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REPORT OF THE WORKING GROUP ON THE EFFECTS OF EXTRACTION OF MARINE SEDIMENTS

Uppsala, Sweden, 9-12 May 1989

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TABLE OF CONTENTS

ANNEXES

REPORT OF THE WORKING GROUP ON THE EFFECTS OF EXTRACTION OF MARINE SEDIMENTS

Uppsala
May 9-12, 1989

1. OPENING OF MEETING

1.1 The meeting was opened by Dr Jan Olof Carlsson, Director of the Geological Survey of Sweden who welcomed members of the group to Uppsala and expressed his best wishes for a successful meeting. The Chairman, Dr S.J. de Groot (Netherlands), thanked Dr Carlsson and opened the business of the meeting.

2. INTRODUCTION OF MEMBERS

2.1 The attendance list is attached as Annex I. Apologies had been received from Mr. Bide (UK) and Drs. Dethlefsen (FRG), Essink (Netherlands), Geoghan and Minchin (Ireland).

3. APPOINTMENT OF A RAPPORTEUR

3.1 On the proposal of the Chairman, the working group appointed Dr S.M. Rowlatt as rapporteur.

4. TERMS OF REFERENCE

4.1 The Chairman gave the terms of reference of the Working Group as laid out in Council Resolution 1988/2:32 (Annex II). He noted that the resolutions agreed by the ICES statutory meeting suggested that the Code of Practice and Co-operative Research Report would be finalised at this meeting. He suggested that this was unrealistic and the group agreed that the resolutions should refer to the continuation of work on these documents rather than its completion.

5. ADOPTION OF AGENDA

5.1 The agenda as adopted is at Annex III. Papers submitted for discussion are listed in Annex IV.

6. PRESENT STATE OF MARINE SEDIMENT EXTRACTION AND ITS IMPACTS ON THE MARINE ENVIRONMENT (1988) BY ICES MEMBER COUNTRIES

6.1 Belgium

Dredging occurs in three zones off the Belgian coast; on the Zealand banks, the Flemish banks and around the approach channels to the harbours of Zeebrugge and Oostende.

There was little new information to add to earlier reports. Dredging continued at a similar level to that in 1987 although the data for 1988 were not ready for the meeting.

A tax of $9BFrm^{-3}$ is charged on marine won aggregate. 3BFr is passed to the Ministry of Economic Affairs, which is used to support university
studies of geology and benthos at extraction sites. 3BFr is used by the Ministry of Agriculture for benthos and fisheries studies. The remaining 3BFr is taken by the Ministry of Public Health. This organisation co-ordinates all other studies and brings them together as part of mathematical models. At present the models work for currents and presently are being expanded to include sediment transport.

6.2 Canada

Regulatory responsibility for exploration and mining of non-fuel minerals, including sand and gravel in the Canadian offshore, resides with two federal departments. One of them, the Department of Indian and Northern Affairs, regulates activities in marine waters north of 60°N. Thus far this has been limited to sand and gravel exploration and mining in the Beaufort Sea. Since 1972 some 23 million cubic metres have been dredged to construct more than 25 man-made islands. To date the aggregates have only been used to construct exploration islands: should the oil and gas industry decide to progress to production a single permanent island could require in excess of 20 million m^3.

The Department of Energy, Mines and Resources is mandated to regulate mineral exploration and development activities elsewhere in the Canadian offshore. The Department is endeavouring to establish legislation and accompanying regulations but this is perhaps 1-2 years from completion. Until such time the few industry proposals that are submitted are screened for possible environmental effects and, if the response is favourable, exploration may progress. Certain restrictions may be imposed upon the operator with regards to when and how the work may be carried out in a particular area. Mineral rights are not currently issued, therefore, most companies are adopting a wait-and-see attitude.

An operation had been proposed to collect a bulk sample from a placer gold deposit. Although small in scale and unlikely to have any harmful effects on the environment, the project had been abandoned as a result of public concern.

A discussion of the importance of placer deposits followed and it was agreed that consideration of such deposits should be included in the work of the group.

6.3 Denmark

Extraction of sand and gravel for construction occurs in several areas in the Inner Danish Waters and on one location in the North Sea (Horns Rev). In general, 10-15% of the sand and gravel used in Denmark comes from marine sources.

In 1987 a total of 5.6 M m^3 was extracted in the Danish Waters. 1.7 Mm^3 has been used for construction on land, and 3.9 M m^3 for artificial land construction.

The 1987 figures include one major project of 3 M m^3 of sand for artificial land construction in Malmo, Sweden.

Figures for the extraction of sand and gravel in 1988 have not been collected, but will include extraction of at least 3 M m^3 sand for construction of the Great Belt tunnel and bridge.

6.4 Finland

There is little to report for 1988. Areas in the Gulf of Kotka off Helsinki are licenced for the extraction of 1-2 M m^3 of sand. Although fishermen work the area there is no conflict as it is not a spawning ground. The licences have not yet been taken up.

6.5 France

The situation in France has remained essentially unchanged in the past 5 years. 1% of total sand and gravel used is derived from marine sources. All this is extracted off the north coast of France in the Dunkirk and Dieppe areas by English dredging companies. About 3 M m^3 is siliceous sand and 5 M m^3 is calcareous sand.

The primary reason for the low use of marine aggregate is that it is about 20% more expensive than land-derived aggregate.

6.6 Netherlands

In the Netherlands part of the continental shelf of the North Sea and adjacent estuaries only sandy sediments are extracted. For the North Sea the figures for 1986, 1987 and 1988 are respectively ca 2.0, 4.4 and 7.0 M m^3 per year. At least 90% of this quantity is derived from the access channel to the Amsterdam harbours.

The rise in extracted quantities reflects the governmental policy, i.e. to stimulate extraction at sea and limit extraction on land as much as possible.

Apart from the above mentioned extraction for use on land, an amount of ca 5 M m^3 is needed annually for the various beach nourishment programs. In 1988 no major projects were carried out, but in 1989 one of 3 M m^3 is expected for the island of Texel.

Recently the coastal protection policy has been reviewed. As a result of this review beach nourishment emerged as one of the most economic methods of coast protection, so the amount of sand for this purpose will certainly not decline.

Sand extraction in the Wadden Sea is limited to 4.5 M m^3 per year. This is because it is thought that this quantity is not detrimental to the natural subsidence of the area, which is balanced by the tidally induced import of sand from the North Sea.

