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

Stromness, Scotland
23-26 April 1996

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International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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<td>6.5 Germany</td>
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Item 1 Royal Decree concerning the exploration and exploitation conditions related to the concession for the exploration and exploitation of sand and gravel on the Belgium Continental shelf.


Item 3 Review of licensing of minerals dredging in England and Wales: proposed statutory procedure.

Item 4 The dredging operations for the fixed link between Sweden and Denmark.


Item 6 Vyncke W. and Hillewaert H. Colour measurements on marine sediments off the Belgium coast as a means for estimating grain size.

Item 7 Kenny A.J., Greening J. and Rees H. L. Determination of trophic links between macrobenthos and fish in areas of commercial aggregate interest.

Item 8 SEBA 1996 Summary Record: identification of further sea-based activities which give rise to the effects on the marine environment.

Item 9 Draft contents for the forthcoming Cooperative Research Report.

Item 10 Map showing licensed extraction areas on the Dutch Continental Shelf.
REPORT OF THE WORKING GROUP ON THE EFFECTS OF EXTRACTION OF MARINE SEDIMENTS ON THE MARINE ECOSYSTEM

April 1996

1 INTRODUCTION

The Working Group was welcomed to Orkney and to the International Centre for Island Technology by Dr Jonathan Side who outlined arrangements for the week. The meeting was opened by the Chairman, Dr S J de Groot, who welcomed all the participants. Dr de Groot provided new participants with a brief overview of the history of the Working Group and its activities. The Terms of Reference were confirmed (see Section 2 below) and the Agenda adopted (Annex 1). The participants appointed Dr Jonathan Side as Rapporteur.

2 TERMS OF REFERENCE

The Terms of Reference of the Working Group on the Effects of Extraction of Marine Sediments on the Marine Ecosystem (Chairman: Dr S J de Groot, Netherlands) as set out in the ICES Council Resolution 2:26 (1995) were to:-

a) review and report on the status of marine sediment extraction activities (in relation to use categories) in ICES Member Countries and related environmental research;

b) review and report on the development of seabed resource mapping in ICES Member Countries;

c) review approaches to Environmental Impact Assessment related to marine extraction operations, and continue to work on sampling strategies related to impact assessments and monitoring of dredging operations in order to develop reliable and cost-effective methods;

d) review and report on developments in legal and administrative frameworks and procedures in accordance with ICES Cooperative Research Report No. 182;

e) review and report on requirements for and developments in habitat mapping, with particular reference to fish and shellfish spawning areas and consider research investigations and strategies that will lead to an increased understanding of the effects of aggregate extraction activities on sensitive or critical habitat areas of importance to the early life histories of fish and shellfish stocks spawning on the seabed;

f) collect material from the work of the Working Group to begin the preparation of a manuscript to be published in the ICES Cooperative Research Report series to update No. 182 of this series.
3 REVIEW OF NATIONAL MARINE AGGREGATE EXTRACTION ACTIVITIES AND RELATED ENVIRONMENTAL RESEARCH

3.1 Belgium

In 1995 a total of 1,669,488 m³ of sand was extracted on the Belgian continental shelf by 12 concession holders. The extraction area has not changed from previous years. Three sand banks are situated in the area: the Kwintebank, East Dyck and Buiten Ratel. The table shows that most of the extracted sand is taken from the Kwintebank. The reason for this is the quality of the sand. In Belgium the sand is exclusively used in the construction industry.

<table>
<thead>
<tr>
<th>Concession holder</th>
<th>Kwintebank</th>
<th>Buiten Ratel</th>
<th>East Dyck</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP01</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CP02</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CP03</td>
<td>360,892</td>
<td>23,144</td>
<td>11,727</td>
<td>395,763</td>
</tr>
<tr>
<td>CP04</td>
<td>79,783</td>
<td>0</td>
<td>5,322</td>
<td>85,105</td>
</tr>
<tr>
<td>CP05</td>
<td>141,177</td>
<td>0</td>
<td>0</td>
<td>141,177</td>
</tr>
<tr>
<td>CP06</td>
<td>42,462</td>
<td>0</td>
<td>0</td>
<td>42,462</td>
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<td>CP07</td>
<td>30,624</td>
<td>0</td>
<td>0</td>
<td>30,624</td>
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<td>CP08</td>
<td>461,972</td>
<td>0</td>
<td>0</td>
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</tr>
<tr>
<td>CP09</td>
<td>52,787</td>
<td>0</td>
<td>19,187</td>
<td>71,974</td>
</tr>
<tr>
<td>CP10</td>
<td>114,310</td>
<td>0</td>
<td>0</td>
<td>114,310</td>
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<td>CP11</td>
<td>48,367</td>
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<tr>
<td>CP12</td>
<td>263,947</td>
<td>0</td>
<td>13,787</td>
<td>277,734</td>
</tr>
<tr>
<td>Total</td>
<td>1,596,321</td>
<td>23,144</td>
<td>50,023</td>
<td>1,669,488</td>
</tr>
<tr>
<td>%</td>
<td>95.6 %</td>
<td>1.4 %</td>
<td>3.0 %</td>
<td>100 %</td>
</tr>
</tbody>
</table>

Table 1: Total quantities of sand extracted in 1995 (in m³).

On 1 February 1996 a new geo-morphological study started at the University of Ghent, called "Westbank 3". The study is commissioned by the Ministry of Economic Affairs, as the permitting authority for marine aggregate extraction in Belgium.

In 1995 the Fisheries Research Station at Ostend started a monitoring program on the three sand banks within the licensed area. In addition to the one existing sampling station, three new ones will now be sampled twice-yearly.

