126-37 A

Second addition to the report "De ecologische consequenties van het omleggen van de Eems door de Dollard".

1. Introduction

In the report of October 1978 and the addition of January 1979, the description of the effects of the rerouting of the Ems were based on the predictions of the salinity changes as given by the Bundesanstalt für Wasserbau and the Wasser und Schiffahrtsamt, Aurich. Since then, the hydraulic model of the Ems has been altered and adjusted and a new interpretation of the results has been given by Barg of the Franziusinstitute in a report "Gutachtliche Stellungname zur Veränderung der Salzgehaltsverteilung im Dollart durch den Bau des geplanten Dollarthafens". The Barg report discusses the salinity changes which will occur because of the harbourworks and rerouting of the Ems but also the changes which are the result of a dam which can be built west of Pogum along the southern bank of the new Ems channel. In this present addition to the RIN report the effects of this dam will not be discussed as no information is available about the dam itself, its construction and the disturbance caused by maintenance. Therefore, possible negative effects could not be quantified. The positive effect of the dam on salinity of the Dollard does not seem to be very large anyway.

In the meeting of environmental specialists on 6 April 1979 in Bonn, where the effects of the Dollard harbour were discussed, it became clear that a number of points needed some clarification. Although figure 5.1 on page 102 (Dutch version) and page 143 (German translation) indicates that there are a great number of biological effects, most of these effects cannot be quantified with the available information. This does not mean however that these effects are not important, and they should certainly be considered when political decisions about the harbourworks are taken. Some of the above-mentioned effects will be treated in more detail under section 7 of the present paper. It should be stressed that in this report only the effects of decreasing salinity will be treated if the Barg report prompts to other conclusions than already given in the original RIN report or the first addition. All other conclusions remain the same.

2. The Barg report

The Barg report can be separated into two independent parts. Part I describes the "standard" Dollard situation on a "standard" day with mean high water level, no wind and median riverdischarge.

Figure I gives the isohalines in the Dollard on such standard day. This map has been made with data that were collected in the field over a long period of time.

The second part of the Barg report describes the expected changes in the salinity because of the rerouting of the Ems. This prediction is based on experiments with the model of the Bundesanstalt für Wasserbau. Although the model did not show such clear gradient in salinity between Nieuw Statenzijl and the Punt van Reide as exists in nature, Barg assumed that the model was good enough to predict salinity changes as a result of the proposed engineering works. Figure 2 shows the isohalines in the Dollard after the completion of the proposed harbourworks, one can conclude that the isohalines in the southeastern part of the Dollard will move approximately 3 km to the northwest because of the proposed works (figure 3).

3. Salinity tolerances

In the original RIN report the salinity tolerances of the most important macrobenthic species were described using maps on which the distribution of the species was plotted and maps on which isohalines were indicated. Maps with distribution of species were available from the Weser estuary (Michaelis, 1972) the Delta region (Wolff, 1973 and unpublished) and the Dollard (Van Arkel en Mulder, 1979). Maps with isohalines for these areas were also available, but for both the Delta region and the Dollard these isohalines were drawn for days with an average river discharge. Because the Barg report describes the effects of the harbourworks with median river discharge it is necessary to compare the distribution maps with salinity maps which present the situation during periods with median river discharge, in order to calculate the salinity tolerance of the individual species. Information from the literature which was collected in laboratory experiments or from the Baltic or Zuiderzee could not be used because a stable low salinity has completely different effects on benthic animals than periodic low and high salinities. Table 1 gives the lowest salinities at which a number of species were found in reasonable densities.

It must be mentioned that the information on salinity tolerance which was obtained from data from the Dollard was not used when estimating salinity tolerance. In the Dollard too many other factors as pollution, turbidity and substrate composition may limit the survival of the species before salinity becomes a limiting factor.

Species	Weser (Michaelis,1972) ‰ S	Delta (Wolff,1973) ‰ S	Dollard (V.Arkel,1979) (Barg, 1979 ‰ S)	species disappear below ‰ S
Nereis diversicolor	5	6	14	6
Heteromastus filiformis	8	19 (7)	14	8
Macoma balthica	6	6	12	6
Mya arenaria	14.5	see text	14	see text
Cerastoderma edule	17.5	19	15	15
Lanice conchilega	15	26	16	15
Eteone longa	?	19	15	15
Arenicola marina	9	19	16	10
Corophium volutator	7	6	14	6
Hydrobia ulvae	?	19	14	14

Table 1: Salinity tolerances of some important macrobenthic species. The last column gives the values which were used in the present paper.