Gravel extraction in the Dutch sector of the North Sea has not started yet. The only interesting area is the Cleaver Bank area, about 150 km northwest of Den Helder. A pilot project will be conducted in the summer of 1989. In the pilot project technical, economical and ecological aspects will be addressed.

6.7 Sweden

There is little extraction of marine aggregate because there are large deposits on land in eskers. In 1988 a total of 50 000 m^3 was extracted from the seabed in three areas off the west coast of Sweden. 24 500 m^3 was obtained in the area of Stora Mittelgrund, 35 500 m^3 at Vastra Haker and 4 600 m^3 at Sandflyttan. As a result of public pressure, less sand was extracted from Sandflyttan than originally intended. Instead sand was imported from Denmark to fill the need.

Gravel deposits have been found at Digergrund but due to the environmental sensitivity of the area no extraction has taken place.

A tax of 6 Kr m^{-3} is levied on marine won aggregate. This is equivalent to approximately 10% of the value of the sand and totals about 0.5 M kr.

6.8 UK

The full statistics for 1988 are not yet available although it is clear that there has been an increase since 1987. Approximately 19.8 Mt of marine sand and gravel were used by the construction industry and 5.4 Mt for fill and beach replenishment. About 15% of total UK construction aggregate is supplied from marine sources and up to 35% in the London market.

In 1988 income from royalties was approximately GBP 3 M which is expected to rise to GBP 10 M by 1992.

In the next 12 months about 6 new dredgers will be built. In addition a further 6 new dredgers can be expected to be built within the next 5 years. New dredgers will range from about 4 000 m^3 capacity to 1 000 m^3 or less. Most will be trailer suction dredgers with self discharge
facilities.

Two major changes will be made in the administration of dredging licences.

1. In the new Governmental View Procedure all new production applications will be advertised in the national, local and technical press. It will reinforce the informal contact between the Crown Estate Office, the dredging industry and the consultees for the other seabed users e.g. Fishing industry, navigation, Coastal protection interest etc.

2. New licence regulations will be applied to marine aggregate production. The main changes from the previous licence are:

   1) Exclusive prospecting licences for aggregate companies; Prospecting Surveys and Methodology to be agreed beforehand with the Crown Estate Office.

   2) Production licence will be issued for up to 25 years where aggregate resources justify.

3) Complete reprospect of dredging areas every 10 years.

4) Regular monitoring of dredging activity e.g. annual bathymetric surveys, seabed topography etc.

5) Renegotiation of dredging licence every 10 years.

6.9 United States

There has been very little marine aggregate mining in the US in the past year. With one exception the economics have been unfavourable unless there is a large public-works project. Most of the public works have been beach nourishment schemes. These have been undertaken by a variety of government agencies and there is no central compilation of renourishment projects. An estimated 3 to 4 M m^3 have been used, however, and almost all of this sand has been dredged from inlets.

The only general sand mining operation has been undertaken by a company which volunteered to dredge the main shipping channel into New York if they would be allowed to market the sand. They have been active for a little over a year and recently submitted a proposal to deepen the channel from 45 to 70 feet.

In anticipation of a program of bridge and highway reconstruction the State of New York has prepared a draft Environmental Impact Statement for mining some shoal areas in New York Harbour. They intend to lease sections in which trailing suction dredges could operate.

6.10 Discussion

A discussion followed on the level of royalties charged in various countries. In Denmark the rate is 0.5 kr m^{-3} (about GBP 0.1), in Finland 3 Kr m^{-3} (about GBP 0.3), in Sweden up to 6 SKr m^{-3} (about GBP 0.6), in the Netherlands 10c m^{-3} (about GBP 0.03) and in UK about GBP 0.37 m^{-3} for top quality aggregate and up to about GBP 0.87 m^3 for infill material.

7. AN OVERVIEW OF THE RECENT RESULTS OF NATIONAL RESEARCH PROGRAMMES ON THE EFFECTS OF MARINE EXTRACTION OPERATIONS ON THE MARINE ENVIRONMENT PARTICULARLY THE INFLUENCE ON FISHERIES

7.1 Belgium

The Ministry of Public Works is coordinating efforts by various government departments to develop mathematical models of water movements, sediment transport and benthic communities and fisheries around dredging sites.

In the area of the Flemish Banks sand is extracted from the tops of the banks but not the intervening troughs where there is a productive fishery. However, dredging activities have made the seabed more stony than previously.

The disturbance due to dredging and increase in stones at the seabed has resulted in an increase in benthic diversity but has necessitated the use by fishermen of heavier gear. This gear is not only used inthe dredging area but also in the nearby nursery area where it has had a detrimental effect.

In the approach channels to Zeebrugge dredging has been carried out with little regard for the benthic communities, particularly when disposing of dredgings. In that context it is considered by the Ministry of Public Work that deepening the approach channels is more important than preservation of the small shrimp and flatfish fisheries.

7.2 Canada

Sediments in Halifax harbour contain high levels of contaminants including cadmium and mercury. Research is underway to assess the mobility of the contaminants and to establish an environmentally acceptable method to dispose of them.

Discussions are underway to develop procedures by which consideration of ocean mining and fishing interests can be incorporated into the planning process at an early stage. In this context coastal zone usage maps are being considered. Maps and directories of coastal zone usage are also being prepared by Denmark, the Netherlands and UK.

7.3 Denmark

The impact from dredging operations in Køge Bugt has been studied during and after dredging of 3 M m^3 sand for artificial land construction. One area was laid out for stationary dredgers and another for trailing suction dredgers.

Both areas were mapped with echo sounder and side scan sonar during and after the dredging operation. Bottom samples have been taken in both areas. Macrobenthos will be studied in the trailing suction area. Measurements of water quality in the suction holes (up to 12 m) will be taken monthly. A preliminary report will be published in September.

In connection with the construction of the Great Belt Link an extensive program has been started to predict and monitor the environmental impact from construction and dredging activities.

The studies include: Hydraulic modelling, biological mapping of the sea bed, environmental impact studies on the mussels, fish and birds, impact studies on the sediment spreading during construction. Reports will be published in autumn 1989.

7.4 Finland

There are no new results since the last meeting of the group. In the earlier studies no major effects were found on the spawning or fishing of Baltic herring or coregonids. This may be because the extraction zones were located ca 1.5 km from the nearest good spawning area (off Kotka). Sand extraction in 1989-90 will be monitored at a low level by two private consulting firms. So far, there are no results from the sea area off Helsinki.

