumps. Thus accidents due to hooking are very unlikely, but can not be excluded:

The pelagic fisheries use large floating trawls to catch pelagic species such as Herring, Mackerel and Scad and therefore do not interact with the pipeline at all.

On the other hand damage of pipeline coating due to collisions with beam trawls has been reported. However, due to adaptations of fishing gear as well as the pipeline coating the pipelines today can withstand the impact of any fishing gear without any damage.

Overall it can be concluded, that direct impact on fishery due to pipeline operation is not likely.

EMISSIONS TO AIR AND WATER

No emissions to air occur in the offshore section from the pipeline during regular operation.

No permanent impacts on the water quality are expected during the operation phase, taking into account the neutral chemical covering of the pipeline.

5.2 PRE-INSTALLED SECTION

As the tube for the crossing of the Wadden Sea was constructed during the Europipe I project, no further impact on the eulitoral and sublitoral regions of the area in the National Park is expected.

5.3 ONSHORE-SECTION

For pipe installation a working strip of about 42 m is required for traffic lane, trench and space to store soil. On an overall length of 4.600 m this means a direct impact area of about 20 ha. The trench width will be about 5.5 m at the surface, assuming that the cover of the pipeline will be one metre in average and the slope is 1:1 (common for light clay). This means, that per pipeline metre about 7 m^3 of soil will be excavated.

5.3.1 ABIOTIC SITUATION

SOIL

Soil structure will be altered due to the pipe laying activities within an area of about 19,3 ha. The impact on the soil will be somewhat different in the area of the trench, the area of the traffic lane and of the soil storage area. In the area of the trench (about 5.5 m x 4600 m = 2.53 ha) the soil will be excavated. The top layer of the trench will be stored separately to reduce the impact on this important part of the soil system. Also the deeper layer of the soil will be stored. After pipelaying the trench will be refilled. The upper layer will be replaced carefully.

In the area of the traffic lane the upper soil layer is stored separately and it might be necessary to bring in additional sand to facilitate the construction work. However, due to the the heavy vehicles being used the soil will be partly compressed. When pipelaying has been finished, the sand will be removed and replaced by the original top layer of the soil. Also in the area where the deeper layers of the soil will be stored, the top layer has to be removed before starting the work and has to be stored separately.

This means the top layer of the soil will be removed from almost all of the working strip and that soil will be compacted in the same area. Measures of recultivation by loosening the top layer will be performed.

However, depending on the soil structure, the degree of compactness, the recultivation and other things the soil structure will be altered after completion of the work. As has been shown by recent research in the area of the Europipe I route (BIOCONSULT 1997b), the pore system may be clearly reduced also three years after completion of the work thus influencing also the water content, the biotic situation and the agricultural use. At least in such clay areas several years seem to be necessary until a complete regeneration can take place.

WATER

The existing drainage system for agricultural purposes has already been redirected during the installation of Europipe I. Thus no further impact is forseeable.

Several ditches will be crossed by the pipe. Smaller ones will be crossed by building temporary dams; larger ones will be crossed by subsurface methods. Temporary impacts on the drainage function and the water quality of the small ditches may be expected. However, they will be very local and not permanent.

EMISSIONS TO AIR

Emissions to air due to the use of vehicles during construction will occur. However, no direct impact is forseeable.

5.3.2 BIOTIC SITUATION

The new 40 " onshore pipeline to the ERF will follow the existing Europipe I route parallel in a vicinity of 10 m. Vegetation and soil organisms will be removed in the area of the working strip (20 ha). As has been shown by the recent mapping, no structures of special importance under nature protection purposes do exist in the area since it is used intensively for agricultural purposes. More valuable structures as ponds, hedges, woods etc. are avoided by route design. The regeneration of the vegetation (number of species) will occur within the next year, because it is mainly used as agriculture. As has been shown recently for EP I, biomass might be reduced slightly for several years (BIOCONSULT 1997a). However, no long-term impact on the vegetation is foreseeable.