3.2 Canada

Marine mining is not taking place in the Canadian offshore in 1996. Industry continues to express an interest in marine mining for placers and aggregates, but a lack of a legislative framework is the biggest deterrent to further investment and investigation. However, two scientific marine mining assessment projects are active on the east coast of Canada, sponsored by the federal and provincial governments of Nova Scotia and Newfoundland.

The Geological Survey of Canada (GSC) is involved in the final year of a four year programme, termed the "Canada-Nova Scotia Cooperation Agreement on Mineral Development" or MDA-3, whose objective is to conduct an assessment of the offshore aggregate potential of the Scotian Shelf and adjacent areas, off the Province of Nova Scotia. The GSC has conducted both large and small vessel surveys to map marine aggregate and to collect large volume samples which are tested to determine their characteristics for a wide variety of asphalt, concrete and other applications. An assessment of the macrofauna collected during the aggregate surveys, and the density, diversity and dominance of the fauna has been included in the assessment. Final synthesis reports and maps are in progress and aggregate genesis models will be produced for the continental shelf off southeastern Canada.

Results of surveys conducted on the western Scotian Shelf and Bay of Fundy by the CSS Hudson in 1995, indicate that considerable volumes of suitable sand and gravel occur that could be used in aggregate applications. At present the greatest potential occurs on Middle Bank, where approximately
700 million cubic metres of coarse sand and gravel occur. Additionally, a large sand ridge on Eastern Shoal, Banquereeau, contains 99% pure silica sand that has economic potential.

Multibeam bathymetric data continues to hold considerable promise in the study of placers and aggregates. The quantitative interactive aspects of this emerging technology will be increasingly applied to marine sediment mapping. Canada has expanded the collection of multibeam bathymetry in the coastal zone with the acquisition of two new Simrad EM -5000 systems, mounted on coastal survey vessels, for operations from the beach to depths of 100 m. These systems will be tested and applied to near shore projects during the summer of 1996.

For the Province of Newfoundland, a placer gold assessment project is in the final stage, with the publication of results from studies conducted over the past four years. The byproduct of seabed resource mapping is a detailed understanding of surficial sediments on the inner shelf between White Bay and Cape Freels, Newfoundland.

### 3.3 Denmark

The extraction of marine sand and gravel represents some 10-13 % of the total production of materials for construction and reclamation. The amount of material dredged for construction has been increasing slightly since 1992. The dredging of sand fill for land reclamation has, however, increased markedly over the last 10 years as a result of several large construction works in coastal areas. From 1989 to 1993 more than 9 x 10^6 m^3 of sand fill and till have been dredged for the construction of the Great Belt bridge and tunnel project.

During the construction of the fixed link between Denmark and Sweden up to 8 x 10^6 m^3 of sandfill and 1 x 10^6 m^3 of sand for concrete production is expected to be dredged from the Kriegers Flak in the Baltic. The dredging started in January 1996 and is expected to last 4 years. In the same period up to 7 x 10^6 m^3 dredged materials of glacial till and limestone will be used for reclamation and as hydraulic fill in ramps for the bridge and tunnel.

<table>
<thead>
<tr>
<th>Year</th>
<th>Sand 0-2 mm</th>
<th>Gravel 0-20 mm</th>
<th>Gravel/Stones 6-300 mm</th>
<th>Sand Fill</th>
<th>Misc. (Till)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>1.0 x 10^6 m^3</td>
<td>0.2 x 10^6 m^3</td>
<td>0.6 x 10^6 m^3</td>
<td>3.9 x 10^6 m^3</td>
<td>0.1 x 10^6 m^3</td>
</tr>
<tr>
<td>1991</td>
<td>1.1 x 10^6 m^3</td>
<td>0.5 x 10^6 m^3</td>
<td>0.9 x 10^6 m^3</td>
<td>4.4 x 10^6 m^3</td>
<td>1.0 x 10^6 m^3</td>
</tr>
<tr>
<td>1992</td>
<td>0.7 x 10^6 m^3</td>
<td>0.5 x 10^6 m^3</td>
<td>0.9 x 10^6 m^3</td>
<td>1.2 x 10^6 m^3</td>
<td>0.8 x 10^6 m^3</td>
</tr>
<tr>
<td>1993</td>
<td>0.9 x 10^6 m^3</td>
<td>0.2 x 10^6 m^3</td>
<td>1.1 x 10^6 m^3</td>
<td>2.1 x 10^6 m^3</td>
<td></td>
</tr>
<tr>
<td>1994</td>
<td>1.1 x 10^6 m^3</td>
<td>0.2 x 10^6 m^3</td>
<td>1.3 x 10^6 m^3</td>
<td>2.6 x 10^6 m^3</td>
<td></td>
</tr>
<tr>
<td>*1995</td>
<td>1.7 x 10^6 m^3</td>
<td>0.2 x 10^6 m^3</td>
<td>0.9 x 10^6 m^3</td>
<td>1.7 x 10^6 m^3</td>
<td>0.2 x 10^6 m^3</td>
</tr>
</tbody>
</table>

In 1994 the majority of the sand fill (2.3 x 10^6 m^3) was used for beach nourishment on the west coast of Jutland.

* The figures for 1995 are preliminary.

Table 2: Marine Sand and Gravel Extraction in Denmark

No detailed forecast for the future extraction has been prepared but it is expected that the exploitation of marine sand and gravel will increasingly replace land materials. This is mainly a result of the planned termination of a number of licences on land and increasing environmental conflicts in potential excavation areas on land.