7.5 France

No research programmes are presently underway.

7.6 Netherlands

In the Netherlands a new Act on Aggregate Extraction is being prepared. This Act prescribes regional extraction plans for every province and the Dutch part of the North Sea. The extraction plan for the North Sea also has an environmental impact assessment component. In this context a literature study was performed in which attention was paid to the influence of sand and gravel extraction on planktonic and benthic organisms and fisheries. Significant long term effects were not described. Short term effects, such as increased turbidity are well known; fish tend to avoid these areas and mortality due to turbidity seems to differ between species. Especially vulnerable are the eggs and larval stages, although it should be noted that many fish species develop in shallow coastal waters that are excluded from extraction because of potential erosion problems. The only direct negative effect of sand and gravel extraction on fisheries that was encountered was for sand eel, which bury themselves in the seabed during winter. A positive effect may be that fish are attracted to areas where extraction occurs and where benthos die.

In this context another study was directed towards the effects of extraction on water quality (increased turbidity, release of organic matter and contaminants). Assuming trailer suction during one hour, covering an area of 1 500 x 250 m, extracting 5 000 m^3 with a specific weight of 1.6t m^{-3} containing 5% particles smaller than 80 microns, it was concluded that overflow of fines (240 tons/hour) leads to an increase in suspended matter of 32 mg l^{-1} during slack water. During other tidal conditions the increase depends on the working direction compared to the tidal currents. Dredging perpendicular to tidal currents of 0.75 m s^{-1} leads to 3 mg l^{-1} extra suspended matter, parallel to the currents lends to 25 mg l^{-1}. The increase due to overflow should be compared to natural background levels and levels caused by storms.

Assuming the same overflow of fines, containing 1 ton of organic matter that can be mineralised, it was concluded that the oxygen consumption is about 0.03 mg O_2 per litre per hour. With respect to the release of nutrients and heavy metals from the interstitial/pore water it was assumed that in the worst case (slack water) dilution with sea water will be in the order of 350 times. Negative effects at short time scales are therefore unlikely.

Another important field of research is related to the management of coastal defences. To avoid erosion of the coastline the extraction of sand is prohibited landward of the 20m isobath. This policy was based on expert judgement. Because of a new Sea Defence Act, presently in preparation, shoreface behaviour has been extensively analysed and computer models developed to give an insight into sediment dynamics and shoreface behaviour due to currents and waves.These tools were used to investigate influence of sand extraction on shoreline behaviour.

At one location, considered to be more or less representative of the Dutch situation, extractions of 0.2, 1 and 10 M m^3 were considered at the 16 and 20 m. isobaths (4 and 11 kilometers offshore). No direct effects on the coastline, due to a changing current pattern and wave climate were predicted. Negative effects on the coastline due to landward migration of dredge pits were not expected within 200 years.

The results of this study will not result in another policy with respect to sand extraction nearshore in the short-term because the computer models could not be validated in the field. Therefore the above-mentioned results should be considered to be indicative and a large scale field experi-ment is urgently needed.

The last study to be mentioned has to do with the environmental impact of gravel extraction in the Klaverbank (Cleaver Bank) area. Preceding the extraction phase a field inventory has been executed to obtain information about the benthic life present in the areas to be licenced.

Late in 1988 interest emerged to assess the economic and technical feasibility of the extraction of heavy minerals as a by-product of sand extraction for beach nourishment or dune replenishment.

Early in 1989 it was decided by the Ministries of Economic Affairs and Transport and by Public Works to jointly fund such a study based on an existing plan for sand extraction. The study deals with the situation on the north coast of Ameland island where an area of low dunes needs strengthening. Also Ameland is affected by slow subsidence due to gas extraction. The aim is to dredge sand offshore in a conventional way, store it on the beach and use a portable jig-type separating device to concentrate the 1% of heavy minerals to a concentrate of 80-90%. The most interesting heavy minerals are titanium minerals and zircon. Dredging will take only a short period, the separation may take the whole summer season. The resulting report will appear in June 1989.

7.7 Sweden

No effects studies are presently carried out in Sweden.

7.8 UK

A total of seven extraction sites in three areas have been monitored in the last year: one at Hastings Shingle Bank, three to the east of the Isle of Wight and three to the east of Southwold in the Southern North Sea. The extent and intensity of dredging activity is each license area has been determined by the use of side scan sonar. In one licence area east of the Isle of Wight further information was gained on the effects of trailer dredging activity upon the substrate and its epifauna through deployment of an underwater sledge, bearing video and stills cameras.

Two research programmes are currently being developed to meet the need for more information on the effects of extraction upon the benthic environment and fisheries, with which to help assess licence applications.

1. Monitoring of Hastings Shingle Bank.

Extraction was licensed in this area in 1988. Baseline surveys have been conducted to characterise the substrate and benthic communities. Annual side scan sonar surveys are planned, backed up by deployment of underwater cameras and a seafloor sampling programme. Comparison of these data with that already obtained should provide much useful information on the progressive effects of dredging in this area.

2. Analysis of Dredged Grounds by Divers.

A survey of methodology has been developed for use by divers to permit detailed description and sampling of the seafloor. Direct observation and study of dredge tracks or pits will thus be possible, the results of which should complement the information obtained by more remote techniques. Dredged grounds to the east of the Isle of Wight will be the first to be studied by this technique.

7.9 US

The active mining in the navigation channel in New York Harbour is not being monitored for environmental impact. Environmental impacts for the proposed work are being anticipated from past studies - both site specific studies of the resources and research on the dredging process that has been done elsewhere. Among the principal issues are the potential effects on the recreational fishing in the area. Old borrow pits in the Harbour tend to concentrate fish and, while the sport fishermen use the existing pits as a useful habitat, akin to a fishing reef, they are opposed to the creation of new pits. The basis for seasonal restrictions on dredging is being examined but it seems that dredging windows applied within the river/estuary will not be used in the more open reaches of the harbour.

In related research, the US army Corps of Engineers has begun a Dredging Research Program. One of its main objectives is an improvement of predictions of related sediment transport and the Corps Coastal Engineering Research Center has been working on a new, two dimensional model for predicting coastal sediment motion and morphological changes.