In two small areas where the pipe will be laid close to existing hedges, the width of the working stripe will be reduced to avoid direct impact.

For security reasons no trees are allowed above the pipeline. However, no such trees are existing along the entire pipeline route.

Impact to soil organisms (reduced number of species, abundance and biomass) might last for some years (BIOCONSULT 1997b). This is in contrast to earlier expectations, where a very fast regeneration had been foreseen. This impact seems to be mainly a result of soil compactions.

During construction impact on breeding birds is unlikely due to the proposed construction time (august to october). Some disturbance of resting birds may occure. The impact will however be relatively small, since no especially important bird areas will be crossed by the pipeline (GALAPLAN 1993). However, the area is close to the extremely important Wadden Sea and might thus be of some importance as resting area during high tide, or, at least temporarily, e.g. during storm situations. Possible impacts will be short- term effects. No long-term effects are foreseeable.

5.3.3 SOCIOECONOMIC ACTIVITIES

As a result of pipelaying there will be a loss in agricultural crop in the entire working zone (20 ha). This will be mainly occur in the year of construction. In addition, some reduction can also be expected for the following years, because the biomass of the vegetation along the EP I also showed a slight reduction 3 years after completion of the work (BIOCONSULT 1997b). However, it is assumed that the importance of the agricultural areas (farming/pastures) will remain unchanged in the future.

As a result of the construction activities there will be some positive effects to the local economic situation. However, some impact to the recreational quality during construction is unavoidable, but will be very limited. As has been seen during the construction of Europipe I, negative influence on the number of tourists must not be expected.

5.3.4 IMPACT DURING OPERATION

Normal inspection works will cause no damage to the natural situation. It will be mainly done inside the pipe by using pigs. Only yearly helicopter flights along the route will be necessary in addition.

Some long term impact might occur due to sub zero temperatures of the gas. The minimum temperature allowed is minus 5 ^{o} C. Some calculations have been done for Europipe I (J+P 1995), showing that a temperature reduction of the sorrounding soil must be expected (< 1 ^{o} up to 3^{o} C at the top of the soil). This depends mainly on the soil structure and the thickness of the overburden. This cover was 2.3 m for EP I and will be reduced to a minimum of 1 m for EP II. Thus a considerable temperature reduction might occur, resulting in a reduction of biological activity and agricultural purposes. However, up to now it is not sure, wether the pipeline will be operated with negative temperatures at all.

5.4 ERF AND EMS

5.4.1 ABIOTIC SITUATION

SOIL/WATER

The capacity-extension of the ERF requires new buildings, roads and facilities (s. chap. 3.3). An area of about 2 ha in side the fence will be covered permanently by these new installations, from which about 1,6 ha m² will be buildings etc. and about 0,4 ha roads etc. The existing soil will be partly removed and the area will be covered completely (buildings) or partly (roads, because a water -permeable cover will be used to reduce the impact). However, soil functions will be destroyed or at least reduced within an area of about 2 ha.

In the area covered with buildings the formation of groundwater will be reduced. However, the measure has no impact on exploitable groundwater reservoirs, because the salinity of the groundwater is naturally elevated due to the vicinity of the sea.

EMISSION TO AIR

Sources of air pollution during construction will be the exhaust gases of vehicles and other machines on the ERF-station and in the surrounding area. No direct impact must be expected.

Noise emissions due to the construction activities will occur. They will be within the limits set by the authorities (AVV Baulärm).