### 3.4 France

Current marine aggregate production of 2 x 10^6 m^3 per year of siliceous sands slightly increased in 1995, partly due to a larger extraction amount in Dieppe (from 200,000 tonnes in 1994 to 750,000 tonnes in 1995).
3.5 Finland

Marine sand exploitation has been approved in Finland for use in the coverage operation of the Estonia ferry that sank in 1994.

3.6 Germany

The greatest amount of sediment extraction arises from maintenance dredging within the waterways inside the estuaries. Most of this is carried out by the Federal Water and Navigation Administration (a federal authority). Smaller amounts occur from dredging in harbours and their channels (local authorities).

<table>
<thead>
<tr>
<th>Year</th>
<th>Harbour x 10^6 t</th>
<th>Estuaries/ waterways x 10^6 t</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>1.919</td>
<td>44.240</td>
</tr>
<tr>
<td>1992</td>
<td>1.940</td>
<td>40.530</td>
</tr>
<tr>
<td>1993</td>
<td>5.778</td>
<td>45.872</td>
</tr>
<tr>
<td>1994</td>
<td>5.043</td>
<td>53.088</td>
</tr>
</tbody>
</table>

(Source: Oslo Commission and Federal Institute of Hydrology/Germany)

Table 3: Maintenance dredging and dumping within the German coastal region of the North Sea.

As almost all of the dredging and dumping of the sediment takes place in the tidal influenced estuaries, a considerable amount of sediment is transported back to the place of dredging. This has to be taken into account when, for example, a special emphasis is placed on the input of harmful substances like heavy metals into the North Sea. As the amount of dredged material is only small compared to the natural rate of suspension and sedimentation, it is very difficult to predict the effect of dumping the dredged material beyond the range of the tidal zone.

3.7 Ireland

Two licences to extract marine sediments are currently being processed by the Department of the Marine. These relate to an exploratory licence to extract medium sand off Waterford in the south-eastern corner of Ireland, and an application to extract cobble and sand from the Codling Bank, in the Irish Sea off Greystones, Co. Wicklow.

The first of these applications was given an exploratory licence in 1994 subject to agreeing with the Minister the scope of an EIA for commercial extraction and carrying out any site investigations to ground the EIA simultaneously with the exploratory extraction. Some site surveys for the presence of herring spawn have already been carried out. It has taken two years to organise, but the framework for an EIA has, just recently, been submitted to the Department of the Marine. This is at present awaiting the Minister’s approval. The exploratory work will involve small quantities of medium sand. Any larger scale operation planned is subject to a successful presentation of the EIA findings as part of a licence application. The material removed will be used in cement manufacture. The site selected has proven contentious as the area is reported as a herring spawning ground by local fishermen (part of the spawning area from the Saltees Islands in the East to Cork Harbour in the West), who worry about the effects of the extraction on the fish stocks. There are also some worries concerning possible effects on coastal erosion.

The second application relates to a scheme for renourishment of Bray Beach. The material extracted will be used for fill between groynes on the beach. An EIA has been completed for the area and submitted for approval. Objections have, however, been raised and it remains to be seen if this scheme will receive a licence. The quantities involved in this proposal are likely to be quite small (approx. 250,000 m³).
3.8 The Netherlands

Sand extraction 1995

The amount of sand extracted from the North Sea is as follows:

- Euro-/Maas access-channel to Rotterdam: $7.5 \times 10^6$ m$^3$
- IJ-access-channel to Amsterdam: $3.3 \times 10^6$ m$^3$
- Dutch Continental Shelf: $6.0 \times 10^6$ m$^3$
- Total sand extraction in 1995: $16.8 \times 10^6$ m$^3$

The main applications of the extracted sand are to benefit the beach nourishment programme and for land uses. In 1995 approximately $11.4 \times 10^6$ m$^3$ was used mainly for land fill. In 1995 approximately $5.4 \times 10^6$ m$^3$ was used for beach nourishment.

Gravel extraction 1995

In 1995 no extraction of gravel took place in the Dutch part of the North sea.

Shell extraction 1995

On several locations in the Dutch coastal waters shell extraction is being carried out, especially in the Waddensea, the Western Scheldt and the VoorDelta. The shell materials are used for various purposes, like pathways for bicycles, drainage purposes and humidity protection for houses. The available stock in the sea bottom is finite. Overextraction is not desirable from an ecological or economical point of view. For sustainable development reasons it has been necessary to set up an integrated approach for the shell extraction policy. This approach is based on field surveys to discover the actual amount of shells in the sea bottom as well as the status of these shells, i.e. dead, nearly dead or alive. The latter enables an estimation of the stock growth to be made.

A desk study is also being undertaken in order to make an estimation of the disturbance of the shell extraction due to other activities that influence the bottom of the sea, like sand extraction or fisheries. The final report on this research is to be expected soon.

Environmental research 1995

Several projects are carried out in order to investigate the effects of sand extraction on the marine ecosystem.

A first project is concerned with a large scale ($2.5 \times 10^6$ m$^3$) sand extraction off the coast of Terschelling (Frisian Islands). Before, and 1 and 2 years after the extraction, the bottom fauna has been investigated thoroughly. Preliminary results indicate that the impact for sea life at the extraction site are quite low. One year after the extraction, the benthos had almost recovered. The final report is expected by the end of 1996.

Following negotiations with the Ministry of Defence on the military exclusion zones for sand regional extraction, 3 licenses for extraction were given in 1995/1996. The exclusion zones as defined in the Regional Extraction plan for the North Sea (RON) had proved to be impracticable.