In table 1 no value for Mya arenaria has been given. Wolff (1973) found Mya in areas with a salinity of 6 ^{o}/oo but only in very low densities. The animal occurred in high densities around 11 ^{o}/oo. However it seems that juvenile M. arenaria has a high resistance against low salinities while adults only seem to occur in areas with relatively high salinity. From the available information it is therefore very difficult to give a salinity tolerance for this species. However the species is a very important contributor to the biomass in the Dollard and small inaccuracies in the estimation of the salinity tolerance will result in very large inaccuracies in the estimation of the future production. For example if the salinity tolerance is set at 14 ^{o}/oo it means that the species will disappear from the Maanplaat where at present it reaches a biomass of 5.1 grams/m^2. Therefore the production loss because of the salinity decrease after the construction of the new channel can be calculated at 83.4% or 87.95 tons (table 2). If however the salinity tolerance limit is set at 10% the production loss is only around 32%.

In a very recent survey of the river Ems, Michaelis et al., (1979) investigated the distribution of some macrobenthic species. Although they do not compare the limits of the distribution with the salinity it can be concluded that high densities of Macoma and Mya occur down to approx. 15 ^{o}/oo S at high tide, Corophium and Heteromastus down to 14 ^{o}/oo S and Nereis down to 11 ^{o}/oo S. However one should realise that animals in a river live in an environment with very large fluctuations in salinity, and therefore these animals live under great stress.

On the basis of this table it can be calculated how much macrobenthos can exist in the Dollard in future salinities as expected according to fig. 2.

4. Effects of changes in salinity on the vegetation

The conclusions which were drawn in the original RIN report remain, except the distance over which the vegetation types will move up can now be set at 3 km.

5. Effects of salinity changes on the macrobenthos

Because of the available information on the expected future salinity of the Dollard (figure 2) and the salinity tolerance of the most important species, it is now possible to estimate the decrease in production because of the proposed works. The losses in production have been presented in table 2. For Mya arenaria a limiting salinity of 14 ^{o}/oo has been assumed.

species	present production in Dollard (without Geise)	production losses (without Geise)	% loss
Arenicola marina	2.8	0	0
Nereis diversicolor	77.6	6.2	8
Heteromastus filiformis	33.2	2.11	6.4
Eteone longa	2.0	1.55	97.8
Lanice conchilega	.49	.44	90
Macoma balthica	86.6	5.99	6.9
Mya arenaria	105.4	87.95	83.4
Cerastoderme edule	.1	.1	100
Corophium volutator	37.3	1.10	3
Hydrobia ulvae	5.58	4.56	81.7
Total	351.07	110.0	31.3

Table 2: Production of macrobenthos in the Dollard and estimated production loss due to decrease in salinity (in metric tons dry organic matter/year).

On the basis of this new information one can conclude that the estimated production loss may be of the same order as predicted in the first addition to the report. However the great loss that was predicted for Nereis diversicolor is now thought to be less severe while Mya arenaria is expected to decrease more than thought before.

In this calculation the decrease in production because of the disappearance of the Geise has been left out because the production on the Geise will cease when the harbour is built and the channel dredged, independent of salinity changes.

6. Effects on birds

On the basis of the information supplied under section 5 it can be concluded that around 1/3 of potential food for birds may disappear. A combined Dutch and German working group on birds has tried to translate this information into numbers of birds of particular species that will disappear from the Dollard. However, because Nereis diversicolor and Corophium volutator decrease less than previously assumed, the Avocet (Avosetta recurvirostra) will not incur such great losses as has been predicted earlier. On the other hand, birds that eat Mya arenaria may be effected more. In the Dollard the majority of Mya is of small size (1-2 cm) and is eaten by gulls, Oystercatcher and a variety of other waders.