5.4.2 BIOTIC SITUATION

VEGETATION

The existing vegetation will be destroyed in an area of about 2 ha. This will be mainly lawn on the existing ERF area. In contrary to the „planting plan“ (LAREG 1993) the „green areas“ on the ERF have not been developed as species-rich, extensively used greenland, but as a species-poor lawn as a result of frequent mowing. Thus, no valuable vegetation will be destroyed. However, in the western part of the station, an area with scattered trees, which have been planted during construction of EP I, will be used by the new receiving facility, the new metering station and a new analyser building. This planting has been mainly done to reduce impact on the landscape scenery. But also as a part of the legaly required compensation measures. Although the existing trees have a damaged status at the moment, they must be replanted. Details must be agreed on with the local community of Nesse and the Untere Naturschutzbehörde Landkreis Aurich. A so called „Landschaftspflegerischer Begleitplan“ has been worked out (BIOCONSULT 1997a).

During construction the groundwater level must be locally lowered. Minor temporary consequences for the vegetation are possible, depending mainly on the time schedule of the construction works and the amount of precipitation during construction.

FAUNA

Only local impact to soil fauna and insects due to removal of soil and vegetation and construction of the facilties is foreseeable. However, it will be a permanent impact.

5.4.3 SOCIOECONOMIC ACTIVITIES

During construction there will be small positive as well as small negative effects. There will be a positive temporary effect due to the several construction activities, which will be partly performed by local or regional companies. In addition, a positive effect will arise due to the increasing demand for accomodation and consumption.

However, some impact to the recreational quality during construction due to increase in vehicles traffic and noise emissions is unavoidable, but will be very limited. The temporary increase in the number of heavy vehicles on the roads may contribute to regional or local bottle-necks during holiday periods.

5.4.4 IMPACT DURING OPERATION

Onshore-noise

Operation of the extended ERF will create permanent emissions of noise and air pollutants. Noise emissions of the ERF must follow the German noise emission standards. These allow night-time noise immissions only up to 35 dB at the nearest building (a farmhouse within 600 m distance). During day-time operation, the immission standard is 15 dB above the allowed night standard value (TA-Lärm).

As calculated by GENEST (1997), the noise immissions of the enlarged ERF will be at 34,6 dB at all times under normal operation conditions in a distance of 600 m, if the proposed sound wave reduction devices will be installed. As the created noise by the ERF is, under normal circumstances, not subject to variations, the allowed maximum value of 35 dB during night time operation will therefore not be exceeded. Due to special noise reduction measures, the allowed emission for the ERF of < 50 dB will be given.

Short-time noise events must not exceed immission values of over an additional 30 dB; during night-times not more than additional 20 dB. Therefore, during short period events, the standard noise emission values are limited to 80/55 dB. These standards can only be reached by additional noise reduction measures. During emergency situations, the existing and the planned second vent stack both have sound wave reduction devices incoorporated. These reduce noise emission to < 120 dB during emergency gas emission.

However, within an enlargement of the ERF all regulatory devices have to be surrounded with sound wave limiting capsules. In addition, all in- and outgoing pipelines must be covered with similar noise reducing elements. The chimmeys also all need sound reduction devices, so that each chimmey will have a maximum noise emission value of < 80 dB.

In summary, GENEST (1997) has calculated the following mean noise values for the proposed modified ERF, if all noise reduction devices are incooporated as proposed by GENEST (1997):

- normal operation (night immission value)	34,6 dB
- normal operation with 10 t/h burning of gas (day immission value)	48,3 dB
- emergency situation; burning of gas and emergency electricity generation	56,7 dB

The enlarged ERF would then meet the current TALärm (noise emission) standards.

At the EMS, the oberservations reveal low noise values during the operation of the facility. Therefore it can be concluded that even an increase of retrieved natural gas from the Europipe II will not cause any increase of noise emmissions.

<u>Onshore-air emissions</u>

Possible air emission and immission impacts during the operation of the extended ERF have been assessed by the TÜV Hannover/Sachsen-Anhalt (TÜV 1997).