In 1994 a new type of sand dredge, the "pin-point" dredge, has carried out a beach nourishment project at a near shore location. At a depth of approximately -7 m NAP (Dutch Ordnance Datum) a large borrow pit was made in the sea bottom, with a depth up to 17 m and covering an area of approximately $300 \times 175$ m$^2$. From this pit 300,000 m$^3$ of sand was dredged and discharged on the beach. The pit was refilled after the nourishment was completed. An environmental assessment monitoring programme was started to investigate the environmental effects. Preliminary results indicate that these effects appear to be only minor. However, definite conclusions on temporary borrow pits cannot yet be made. Therefore more research will be carried out in the near future.
At present, several plans for huge land reclamation projects are being launched in the Netherlands, for instance Maasvlakte II and the shore-location Hook of Holland-Scheveningen. These 2 projects together might require an amount of sand extracted from the North Sea, of approximately $1.3 \times 10^9$ m$^3$. At present a discussion upon the need and necessity of Maasvlakte II is being conducted on a national level. Should this discussion result in a positive decision, a Environmental Impact Assessment study will be undertaken.

3.9 Norway

Sand and gravel. Very little extraction of sand and gravel from the sea bottom has taken place. Some minor extractions in the delta front of some deposits in fjord areas (less than 100,000 m$^3$).

Carbonate sand. The statistics from the STIL (National Agricultural Institute) for 1995 have not been published yet, but the extraction is believed to be about the same scale as in the two preceding years, between 100,000 and 150,000 tonnes. The two important exploitation counties are still Hordaland and Rogaland on the west coast.

3.10 Sweden

There has been no extraction of marine sand and gravel in Sweden since 1992. The last extraction area, the Vastra Hakan in the Sounds between Sweden and Denmark, ceased when the Falsterbo Peninsula, which includes the former extraction area, became a marine nature reserve. The regulations of the reserve prohibit further exploitation. In Table 4 the extraction of marine aggregate in Sweden is summarized for the years 1989-1995.

During 1995 only one new permit for marine exploitation was granted in Sweden. This was the permission for the Oresund Link Consortium to dredge a new stretches for part of the Flint shipping channel between the Saltholm island and the coast of Scania in connection with the building of the new Oresund Link between Sweden and Denmark. All the material dredged will be used for construction of two islands south of the Saltholm island at the Danish side of the Sound. The amount of extraction is limited to $2.0 \times 10^6$ m$^3$.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Disken</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sandflyttan</td>
<td>1692</td>
<td>1692</td>
<td>423</td>
<td></td>
<td>0</td>
<td>3807</td>
</tr>
<tr>
<td>Vastra Hakan</td>
<td>35509</td>
<td>31302</td>
<td>33840</td>
<td>52739</td>
<td>0</td>
<td>153390</td>
</tr>
<tr>
<td>L. Middelgrund</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>S. Middelgrund</td>
<td>30768</td>
<td>138776</td>
<td>82534</td>
<td></td>
<td>0</td>
<td>252078</td>
</tr>
<tr>
<td>Faro</td>
<td>2400</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>2400</td>
</tr>
<tr>
<td>TOTAL</td>
<td>70369</td>
<td>171770</td>
<td>116797</td>
<td>52739</td>
<td>0</td>
<td>411675</td>
</tr>
</tbody>
</table>

Table 4: Extraction of Marine Aggregate (m$^3$) in Sweden 1989-1995
3.11 United Kingdom

Market Trends

Production in the UK in 1995 rose to $26.1 \times 10^6$ tonnes from $20.8 \times 10^6$ tonnes in 1994. Regional summaries are shown in Table 5:-

<table>
<thead>
<tr>
<th>Licensed Area for aggregate extraction</th>
<th>Actual Removal 1995 (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humber</td>
<td>1,788,452</td>
</tr>
<tr>
<td>East Coast</td>
<td>10,497,352</td>
</tr>
<tr>
<td>Thames Estuary</td>
<td>1,661,324</td>
</tr>
<tr>
<td>South Coast</td>
<td>4,428,356</td>
</tr>
<tr>
<td>South West</td>
<td>2,285,898</td>
</tr>
<tr>
<td>North West</td>
<td>278,120</td>
</tr>
<tr>
<td>Rivers and Miscellaneous</td>
<td>14,113</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>26,122,758</strong></td>
</tr>
</tbody>
</table>

Table 5 UK Marine Aggregate Production

In 1995, $13 \times 10^6$ tonnes was used by the construction industry mainly for concrete. A further $5.17 \times 10^6$ tonnes was used for beach recharge and reclamation and $7.5 \times 10^6$ tonnes went for export primarily to the Netherlands and Belgium with smaller quantities to France and Germany. A summary of port statistics for material exported is shown in Table 6:-