The classification and handling of contaminated sediments has recently been renewed by separate working groups in the US; the Environmental Protection Agency and the National Research Council. The US Corps of Engineers is also planning a major national programme for the study of contaminated sediment.

The development of automated or remotely sensed monitoring systems is attracting attention. The US Coast Guard uses "black boxes" on sewage sludge barges to monitor barge location and draft. Similar devices may be considered for dredging operations as well as the use of acoustic turbidity sensors at dredging and disposal sites, the telemetry of information in real time and the use of "intelligent" data loggers.

8. PROGRESS SINCE LAST MEETING ON THE EFFORTS TO MAP SUPERFICIAL MARINE SEDIMENTS BY ICES-COUNTRIES

8.1 Belgium

Seabed mapping of the Belgian Continental Shelf is being carried out by the Fisheries Research Station of the Ministry of Agriculture and by various University departments, co-ordinated by the Ministry of Public Works. The first eight maps were published early in 1989. These are:

i. A 1:100,000 scale map of the superficial sediments of the Belgian Continental Shelf

ii. Six 1:40,000 scale maps depicting different aspects of an area of the Flemish Banks encompassing the Buiten Ratel, oost Dijk and Kwinte Banks/: Detailed Bathymetry, Gravel Content, Percentage Mud, Sorting of 4mm fraction, Median Grain Size and Morphostructure.

iii. A 1:20,000 scale map of the bathymetry of the Rateltop.

8.2 Canada

Over the past couple of years the Geological Survey has begun to devote greater effort to regional mapping of the shallow water coastal areas of Atlantic Canada. In 1987 a detailed survey was carried out off the east coast of Cape Breton Island, Nova Scotia. High resolution geophysics and bottom grab samples were used to prepare a map of the superficial sediment distribution for the purpose of assessing aggregate resource potential. This map will be released within the next few months.

In the summer of 1988 13 cruises were run to map the distribution and thickness of shallow bedrock, surficial sediments and seabed features such as sand waves. The cruises were largely geophysical but select bottom samples were also collected. Mapping of the coastal waters was done in the Bay of Fundy, off the Scotian Shelf, the southern Gulf of St. Lawrence and off southern Newfoundland. Plans are underway to construct a fixed link between Prince Edward Island and the mainland in the Gulf of St. Lawrence. For this reason the data collected in this region are the first to be interpreted and published. Maps for the other regions will be released over the coming year.

For 1989 the nearshore mapping programme will be more modest. Two areas have been identified for investigation: Halifax Harbour and Cape Split in the Bay of Fundy.

8.3 Denmark

Mapping has been undertaken in many areas. The main purpose of this effort is to identify areas of interest. Rapid mapping techniques are used to achieve this end. There are large areas of glacial and reworked glacial sediments. The latter contains localised deposits of sand and gravel and further effort will concentrate on these areas.

8.4 Finland

The sea area off Kotka and Pyhtaa (eastern Gulf of Finland) has been mapped at 1:25 000 and mapping is almost complete off Helsinki. In the future, mapping of superficial sediments will be carried out in the Archipelago Sea off south-west Finland and in the Gulf of Bothnia.

8.5 France

Maps are being produced of the French EEZ, an area of 11 x 10^6 km^2. This production is being coordinated by IFREMER.

The first stage is a series of bathymorphologic maps of geology and sedimentology. The scale will be 1:250 000 in shallow water and 1:500 000 in deep water.

The second stage will be the production of thematic maps including topics such as mineral resources and geological hazards. A series of fishing charts along the Atlantic coast are being produced at 1:60 000.

8.6 Ireland

Dr Geoghan informed the group of mapping activities in Ireland by letter.

The Geological Survey of Ireland (GSI), Marine Section is responsible for and carries out the mapping of aggregates and surface sediments within the continental shelf of Ireland. The resource based mapping programme which started in 1976 is concentrated on the following topics:

1. resources such as sand and gravel down to 38m depth along the south-eastern coast of Ireland. As well as producing its own map GSI has cooperated with BGS and the results are included in the BGS maps of the area;

2. offshore coal in the Kish Bank Basin east of Dublin. Some results from this work are included in the BGS maps;

3. investigations on the south coast related to hydrocarbon exploration activities, where the GSI purpose is Geotechnical mapping and identifying suitable submarine routes for pipelines. The investigation area goes from 1 Nm off the coast to about 10 Nm offshore.

4. Geological mapping in the Galway Bay Area out to 11°W, with particular emphasis on the Quaternary history and the occurrence of paleo-shorelines. Techniques used are mostly Geophysical but include some benthic sampling.

5. for fisheries use thematic mapping (side-scan sonar) of fishing grounds NW Donegal (NW Ireland) on behalf of the Sea Fisheries Board of Ireland (BIM)

6. Mapping Heavy Mineral Beach Sand occurrences and their extensions offshore.

The equipment used for this work includes sparker, boomer, pinger, sidescan sampler and various sediment samplers. No complete maps have yet been published although sections have appeared in various publications.

8.7 Netherlands

Dr Schuttenhelm presented a report on the Netherlands mapping programme which is attached as Annex VI.

8.8 Sweden

The Swedish continental shelf is about 160 000 km^2 in area. Geological maps have been produced in the Sounds and to the north of Gotland. These maps are at scales of 1:50 000 and 1:100 000 respectively

Thematic maps are also being developed for the Gotland area. These include maps of sand resources and bedrock.

In order to increase continental shelf mapping the Swedish government is funding a new ship (costing 30 M SEK) and will double the size of the marine geology unit of the geological survey. In the field, data will be acquired using a variety of acoustic and seismic techniques. All data will be logged on and interpreted using a computer. The first stages of the interpretation will occur in the field. On return to the laboratory the data will be combined with results from laboratory analyses of sediment (e.g. particle size analysis) and be interpreted further.

It is hoped that the maps in Sweden will be combined with those from Denmark to produce a complete map of the Skagerrak. The Danish maps are less detailed than the Swedish and careful consideration is therefore needed to ensure the final product is of uniform detail.

8.9 UK

The British Geological Survey are producing a suite of maps covering the continental shelf around the British Isles. The sheets are being produced at 1:250 000.

In addition, more detailed studies of selected areas are being carried out to produce a three dimensional picture of the geology including information on bottom conditions and aggregate deposits. This information is presented on 1:100 000 scale maps and is intended to improve offshore resource management. These projects are not designed to evaluate aggregate resources but to provide information on regional geology and allow judgements to be made concerning the likely location of deposits.