Taking the above mentioned parameters (s. chap. 3.5) for air emission and a minimum chimmey height of 19,7 m above the earth´s surface into account, the immission to the surrounding area of the ERF can be calculated according to the procedure given in the TALuft:
The immission impact area covers 4 km² and thus partly includes the adjacent villages Dornum and Nesse. The impact area is predominantly used as grazing pastures and several farmhouses lie in close neighbourhood of the ERF. As immssions are mainly influenced by wind direction, velocity and turbulence the predicted increase of air immissions have to take long-term meteorological data (timeframe 10 years) into account This data was derived from the meteorological station of Wittmund, 30 km southwest of the ERF. As no major obstacles in the landscape of the region are existent, this data could be safely extrapolated.
Several immission measurements of the above mentioned parameters have been conducted during the years throughout 1993 till 1996. It can therefore be concluded, that the findings represent an accurate measurement of the pre-existing immission impacts on the adjacent region of the ERF (s. chap. 4.3.1.1). The results are compiled in tab. 5.1 and 5.2.

If all parameters of the orginial, natural immissions are summarized togehter with the present values and the calculated additional values for the modified ERF tab 5.1/5.2), it can be concluded that virtually no increase of the immission impact from the enlarged ERF would take place on a yearly mean. The additional immission impact of the parameters under consideration would reach values under 1% in the yearly mean at the vicinity of the ERF. The LAI (Länderausschuß für Immissionsschutz) regards such low additional impact values of 1% to be negligible.

Tab. 5.1: Yearly averages of NO_2, CO and dust in the surrounding of the ERF according to TA Luft. I1V=pre-burden; max. I1Z= calculated maximum of the additional immission due to the extension of the ERF; I1G=amount of I1V and max. I1Z; IW1= limit according to TALuft.

	I1V	Max. I1Z	I1G	IW1	
NO_2	13	0,38	13	80	µg/m³
	16	< 1	16		% (IW1)
CO	< 0,5	0,0004	< 0,5	10	mg/m³
	< 5	< 1	< 5		% (IW1)
dust	30	0,04	30	150	µg/m³
	20	< 1	20		% (IW1)

Tab. 5.2: Short time values of NO_2, CO and dust in the surrounding of the ERF according to TA Luft. I2V=pre-burden; max. I2Z= calculated maximum of the additional immission due to the extension of the ERF; I2G=amount of I1V and max. I2Z; IW2= limit according to TALuft.

	I2V	Max. I2Z	I2G	IW2	
NO_2	13	0,38	13	80	µg/m³
	16	< 1	16		% (IW1)
CO	< 0,5	0,0004	< 0,5	10	mg/m³
	< 5	< 1	< 5		% (IW1)
dust	30	0,04	30	150	µg/m³
	20	< 1	20		% (IW1)

The total impact from the air immissions NO_2, CO and dust will lie also below the current immission values of the TALuft in the future. The overall air situation of the Dornum community will not be alternated by the plannend construction, thus all immission will be below the standards for the continuing approval as health resort.
It is expected that the emissions to air from the modified ERF will be below the present German standards. The emissions will be controlled on a regular basis. The first measurement will take place in the first year of the operation of the new ERF, earliest after 3 months of operation time.

On the EMS there will be no changes compared to the present situation.

5.5 RFO-ACTIVITIES

As mentioned above (chap. 3.4) the ready for operation (RFO) activities include the hydrotesting of the offshore section of Europipe II and the discharge of about 520.000m³ of inhibited test water and additional another 260.000 m³ of inhibited flushing water.
The use of sodium bisulphite and caustic instead of a biocide is a new technique, which has been recently developed by Statoil in order to minimize the impact on the environment during RFO-activites. It has been successfully implemented during the RFO activities of other pipelines. This method shall be applied in the Europipe II project after approval by the German Federal State authorities had been given.

The effects of the pressure water discharge on water quality and the mixing behaviour have been calculated by using numerical modelling (ALKYON 1997) and possible effects on the environment have been discussed in the application.