<table>
<thead>
<tr>
<th>Port</th>
<th>Tonnage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amsterdam</td>
<td>1,987,362</td>
</tr>
<tr>
<td>Angerstein</td>
<td>706,738</td>
</tr>
<tr>
<td>Antwerp</td>
<td>743,065</td>
</tr>
<tr>
<td>Bidna</td>
<td>77,295</td>
</tr>
<tr>
<td>Brest</td>
<td>16,544</td>
</tr>
<tr>
<td>Brugge</td>
<td>376,336</td>
</tr>
<tr>
<td>Calais</td>
<td>128,114</td>
</tr>
<tr>
<td>Dunkirk</td>
<td>744,261</td>
</tr>
<tr>
<td>Fecamp</td>
<td>42,139</td>
</tr>
<tr>
<td>Flushing</td>
<td>1,101,324</td>
</tr>
<tr>
<td>Hamburg</td>
<td>207,442</td>
</tr>
<tr>
<td>Harlingen</td>
<td>337,183</td>
</tr>
<tr>
<td>Le Havre</td>
<td>10,073</td>
</tr>
<tr>
<td>Le Treport</td>
<td>5,092</td>
</tr>
<tr>
<td>Nieuwpoort</td>
<td>269,194</td>
</tr>
<tr>
<td>Oostende</td>
<td>373,499</td>
</tr>
<tr>
<td>Roscoff</td>
<td>53,292</td>
</tr>
<tr>
<td>Treguier</td>
<td>46,428</td>
</tr>
<tr>
<td>Zeebrugge</td>
<td>359,530</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7,584,911</strong></td>
</tr>
</tbody>
</table>

Table 6 Exports 1 January 1995 to 1 January 1996

The dredging industry experienced an upturn in activity during 1994 although market demand remained fragile during 1995 due to cuts in government infrastructure funding and reduced house sales which had a dampening effect on the industry, delaying reinvestment.

Marine derived aggregates/sand continued to supply about 15% of the total demand in Great Britain during 1995, the main areas of use being concentrated in the South East principally London and the Thames Estuary and South West.
There was no calcareous seaweed extracted from Crown Estate land in 1995 although a limited amount of extraction did take place in the Falmouth Estuary under the ownership of the local Harbour Commissioners. A limited amount of waste coal was extracted. Very small quantities of marine sand and gravel were extracted from non-Crown land.

Increasingly individual wharfs are supplied by sand and gravel from a variety of licensed areas. This is coupled with an increase in the number of joint ventures due to the variations in quality and gravel concentration in material. Companies are now husbanding good quality/high concentration gravel reserves by blending at as many wharfs as possible so that acceptable material is available to the widest possible market. The blending of high and low quality material from gravel areas is likely to become more complex in the future especially when consideration is given to the commercial implications of increasing screening times necessary to produce acceptable cargoes.

Demand

The aggregate demand forecast for England in the fifteen year period 1992 to 2006 inclusive is given in Mineral Planning Guidance Notes, MPG6, published by the OOE in April 1994. For marine sand and gravel the demand in England (excludes coast protection and exports) averages 21 million tonnes per year for the fifteen years. Over the first five year period, 1992 to 1996 inclusive, the average demand is forecast as 18 million tonnes per year.

In the first three years of this period actual supply to ports of landing in England was 11.1 million tonnes (1992), 10 million tonnes (1993), and 12.5 million tonnes (1994). Thus, at the end of 1994 actual supply was only 70% of the demand forecast.

The corresponding OOE average forecast demand for the fifteen year period for land won crushed rock and land won sand and gravel is 127 million tonnes and 80 million tonnes per year respectively. These actual tonnages were both 80% of the average fifteen year demand.

MPG6 envisages marine aggregate supply to England alone of at least 30 million tonnes per year by the year 2006.

Research

(a) Seabed Sediment Mobility Study - South West Isle of Wight

The Crown Estate, DOE, Marine Aggregate Industry, NRA and English Nature are sponsoring a pilot study to investigate the mobility of seabed sediments, clarifying the physical processes and developing techniques for zoning the seabed based on seabed mobility. The project compliments work proposed by BGS dealing with sediments closer inshore. CIRIA are managing the project and the original specification has been changed from site specific to pilot study for wider non-site specific application, it is hoped the research will produce a model procedure for application to other areas around the UK.

(b) Recovery of the Seabed

The jointly funded project by the Crown Estate and MAFF looking at recovery of an experimental dredging plot off North Norfolk has been extended for a further 3 years. The site will continue to be monitored until dredging related changes have stabilised. Fish populations in the vicinity of aggregate areas will also be sampled and their feeding preferences determined through analysis of stomach contents. The information can then be used to assess how commercial dredging affects the seabed food resource in different areas and whether these affects change with the season. Plume dispersion will also be examined. The geographical scope of a study aimed at characterising the marine life inhabiting gravel deposits near areas of commercial interest will be extended and quantitative techniques employed.

(c) Seabed Habitat Mapping

This is a 3 year research programme funded by Crown Estate, Scottish Natural Heritage, English Nature and the Countryside Council for Wales. The BioMar team at the University of Newcastle has developed a technique using acoustic signals for mapping habitats on the seabed. The reflected signals are analysed using specially developed software packages. The results can be displayed in real time on board the survey vessel or with more sophisticated analysis in the laboratory to produce maps or
overlays on existing charts. It is then relatively straightforward to relate the habitats to seabed features such as wrecks, reefs, banks, pipelines, cables etc and areas which are subject to disruption e.g. dredging, beam trawling, drilling, discharges etc.

The BioMar project epitomises the holistic approach now taken to marine environmental studies. The Conservation Agencies want to map the whole of the UK seabed and Continental Shelf very much as the land is mapped. By taking a joint approach, extra resources can be made available to complete the whole picture whilst focusing on areas of special interest or sensitivity to particular groups. It will also have the major benefits of ensuring consistency of approach and comparability of results.

Unlike many of the other techniques for surveying seabed habitats e.g. grab samples and divers, acoustic mapping is quick and cost effective, allowing large areas of seabed to be mapped economically.