The 1:100 000 series maps are based on studies using high resolution seismic profiling and sidescan sonar, grab and core sampling. 7 maps are produced in each area: bathymetry, location of geophysical and grab/core sampling, seabed sediments and bedforms, thickness of superficial sediments, seismostratigraphy, geology, potential aggregate resources. A set of maps have been published recently of the Southwold area off East Anglia and further programmes are underway to the east of the Isle of Wight (in the Channel) and off the Humber.

The Crown Estate Office is developing a Geographic Information System which will eventually store all the relevant information related to the marine sand and gravel industry in the United Kingdom.

8.9 US

Mapping efforts in the USA have been generally limited to the re-analysis of existing data and samples. Available information on surficial sediments is being recompiled by the US Geological Survey at a scale of 1:1 000 000. They intend to remap the entire Atlantic coast and the coast of the Gulf of Mexico; the first map will be of the New England Shelf. In the northeast the Survey has done extensive, regional seismic surveys (Uniboom) and maps of the acoustic stratigraphy are being produced.

The US Minerals Management Service has provided about USD 30 000 per year to the individual state geological surveys. The service has also provided for the analysis of existing vibrocores for heavy minerals. The cores had been taken during the early seventies by the Corps, Coastal Engineering Research Center. Originally intended to document sand resources for beach renourishment they are now being used to search for evidence of placer deposits.

9. CONTINUE WORK ON DRAFT COOPERATIVE RESEARCH REPORT

It was decided that this item would not be discussed at the meeting but would be progressed intersessionally.

10. CONTINUE WORK ON DRAFT CODE OF PRACTICE

The draft produced at last years meeting was modified and is attached as Annex V.

11. ANY OTHER BUSINESS

Dr Hale demonstrated a computer based geographical information system which contained information relating to fisheries, mineral deposits and various physical and other variables (bathymetry etc). This could be used to identify potential conflicts in coastal zone usage. It was agreed that this system had great use and should be discussed at future meetings of the group.

12. WORKING GROUP RECOMMENDATIONS

The working group adopted the recommendations listed below

1. Include industrial and placer mineral deposits in the work of the group (this is a topic of interest in Canada, the Netherlands US and UK).

2. Evaluate programs to study sand and gravel movement and dispersion.

3. Review the development and implementation of "Black boxes" for recording the movement and operation of dredging vessels.

4. Continue efforts on seabed mapping aimed at amongst other things an improvement in survey techniques, presentation methods and harmonisation and coordination of national mapping programmes.

5. Produce an inventory of sediment textural classification and resource definition schemes.

6. Produce a booklet and chart of superficial sediment and resource distribution maps of the whole ICES area.

7. Continue work on the Cooperative Research Report on the 'Effects of marine aggregate extraction on fisheries'.

8. ICES should provide the group with summary data on sand and gravel extraction data submitted by member countries.

9. Finalise the code of practice on effects of the extraction of marine minerals and aggregates on fisheries. Regulatory officers from member countries should attend the 1990 meeting of the group.

10. The group should met in Charlottetown Canada on May 15-21, 1990.

13. CLOSE OF THE MEETING

Dr de Groot thanked Dr Cato and the Swedish Geological Survey for their hospitality and the various attendees for a stimulating and fruitful discussion. He then declared the meeting closed.

ANNEX I ATTENDANCE LIST

ICES, WG Effects of the Extraction of Marine Sediments, Uppsala 9-12 May 1989

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ANNEX II

C. Res. 1988/2:32

2:32 The Working Group on the Effects of Extraction of Marine Sediments (Chairman: Dr S J de Groot) will meet in Uppsala, Sweden, from 9-12 May 1989 to:

a) finalize work on an overview paper on the effects of marine extraction;

b) finalize work on the Draft Code of Practice on Effects of the Extraction of Marine Sediments on Fisheries.

ANNEX III

Draft Agenda - meeting ICES WG on the Effect on Fisheries of Marine Aggregate Extraction, SGU - Geological Survey of Sweden, Uppsala, 9-12 May 1989.

1. Opening
2. Introduction of the members
3. Appointment of Rapporteur
4. Terms of reference of the WG (C. Res. 199/2:32)
5. Adoption of the Agenda
6. Present state of marine sediment extraction and its impacts on the marine environment (1988) by ICES member countries.
7. An overview of recent results of national research programmes, environmental impact studies, on the effects of marine extraction operations on the marine environment.
8. Progress since last meeting on the efforts to map superficial marine sediments by ICES-countries.
9. Continue work on draft Cooperative Research Report
10. Continue work on draft Code of Practice
11. Any other business
12. WG recommendations
13. Close of the meeting

ANNEX IV PAPERS MADE AVAILABLE AT THE MEETING

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ANNEX 5

DRAFT CODE OF PRACTICE ON EFFECT OF THE EXTRACTION OF MARINE MINERALS ON FISHERIES

I INTRODUCTION

The guidelines outlined here are intended to foster cooperation between two of the principal users of coastal resources. They are not intended to be universally applied but rather to provide a flexible framework that every country must adapt to its own regulatory system. It is also recognised that the fisheries impacts are not the only important issues that must be addressed.

It also needs to be borne in mind that in some countries it is made clear to the fishermen that fishing may continue in dredging areas but at their own risk, in others provision can be made for regular contact to allow as far as possible for fishing to continue. For example, active fishing techniques and dredging can often exist side by side quite comfortably but static fishing methods cannot. In some cases it may be necessary to restrict dredgers access to areas to allow fishing to proceed.

Because of radical differences in approach by each country we cannot foresee at this stage any generalised code of practice being applied to navigational dredging. Our recommendations relate to licences of extractions of sand and gravel and other minerals for specific purposes.

II PRE-PROSPECTING

1. Need for initial round of consultation to identify all immediate conflicts between relevant government departments.

2. A need for a list of sources of information to advise companies of the procedure prior to licensing.

3. Prior to issue of the Prospecting Licence maximum relevant information needs to be made available to fishermen and all other interested parties.

4. In the case of very large areas to be licensed for prospecting companies should provide an outline prospecting programme detailing type of operation.

5. For future use of information gained by prospecting activity normal mining code provisions will apply.

III PROSPECTING

Needs to detail fundamental elements that a prospecting licence will cover.