Tab. 5.3a: Concentration of relevant substances in the pipe and in the sea for different dilution factors as well as in natural seawater for the <u>hydrotest-water</u> (ALKYON 1997).

	dilution-factor	1 (in pipe)	2	5	10	100	natural seawater
pH-value		11.2	9.2	8.5	8.4	8.3	8.2
O_2	mg/l	0	1.8	5.4	6.7	8	8
$CaCO_3$	mg/l	200	175	68	33	0.7 - 3.5	0
SO_3^{2-}	mg/l	22	0	0	0	0	0

Tab. 5.3b: Concentration of relevant substances in the pipe and in the sea for different dilution factors as well as in natural seawater for the <u>flushing-water</u> (ALKYON 1997).

	dilution-factor	1 (in pipe)	2	5	10	100	natural seawater
pH-value		6.7	7.2	7.7	8.0	8.2	8.2
O_2	mg/l	0	1.8	5.4	6.7	8	8
$CaCO_3$	mg/l	0	0	0	0	0	0
SO_3^{2-}	mg/l	22	0	0	0	0	0

As shown in tab. 5.2 and tab. 5.3 the inhibited seawater in the pipe will be free of oxygen and the ph-value will be increased to about 11.2 in the hydrotest-water and decreased to about 6.7 in the flushing water.

During discharge, the initial mixing process of the effluent by entrainment of ambient water is very strong. The jet reaches the water surface directly due to the high jet velocity. Immediately after the initial mixing the diluted effluent in the upper layer of the water column reaches a dilution factor of at least 7. This means, that oxygen content and ph-value will be very close to the natural situation (s. tabs. 5.2/3). However, in the direct vicinity of the outlet the discharge will lead to:

- increase in pH
- reduction in oxygen concentration
- precipitation of $CaCO_3$

To assess the effects of the water discharge, the water quality parameters were compared with the standards of the European Community. These quality standards have been the results of EC action programmes and are obligatory for all national governments. On this basis, the pH may not exceed 9 and the oxygen concentration may not drop below 5 mg/l outside of the direct vicinity of the jet.

The model results display that significant anoxia outside of this jet steam will not occur and hence no effect on marine life is to be expected (ALKYON 1997). Also the pH value will not exceed the pH standard of 9 and is therefore within the range of the natural variation which can be compensated by the marine environment. However, some very local and temporary impact to plankton and juvenile fish might occur.

In summary it is expected that water quality criteria regarding pH and oxygen concentration will be met after the initial dilution stage, i.e. the jet phase. A noticeable effect may be the slight increase of suspended solids due to calcium carbonate percipitates and locally increased sedimentation of carbonate, which are natural components of (suspended) sediments. The affected area of increased sedimentation is expected to be very small (less than 0.1 km²).

As the discharge point is beyond the ship traffic routes, it can easily be avoided. Due to the very small area of possible impacts, the possible depletion of fishing quota will be probably minor. However, there might be some difficulties due to local opposition of fishermen and tourist managers, although approval by the German authorities has been given.

6 POSSIBLE MITIGATION MEASUREMENTS

The construction activities for standard offshore and onshore pipe laying have been improved during the last years also under environmental and safety aspects. Main item to be improved for each project under environmental aspects is the routing especially in the landfall area. For

Europipe II pipe laying in the landfall area has been done in parallel to Europipe I thus avoiding a separate route finding and approval procedure.

However, mitigation measures for Europipe II are:

- Solutions to reduce dredging operations, sediment transport and increase of turbidity in the offshore section
- With respect to accidental pollutions from the construction vessels precautive measures should be taken. However, preparation and implementation of an Emergency Preparedness Plan is integral part of project planning
- In regard to the RFO-activities, the technique used must be seen as a mitigation effort. However, a monitoring programme during the discharge period is planned
- Sound reduction measures for the ERF will be implemented. Due to special noise reduction measures, the allowed emission for the ERF of < 50 dB will be given
- Some planting of trees and bushes around the ERF station is planned. This has been detailed in a separat planting plan
- A reduction of the width of the working strip onshore should be checked
- Recultivation of soil structure (mainly loosening) on the onshore part after refilling of the trench
- Separate storage of topsoil and careful backfilling of topsoil
- In two small areas where the pipe will be laid close to existing hedges, the width of the working stripe will be reduced to avoid direct impact

7 CONCLUSIONS

Construction activities for Europipe II in the German sector and onshore will lead to some environmental impact. However, this impact will be locally restricted and temporarily.