In 1993 English Nature and Scottish Natural Heritage commissioned the BioMar team to map specific marine habitats and their associated communities, a key requirement for the designation of Marine Nature Reserves and Special Areas of Conservation under the EU's Habitats Directive. The results of the programme have shown good correlation between existing data collected by physical sampling and the acoustic mapping surveys. The first stage involves mapping of three or four areas of the east, west and Scottish coasts.

(d) Anglian Coastal Authority Group (ACAG) N.E. Regional Study

This study continues to look at the sediment regime out to the 50m depth contour from the Holderness Coast to the Thames Estuary. The first stage is design of a database likely to include at least 4500 published references to relevant research plus unpublished but verified survey results. The results will be used to develop a conceptual model of sediment movement in the Survey area. Stage two is intended to look to develop the model and verify the predictions with field studies. The results will help assess the impact of existing and future marine aggregate extraction.

(e) CIRIA Beach Recharge/Resource Study

BGS, Hydraulics Research and Posford Duivier were commissioned in 1994 to provide a quantitative estimate of the national demand for beach recharge material and of the resources suitable to meet the demand over the next 20 years, taking into account the likely requirements of the aggregate industry for the same material. Their report was published in August 1995.

Use was made of existing data sets on marine materials occurring on the continental shelf of England and Wales in water depths less than 60m. This data was used to estimate the volume of suitable materials on the sea floor. The potential demand for material for beach recharge was based on demand for a representative set of 19 beaches from around England and Wales, extrapolated to all of the lengths of coastline for which beach recharge schemes may be implemented.

The demand for gravel and sand for beach recharge over the next 20 years is estimated to range from 23 to 47 x 10^6 m³ and 36 to 83 x 10^6 m³ respectively. Equivalent figures for gravel and sand for aggregate use were 200 x 10^6 m³ and 180 x 10^6 m³ respectively. Resources of marine sand were estimated to considerably exceed demand. Sources of gravel for beach recharge were considered to be more limited.

The report also considered the potential for use of materials for beach recharge other than marine sand and gravel, such as land-won primary aggregates, secondary aggregates and mineral wastes. It was concluded that such materials were unlikely to be suitable to satisfy the requirements of most major schemes.

(f) BGS Thames Estuary Study

The final report of this resource study was published in the Spring. The conclusion/recommendations in the report have been discussed with the Port of London Authority (PLA) to identify particular sensitivities regarding the navigation channels in the estuary. In the longer term the exploitation of reserves in the Thames Estuary will be market led e.g. the Environment Secretary John Gummer has recently announced plans to transform the river-front of the Thames between Blackfriars and Tower Bridge.
(g) Bristol Channel Study

The Bristol Channel has the second highest tidal range in the world and consequently has a very dynamic physical environment. It supports a diversity of marine flora and fauna, and contains a number of sites of national and international importance. There are also adjacent coastal areas of high amenity value, and important submerged archaeological remains.

The overall hydrodynamics and movement of sediments in the Bristol Channel is not fully understood, and information on the extent of sand and gravel resources and constraints on working are sparse. Consequently it is difficult to predict the effects of individual and cumulative dredging activity on hydrodynamics and sediment movement or to assess the effects of dredging activity in relation to natural processes, harbour capital and maintenance dredging, or other engineering works.

The aim of this research is to develop a better understanding of the physical processes operating in the Bristol Channel, to provide advice on the marine aggregate resources and to evaluate constraints on their exploitation.

3.12 United States

There continues to be a relatively low level of activity in the U.S. The one active operation for commercial extraction of marine sand removed about $1.4 \times 10^6$ m$^3$ in 1995. All of this was extracted from navigation channels. Sand is mixed with crushed rock for construction. This company has prospected in an area of the shelf 3 miles off the coast of the state of New Jersey and has begun an application with the U.S Minerals Management Service to lease an area for mining.

Other offshore mining in the region has been done for beach renourishment. About $2.8 \times 10^6$ m$^3$ has been removed from the shelf for beach renourishment along the coast of New Jersey and $1.2 \times 10^6$ m$^3$ for the New York coast. (A tabulation for the more minor projects is not available but monitoring of the large beach nourishment project continues).
4 REVIEW OF NATIONAL SEABED RESOURCE MAPPING PROGRAMMES

4.1 Belgium

There are no seabed resource mapping programmes underway in Belgium.

4.2 Canada

Marine mapping remains the responsibility of the Geological Survey of Canada, and projects are continuing on both the Atlantic and Pacific coasts. Surveys are conducted in the nearshore and on the continental shelf and slope. During 1995, the Geological Survey of Canada implemented a reduction in staff of approximately 30%. This will have implications to future programmes of seabed resource assessment with reductions in mapping in northern areas. Both the initial federal and provincial cooperative efforts in aggregate and placer gold assessment in offshore Atlantic Canada are in the final stages of completion. As a result of these studies, vast quantities of aggregate have been delineated at a reconnaissance level on the shallow offshore banks and in other areas of the inner, central and outer Scotian Shelf. Their suitability for varied industrial uses is also known.

The importance of the collection of multibeam bathymetric data is increasingly seen as a first step in seabed resource mapping. Cooperative survey efforts are in place with the Canadian Hydrographic Service to apply this new technology. These new systems have provided an enhanced insight into shallow water seabed sediments and processes. Backscatter acoustic data is extracted from the multibeam signals and maps of calibrated seabed type (lithology) are produced. The future approach will be to integrate bathymetric and backscatter attributes using statistical approaches. It is hoped that the collection of this information will be expanded to many areas of the southern Canadian continental shelf.