Elements

1. Duration of licence (2-4 years)
2. Exclusive/non-exclusive
3. Size (geographical coordinates)
4. Forms of activity eg hydro acoustic methods, dredging, grab sampling or screening activity etc
5. Volumes of material sampled
6. Royalty, fees
7. Statutory/non-statutory
8. Notice to other marine users

It needs to be considered that:

1. The applicant must consult the fisheries interests whether via the appropriate authority or directly
2. Techniques that might have a physical effect should be subject to a specific consultation procedure
3. In areas of sensitive fisheries or environment, techniques should be restricted to non-intrusive activities; however prospecting should occur over the whole area whether extraction is likely to be licensed or not to provide a complete picture of the geological environment
4. It is the responsibility of the regulatory authorities to identify areas of particular sensitivity that require environmental assessment before any prospecting activity proceeds (for example marine nature reserves or sensitive spawning areas)
5. There also needs to be voluntary procedures on communication at
   a) government/company management level
   b) district inspector of fisheries/dredging operations level
   c) immediate contact, skippers of fishing vessels and dredging masters
6. Minimum periods must be laid down for notice to be given to fisheries interests of dredge samples to be taken (4 weeks in UK but depending on each country's levels of communication between industries)

7. There must be provision for conflict resolution procedures at this stage. There needs to be representation of the regulatory authority, the fishery and the company, and any other interests. The exact procedure will depend on national requirements.

IV CONSULTATION BEFORE LICENSING OF EXTRACTION

Two aspects need to be identified

1. Who should be consulted
2. The practical issues

Bodies to be consulted

a) Wildlife/conservation/environmental representatives
b) Fisheries
c) Defence
d) Energy
e) Navigation
f) Coastal protection
g) Engineering and construction works (cables; telephone and power etc/general works)
h) Littoral councils (local planning authorities)
i) Recreation/amenity interests.
j) Waste disposal authorities

The group also recommends that when a proposal is being considered it should be published in the Press indicating where relevant information can be obtained providing an administrative address for all representations to be sent to. All consultees should be informed of the outcomes of the consultations.

The exchange of information among the licence authority, the mining industry and representatives of the fisheries is essential. There should be one body (not necessarily the licence authority) who acts as coordinator in this process. In addition, when a proposal is being considered it should be published in the Press indicating where relevant information can be obtained providing an administrative address for all representations to be sent to.

Issues to be considered

Specific information both desirable and essential will be required from dredgers and fishermen in considering licensing of extraction.

1. Dredging information

a) Specific area - specific coordinates must be supplied detailing the area for practical exploitation of the resource taking into account maneouvering of the dredging vessel.
   - larger areas for extraction to be zoned into smaller strips for extraction. This could relate to seasonal fishing patterns and the need for general access by other resource users
   - extraction areas could be marked/buoyed to assist identification at sea.

b) Types of dredger should be specified in the application.

c) The application should attempt to quantify the level of dredging activity to assess the level of disturbance likely to occur.

d) The application should detail routes to and from the dredging site especially in areas where there is particular potential for conflict.

e) Requirements on how the area will be left after extraction.

f) Maximum thickness of sediment which can be taken.

g) Sedimentation patterns from outwashing, level of screening and types of fines discharge.

h) Expected life time of the resource and rates of extraction.

i) Provisions for regular review of this information.

j) Action to be taken in the event of non-compliance with licence conditions.

2. <u>Information on the fishery resource and the intensity of fishing activity</u>

a) Location of spawning grounds and the identification of spawning seasons

b) Sensitive nursery areas

c) Location of shellfish beds

d) Feeding grounds of finfish and crustaceans

e) Migratory routes of crustaceans and finfish

f) Number of vessels fishing the areas

g) Type of gear used (eg potting, long-lining, fixed nets, trawls, drifting nets, etc)

h) Periods and areas of intense fishing activity

i) Points of contact with fishery organisation

j) Size of the catch

k) Routes used to and from fishing grounds

This should cover as much detail as reasonable but particularly identify sensitive seasons and sensitive areas.

The regulatory authority should make the final decision on licensing of extraction. Before reaching this decision it is important that there should be provision for information to be given to the local fishing interests and for them to provide information on potential conflicts and fisheries interests so that this can be incorporated into the licensing procedure either by resolving these problems completely or by including specific conditions in the licence.

The outcome of the consideration should be published or made available to interested bodies before dredging commences in licensed areas.

V ISSUES TO BE COVERED IN PERMIT FOR EXTRACTION

1. Area by coordinates
   a) extraction
   b) additional area for maneouvering
   c) area where there would be no compensation for loss of fishing gear.
2. Period of licence and provisions for premature termination of licence.
3. Maximum volumes permitted within period of licence. The point of measurement of this volume should be specified in the licence (for example whether in the hopper or when landed). Subsidiary periods could also be included for example an annual extraction limit rather than a total amount.
4. The depth of extraction should be stipulated where necessary and a maximum permitted sediment depth of extraction could be included where appropriate.
5. The licence should contain a requirement to leave behind a habitable substrate of specified composition. In most cases this will be the same as exists before extraction.
6. The methods of dredging must be detailed in the licence.
7. The licence should specify whether screening may be carried out.
8. An appropriate programme of monitoring should be agreed and incorporated into the licence. Monitoring may include rates of extraction, effect on bottom conditions, effects on biota and effects on fish stocks.
9. There should be surveillance to ensure that amounts stipulated by the licence are not exceeded, areas not transgressed and physical conditions complied with. In this regard, the licence should provide for access by an appropriate authority to the dredger's log, company's records etc and for inspection to operations by regulatory authorities. It could be considered whether a black box system would be appropriate or feasible.
10. A minimal navigational standard of positioning system on the dredging boats to be stipulated.
11. The dredging company must supply regular returns of volumes extracted to an appropriate authority.
12. The licence should specify whether or not the permit for extraction is assignable.
13. The licence should include provision for seasonal adjustment including the suspension of dredging if necessary at certain times.

ANNEX 6

Netherlands contribution to the ICES Working Group 'On the effects of Extraction of Marine Sediments' meeting at Uppsala, Sweden, May 8-12, 1989

Superficial sediment, seabed resources and morphological mapping in the Netherlands sector of the North Sea

by R.T.E. Schüttenhelm/J. van Alphen

Geological Survey of the Netherlands (RGD)/The Netherlands Ministry of Transport and Public Works (RWS)
Haarlem/Rijswijk, May 10, 1989

Introduction

Interest in the geology and morphology of the Netherlands sector of the North Sea has grown considerably over the last decades. In part because there are various resources at depth and near the surface, in part because it is the last remaining open space of some extent in the Netherlands.