7. Other effects

As has been said in the introduction and as can be seen in figure 5.1 of the RIN report, the proposed works have a great number of biological effects. Most of these effects cannot be quantified due to lack of sufficient data, but the impact on the ecosystem of the Dollard may be large and these possible ill effects should certainly be taken into account when decisions about the works and industrial settlement are taken. For example, when in an estuary fresh and salt water meet, an increase in turbidity occurs. Part of the sediment, both at the bottom as in the watercolumn consists of organic matter. When this is broken down, oxygen will be used, and locally oxygen shortage may occur. Also there is a risk that when the fresh and salt water are not thoroughly mixed, which will be the case at the end of the ebb, each flood will first push fresh water on to the sand- and mudflats bordering the channel, thereby exposing the animals to extreme shocks. Another aspect which has not been treated in detail is the fact that although many animals disappear below a certain salinity they are less vigourous at salinities far above this lethal level. However, no data were available to quantify the loss in production at these salinities and therefore this has not been included in the calculations. Therefore the effects of the salinity decrease are almost certainly more severe than the calculations indicate.

Texel, August 1979.

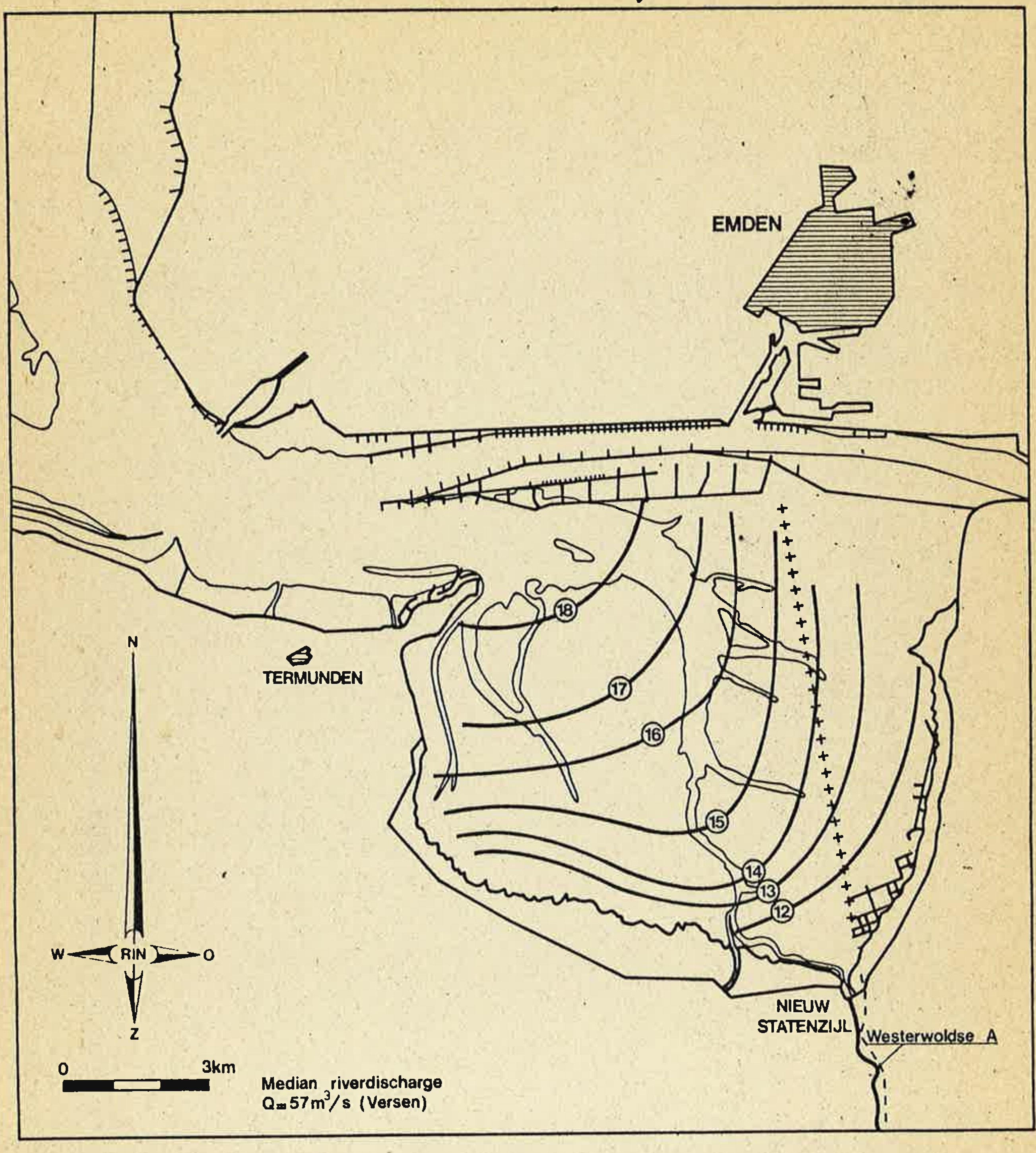

Fig. 1: Salinities in the Dollard on a standardised day (Barg 1979).