Developments in Habitat Mapping

The Geological Survey of Canada is initiating a new applications and research programme in marine mapping regarding seafloor habitat characterization. This project will be divided into two phases. The first is the application and enhancement of existing survey tools for remote, high-resolution sensing of seabed habitat. This will involve the maximization of resolution of existing 500 kHz side-scan sonars and high-resolution seismic reflection profilers to portray decimetre seafloor characteristics of grain size, variability, particle shape, porosity, roughness, relief and stratigraphy. The second phase of the project will be to extract quantitative sediment data from the acoustic signals of multibeam, sonar and seismic reflection systems. The Department of Fisheries and Oceans is supporting this research as it relates to lobster, clam and shrimp habitat classification and the impact of fishing operations on the seabed.

A cooperative joint study on the effects of bottom fishing gear on the sediments and marine ecosystem has entered a new phase for areas of the Scotian Shelf. A five year program, beginning in 1996, is planned to investigate selected areas where fishing has been prohibited for several years. Experimental fishing will take place in these areas, followed by a series of investigations to assess the disturbance on the sedimentology and benthic communities. Monitoring will follow to evaluate the temporal and spatial recovery of the seabed. This research has direct applications to potential mining of mineral resources on the seabed, as several of the bottom fishing techniques disturb the substrate in a similar fashion to seabed mining.

4.3 Denmark

Overview of Seabed Sediment Mapping Programmes in Denmark

A map of the surface sediments in the Danish part of the Sound in scale 1:100,000 was published in 1990. An overview map of the bottom sediments around Denmark and western Sweden in scale 1:500,000 was published in 1992, a result of cooperation between The National Forest and Nature Agency, The Geological Survey of Denmark and The Geological Survey of Sweden. A detailed map of the Flensborg Fjord area was published during 1994 by the Geological Survey of Denmark.
Some of the most important stone reefs in Danish waters have been mapped during 1990-1995 using shallow seismic equipment, side scan sonar, SCUBA diver survey and sampling. The project is a cooperative one between The National Forest and Nature Agency, The Geological Survey of Denmark and University of Copenhagen. Two reports have been published which include surface sediment maps, gravel and stone concentration maps and descriptions of the biology in the areas.

The systematic reconnaissance resource mapping continues and is concentrated in The North Sea and The Baltic. Since 1991 mapping programs have been carried out on Jutland Bank and Horns Reef in The North Sea and in Fehmarn Baelt, Adler Ground, Ronne Banke and Kriegers Flak in The Baltic. Maps at scale 1:100,000 of surface sediments, Quaternary geology and sand and gravel resources have been prepared. At present, between 80% and 90% of potential resource areas in the Inner Danish Waters have been mapped.

In 1996 reconnaissance mapping will be carried out on greater water depths in the central part of Kattegat and in the North Sea. The Geological Survey will later in 1996 start a reinterpretation of existing seismic data in order to identify thin lag deposits which may be a potential gravel resource.

Detailed resource mapping programmes have been carried out in some regional extraction areas with materials of high quality and in areas licensed for bridge and tunnel projects. Detailed seabed sediment maps has been prepared from Fener Baelt, Adler Ground, Kriegers Flak and the Sound between Copenhagen and Malmoe.

4.4 France

The French Geological Survey (BRGM) published in 1995 several geological maps of North-Brittany and Baie de Seine at a scale of 1:50,000 in co-operation with the SHOM for bathymetry and local Universities for surface sediments.

IFREMER published morphological and sedimentological maps for the Nord/Pas-de-Calais (1:100,000) and Groix Island (1:20,000) and continued to develop a GIS in Baie de Seine (Normandy) and Baie de Saint-Brieuc (North Brittany).

4.5 Finland

The Finnish seabed mapping programme is progressing with a reduced speed in the Helsinki area. This is due to extensive commissioned work involving mapping of possible cable routes and search for sunk timber in some estuaries of Finland. The sunk timber is a consequence of the traditional practice of timber floating on the rivers.

4.6 Germany

There are no resource mapping programmes currently underway in Germany.

4.7 Ireland

The only work carried out since the last report relates to mapping studies off the coasts of Clare and Kerry, by Dr. Ray Keary of the Geological Survey of Ireland. No deposits suitable for commercial exploitation were found.
4.8 The Netherlands

A review of the development of sea bed resource mapping completed by the Geological Survey in 1995/96 is summarized below:

1:250,000 series

Sea bed sediments and Holocene Geology, sheet Terschellingbank, Dutch sector (53° N to 54° N and 4° E to 6° E) in progress.

1:100,000 series

Sheet Buitenbanken digitally available (printed in 1996) (51° 40' N to 52° N and 3° E to 3° 40' E).

Applied geological investigations in 1995/96

Along the 20 m isobath off the Dutch coast at several locations detailed studies have been carried out in order to determine the presence of suitable sand for beach nourishment. At several locations along the 8m isobath also investigations have been carried out to a depth of 10m below seabed to determine the sand quality. At these locations pits will be dredged with dimensions of approximately 2000 x 1000 metres in which a special submarine dredger will be lowered.

This dredging device ("pinpoint") pumps the sand from the pit to the beach. The sand is brought into the pit be 'normal' dredgers which extracting seaward of the 20m isobath. The advantage of this method is that the pipeline is much shorter and the bad weather delay will be reduced.

After completing the beach nourishment the pit has to be refilled with sand.

West of Hook of Holland a study has been carried out at several locations for sand quality to a depth of 12 m below sea bed. At these locations probably pits will be dredged in which sludge from the Rotterdam harbour will be dumped. The extracted sand will be used for beach nourishment and/or for industrial use.