The (near) surface resources, mainly consist of various kinds of sand. Increased sand and gravel exploitation offshore would be in line with the national policy to put more restrictions on further exploitation on land.
In order to know what is where, systematic mapping of (near) surface sediments as well as surveys for particular types of raw materials have increased over the last years. In addition a geomorphological map of the Dutch shoreface and adjacent part of the continental shelf has been prepared.

The Netherlands and the Netherlands North Sea- Reconnaissance map of raw materials at or near the surface

This 1:1,000,000 map (Niessen & Schüttenhelm, 1986) in a local stereographic projection, is, as regards the offshore part, an updated version of a superficial geology map (same scale, Mercator projection) of the Dutch sector (Schüttenhelm, 1980). The map depicts the composition of the uppermost 50 cms using the international phi (Wentworth) units. The map is available at the Geological Survey of the Netherlands.
The data show that surface sediments of the Dutch sector of the North Sea only contain relatively small to very small quantities of coarse sand and gravel. Medium sand is being extracted in the southern part where it occurs over large areas. Fine sand is present in the central, the northernmost and the northeastern parts of the shelf. Very fine sand an mud occur mainly in the Oyster Grounds area, the north-central part of the Netherlands North Sea.
In Schüttenhelm (1980) some particulars are given on the composition, distribution and origin of these surface sediments.

Reconnaissance mapping of Sea Bed and Holocene (and older) Sediments on both sides of the median line by the British Geological Survey (BGS) and the Geological Survey of the Netherlands (RGD) on scale 1 to 250.000.

BGS and RGD are jointly publishing a series of 1:250,000 maps of North Sea areas straddling the median line. The map series per area consist of pre-Quaternary (Solid), Quaternary (Pleistocene) and Sea Bed Sediments (Holocene) maps. RGD has started to continue this series towards the German sector. The Netherlands Ministry of Transport and Public Works (RWS) contributed much to the data collection in the Netherlands sector.

The Quaternary map shows a number of seismo- and lithostratigraphic units (formations) ranging from deltaic, and marine transgressive sediments, tidal flat deposits and lacustrine clays to various non-marine, including glacial, deposits. See Laban et al (1984). Relevant properties of formations are shown.

Also the sediments of the Holocene marine transgression have been subdivided into a few formations, each with a characteristic lithology. Various properties of the (near) surface sediments, are shown, as they are the main target for sand and gravel exploration and exploitation offshore.

At present Sea Bed Sediments (Holocene) maps are available at BGS and RGD from the Flemish Bight area (52°-53° N, 2°-4° E) and the Indefatigable area (53°-54°N, 2°-4° E). See Cameron et al (1984) and Harrison et al (1987).

A similar map of the Silver Well area (54°-55° N, 2°-4° E) is just published while maps of the Dogger area (55°-56° N, 2°-4° E) and Ostend area (51°-52° N, 2°-4° E) are in press. The Ostend maps have been prepared in cooperation with the Geological Survey of Belgium (BGD), while the Dogger maps have been made with German Geological Surveys and the Danish Geological Survey.

Mapping of exploitable sands for industrial use in the nearshore areas of the Netherlands North Sea

At the request of the North Sea Directorate of Rijkswaterstaat a report with 1:100,000 maps (Niessen, 1986) was made to show the occurrence of various types of (near) surface sands within a radius of 50 kms from five Dutch seaports.

On the maps occurrences of sands suitable for concrete and mortar fabrication, infill-sand and sand for (coastal suppletion purposes have been distinguished.
Definition used in this report are:

concrete/mortar sand	- d50 $>$ 250 μm and d50 $\leqslant$ 1000 μm, mud content $\leqslant$ 2%, lime content $\leqslant$ 25%
infill sand	- d50 $<$ 250 μm and $>$ 63 μm, mud content $\leqslant$ 50% and with max. 8% $<$ 2 μm
suppletion sand	- d50 $>$ 250 μm, mud content $<$ 10%.

Sand properties were studied down to 5 m below the surface.
The five seaports, the main ports in the Netherlands, are Rotterdam/Hook of Holland, Flushing, IJmuiden, Den Helder and Eemshaven.

Concrete and mortar sand is found locally off the first two harbours mentioned above, infill sand around all harbours. Suppletion sand only occurs southwest of Hook of Holland.

A comparable, but more detailed study, also within a 50 mile radius of the same five main ports but in areas deeper than the 10 m isobath, is planned for the near future.
The present draft of the 'Regional aggregate exploitation plan for the Netherlands sector of the North Sea' (draft of June 1987) however, containes a modified set of sand classifications which should be used from a future date onwards.
Future definitions are:

concrete sand	- d50 > 400 µm, mud content < 2%, lime content < 25%
mortar sand	- 300 µm < d50 < 1000 µm, mud content < 2%
infill sand	- 63 µm < d50 < 250µm, mud content < 8%
suppletion sand	- d50 > 200 µm

Exploration for gravel occurrences

In 1980 a gravel deposit was discovered in an area a little over 150 km northwest of Den Helder, the so-called Botney Cut-Cleaverbank area.
Successive studies showed that the deposit extended over parts of the blocks K1 and E16, southeast of Dogger Bank. Waterdepth is 30-40 m and more.
Gravel content varies between less than 30 to 80%. The gravel layer is 0.2 - 2 m thick. Sand ribbons locally cover the gravel. The gravel is related to the limit of an Weichselian land ice sheet that covered part of the western side of the North Sea. The volume of gravel at waterdepths of less than 40 m is estimated at 40-50 millions of tons, which is 2-2.5 times the annual gravel consumption in the Netherlands (Wiersma & Schüttenhelm, 1984).

The discoverage was made known to industry for exploitation. However, the costs are just above those of gravel mined along the Norfolk coast. Also the working depth of the dredgers is seen as a limiting factor. In 1987 trail dredging was performed there as a first pilot project, which will be continued in 1989. Attention will be paid to technical, economical and ecological aspects.
The gravel deposit is the first such deposit discovered in the Netherlands sector since systematic marine geological reconnaissance and mapping started in 1968.
Recent surveys in small areas northwest of the islands of Texel and Vlieland suggest the occurrence of local gravel accumulations within a large sand area. A study to delimit the area of interest is under way. Gravel percentage and gravel volume estimations are not yet available.