Offshore during construction:

- Hydro- and morphodynamics will be altered only very locally and temporarily due to dredging and jetting activities prior or during pipe-laying activities and some gravel-dumping.
- The pipe will be burried on most of the length in the German sector. Thus no longterm alteration of local sediment structure in the surrounding of the pipe due to locally effected hydrodynamics can be expected.
- There will be some increase of turbidity during dredging and jetting. This is expected to be very local and only during the construction activities.
- The impact of the RFO-activities, especially the discharge of the test-water, will have local and temporal effects on the water quality and not active swimming organisms. However, no long term impact will ocurr.
- As a result of the pipelaying activites the upper sediment layer will be disturbed. Most of the zoobenthos present in the trenched or jetted zone will probably be damaged. The effect is, however, very local and temporarily due to high regeneration potential of the effected communities. It will occur only in the trenched and the dumping zone.
- Concerning fish the main conclusion is, that the laying activities will cause only limited effects on (potential) foraging and spawning areas for fish and will have no impact on the population levels at all. During the RFO-activities, the possible impacts will be on a very local scale.
- As the Europipe II will utilitze the pre-installed landfall section, there will be no impact on the Wadden Sea area.
- The impact of noise emissions and emissions to air will be neglectable, because no sensitive areas will be crossed.

Onshore during construction:

- Soil structure will be altered due to the pipe laying within an area of about 20 ha. Soil functions including soil fauna will be reduced for some years. No longterm impact must be assumed.
- On the same 20 ha the existing vegetation will be removed. A short term regeneration can be expected due to the agricultural use.

- Impact to birds will be low due to the restricted importance of the impact area for birds. However, due to the vicinity of the Wadden Sea, some disturbance for resting birds might be possible.
- Restrictions in the recreation suitability onshore due to construction activities must be expected. However, limitations of the above will be less intense and only temporary.
- Emissions to air during construction will be neglectable. Noise emissions will be locallly and temporarily increased.

ERF and EMS during construction:

- For the capacity-extension of the ERF an area of about 2 ha will be covered by new installations, from which about 1,6 ha m² will be buildings etc. and about 0,4 ha roads etc. Soil functions will be destroyed or at least reduced within this area.
- The existing vegetation will be destroyed in an area of about 2 ha. This will be mainly lawn on the existing ERF area and thus of low ecological value.
- Additional impact due to noise emission and emission to air will be small and temporarily.

Operation (pipeline and ERF/EMS:

- On the basis of existing literature it can be assumed, that significant effects of the pipeline on the fishing gear is unlikely.
- Noise emissions in the surrounding of the ERF will increase due to the enlargement of the ERF. Due to special noise reduction measures, the emission will meet the current TALärm (noise emission) standards.
- Concerning emissions to air it can be concluded that virtually no increase of the immission impact in the surrounding from the enlarged ERF would take place on a yearly mean. The additional immission impact of the parameters under consideration would reach values under 1% in the yearly mean at the vicinity of the ERF.

Long-term damages to the offshore and onshore environment due to the pipelaying activities can be excluded. Concerning operation it can be concluded that the RFO activities will only have a local short-term impact. Some impact might be contributed by the operation of the extended ERF (noise immissions. However, this will be within the given german standards) and negative gas temperatures onshore.

For the socio-economic situation of the region, the construction as well as the operation of Europipe II will imply a positive economic and employment effect.

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