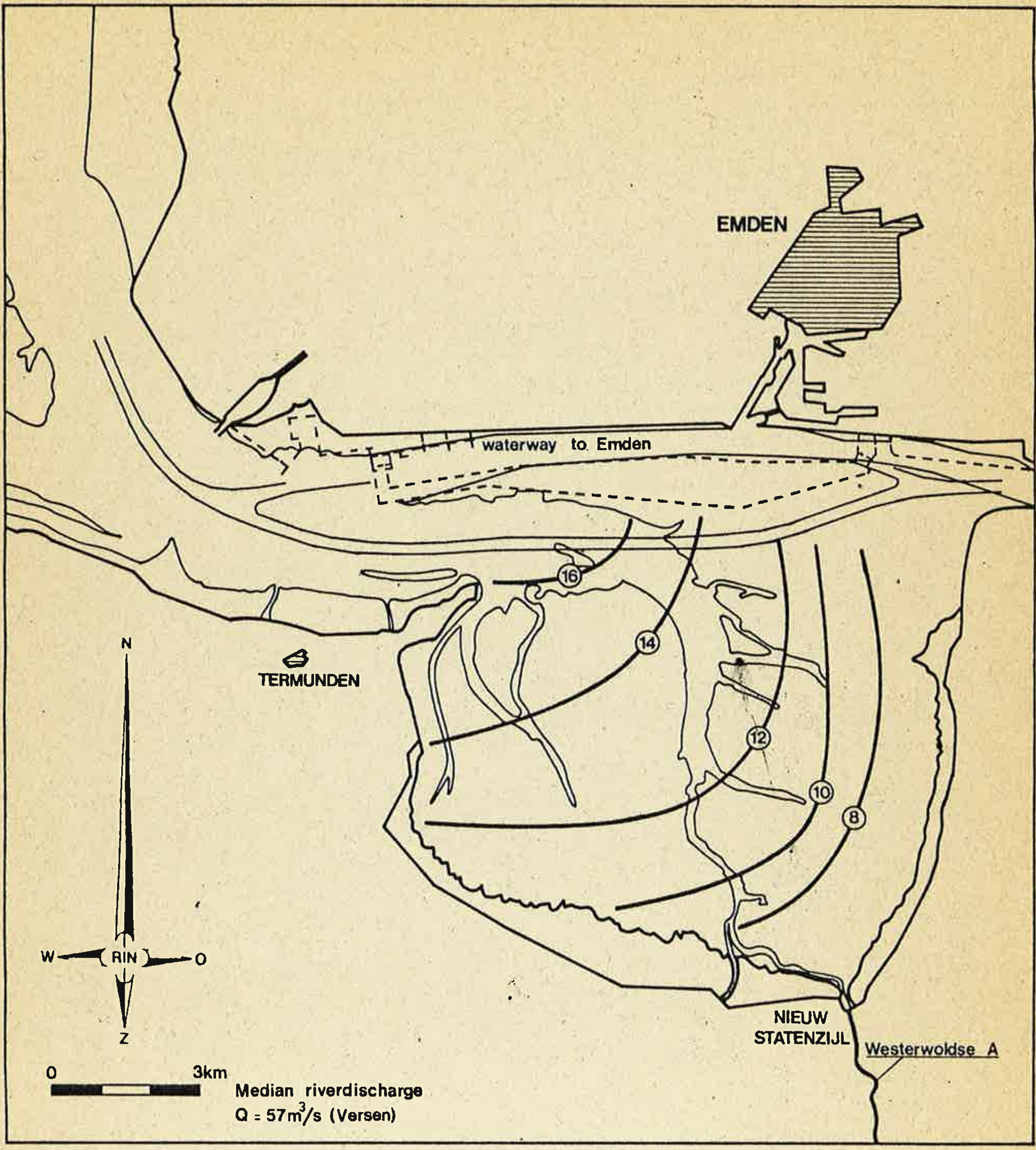

Fig. 2: Salinities in the Dollard after the engineering works have been completed (Barg 1979).