Future developments

The systematic geological reconnaissance mapping on scale 1:250,000 of the Netherlands

North Sea will be continued in such a way that maps of about half of the area will be published in or before 1991, with the other half available before 2000 A.D.

In 1985 in close cooperation with the North Sea Directorate a more detailed geological mapping programme on scale 1:100,000 in the nearshore areas was started anew. First maps will be available within a few years. This mapping programme will include detailed studies of the surface and near surface sediments, their properties and their use. Emphasis will be put on resources with thickness and water depth.

Besides, it is expected that, at intervals, detailed surveys for specific types of aggregates in small areas will take place.
There is for instance still hope that there might be a few more small gravel deposits in the Netherlands sector.

A reliable offshore aggregate exploitation scheme that also takes in account various other interests like that of the fisheries can only be devised when the various aggregate occurrences are identified.

A geomorphological map of the Dutch shoreface and adjacent part of the continental shelf.

Knowledge about the seafloor resources and geomorphology is imperative for further development of the shelf but also for a proper management of the shoreface, that acts as a sea defence for the density populated area of Holland. Within this framework the Ministry of Transport and Public Works (North Sea Directorate and Survey Department) prepared a geomorphological map, scale 1:250.000 of the Dutch sector of the North Sea south of 53.40^{0} N. This map consists of four sheets, printed in colour. It is based on detailed soundings, scale 1:10.000 or 1:25.000. The map shows the distribution of the major morphological elements like the shoreface, ebb-tidal deltas with their shoals and channels, tidal ridges, sandwaves and bars. The legend of the map is explained in Van Alphen & Damoiseaux (in press). In this publication the origin and behaviour of the elements is discussed as well.

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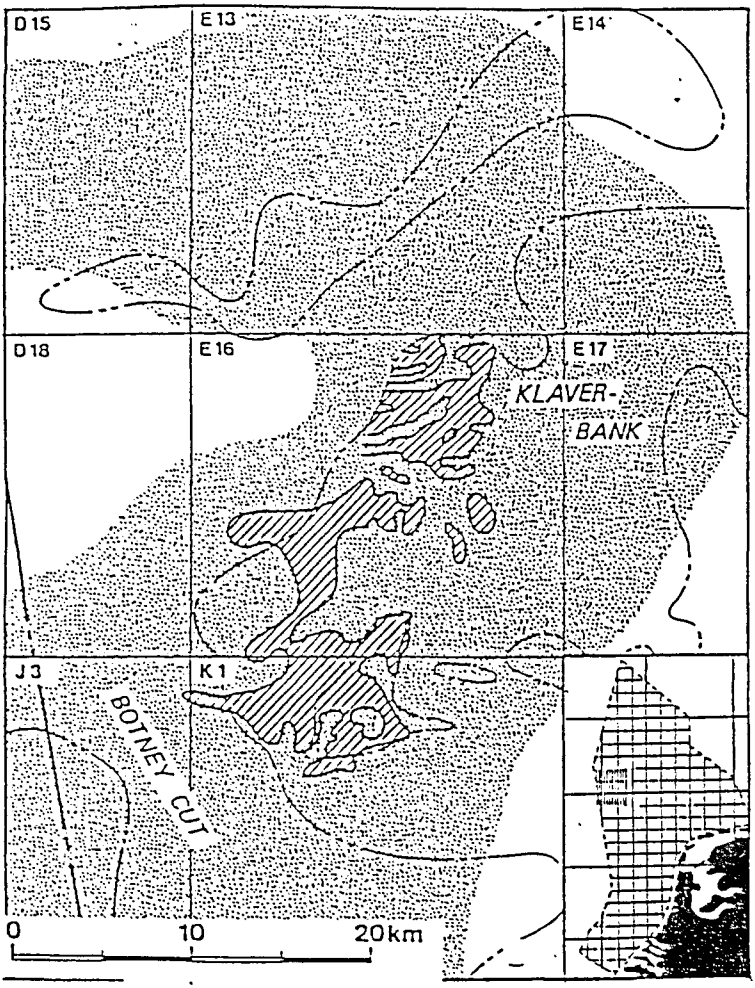
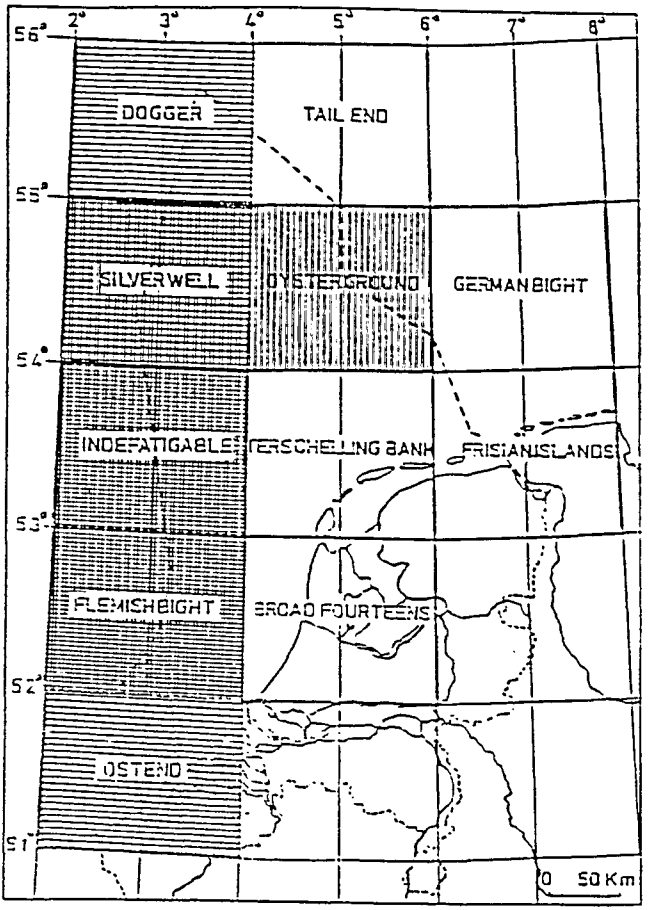


Fig. 1. Hatched area gravel content > 40%



Subdivision of geological reconnaissance map sheets

Published

In press

In preparation

Boundaries Netherlands Sector