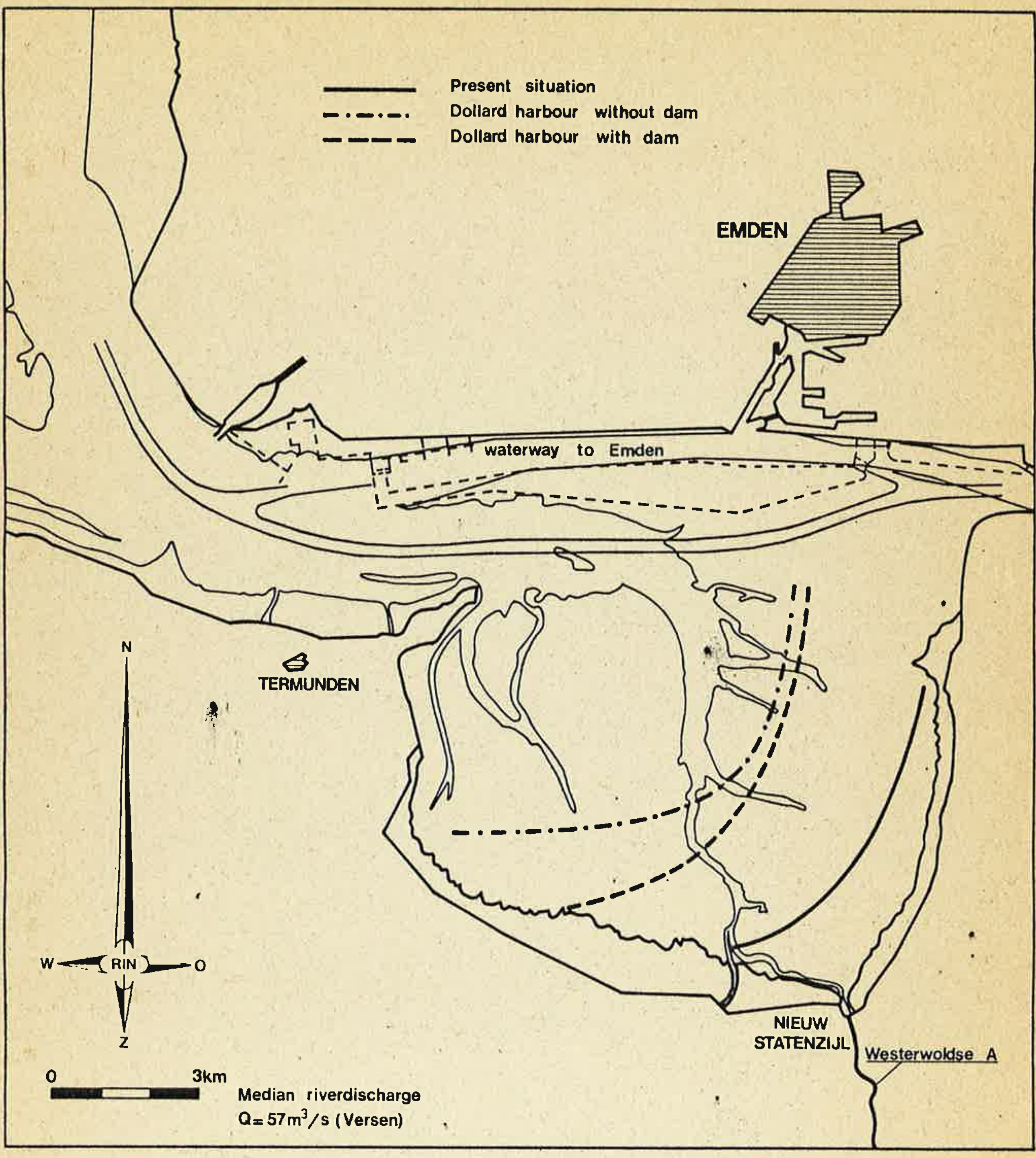

Fig. 3: Distance over which the 12 $^{o}/oo$ isohaline moves up as a result of the proposed works (Barg 1979).