A detailed study has been carried out on the crest of a large sandwave 35 km south-west of Hook of Holland in order to determine the presence of sand suitable for the concrete industry. On the top of the crest 42 high quality cores have been taken to a depth of 4 to 5 m. The d50 of the sand varies between 267 and 557 micron. It can be concluded that only a part of the sand can be used as addition to industrial sand from the land.

Geochemical maps

A geochemical map of the Dutch F and G blocks (54° N to 55° N and 4° E to 6° E) was prepared from data obtained by analysis of about 100 grab samples, the samples were selected from an orthogonal grid. 24 elements (including Zn, Cr, Co, Ni, Al, Cu + Pb) were determined with ICP in the fraction <63 \( \mu m \). For each element a contour map of the concentration in ppm has been made. Using 16 samples from a core to a depth of 1 m, a depth profile has been made for each element.

Reports


4.9 Norway

The cooperative mapping programme in the Norwegian part of the Skagerrak is about to be finished. Several digital maps have been produced in scales varying between 1: 1 mill. and 1: 50,000. The maps cover different topics such as bedrock geology, Quaternary geology, seabed sediments, bathymetry and geochemistry.

Carbonate sand. The Geological Survey of Norway has finished the mapping programme for carbonate sand in Hordaland. The mapping has taken place in four communities and comprises seismic survey and grab bottom sampling. A total of $32 \times 10^6$ m$^3$ has been confirmed as carbonate sand, while possible carbonate sand amounts to $27 \times 10^6$ m$^3$. The total area covered by these deposits is $14$ km$^2$.

Reports:

Bøe, R. & Ottesen, D. 1996: Skjellsandforekomster i Fedje kommune, Hordaland. NGU rapport 96.037 (in Norwegian)
Bøe, R. & Ottesen, D. 1996: Skjellsandforekomster i Øygarden kommune, Hordaland. NGU rapport 96.038 (in Norwegian)
Ottesen, D. & Bøe, R. 1996: Skjellsandforekomster i Fjell kommune, Hordaland. NGU rapport 96.039 (in Norwegian)
Ottesen, D. & Bøe, R. 1996: Skjellsandforekomster i Bømlo kommune, Hordaland. NGU rapport 96.040 (in Norwegian)

The Geological Survey of Norway together with cooperating institutions is about to initiate a mapping programme in the North Sea (south of 59°). This programme will include geological mapping, studies of sediment processes (erosion, transport and sedimentation) and a regional monitoring programme for pollution (both inorganic and organic materials).

4.10 Sweden

The ongoing seabed mapping programme of the Swedish EEZ at a scale of 1:100 000 will continue in 1996 in the southern Stockholm Archipelago. The mapping of this area started in 1995 but could not be finished the same year due to a temporary reduction of the budget for the marine programme at the Geological Survey. The government proposal of laying down the seabed mapping programme at SGU 1 July 1995 was not adopted by the Swedish Parliament. Instead the Parliament approved the importance of a programme which parallel to the geological mapping programme also includes an environmental mapping programme dealing with about 100 organic and inorganic contaminants in the surficial sediments. According to a Parliament decision in 1989 the target year of the Swedish marine seabed mapping programme is 2060, i.e. the year when the mapping of the Swedish EEZ has to be completed. The yearly budget for the mapping programme will stay at the former level (13 MSEK).

At the moment five maps of the Sound (1:50,000), three maps of the northern Gotland area, three maps of the Swedish part of the Kattegat and two maps of the southern Swedish EEZ between the Sound and Bornholm island have been produced (1:100,000). In total about 20,000 km$^2$ of the Swedish EEZ has been mapped so far. An overview map of the bottom sediments around Denmark and South western Sweden (1:500,000) was published in 1992 (see account in Section 4.3)
4.11 United Kingdom

Since completion of the systematic reconnaissance geological survey of the UK Continental Shelf in 1992 the BGS has produced a series of offshore geological reports. The series of 11 reports was completed this year with publication of the Irish Sea regional report.

A series of desk studies which interpret BGS data supplemented by dredging industry prospecting survey data, are also available. The reports summarise seabed sediments and background geology and indicate the approximate location and quality of potential sand and gravel resources. Four studies have been completed, the reports are:

Marine Aggregate Survey phase 1: Southern North Sea; phase 2: South Coast; phase 3: East Coast; and phase 4: Irish Sea (excluding the Isle of Man territorial Sea).

A number of other more detailed resource assessment studies are available including the marine sand and gravel resources off Great Yarmouth, off Isle of Wight and Beachy Head and the marine sand and gravel resources off the Humber.

Seabed Characterisation as a Basis for Policy on Marine Aggregates and Coastal Zone Instability - Inshore UK

The aim of this research is to provide data on the physical inventory of the seabed in the UK's inshore waters (extending to approximately 20 km offshore from the Mean High Water Mark) and to assess the physical processes affecting the seabed.

An initial study in the nearshore area between Shoreham and Dungeness will be used to demonstrate the potential for deriving interpretations of the seabed sediment inventory both in terms of classification and quantity of material from standard survey data available from the BGS, Hydrographic Office and other data sets; and to provide an indication of the nearshore areas around the UK where there is likely to be sufficient existing data to make such interpretations.

Following from this, six study areas within the UK's inshore waters, will be selected for systematic and extensive assessment of the lithological, textural and morphological characteristics of the sediment and rock materials of the seabed. The areas to be included in the study have still to be agreed by the project's steering committee but are likely to include the eastern Irish Sea extending off Liverpool Bay, the outer Thames estuary extending to the Harwich area, and the area off the Humber.

Other projects involving mapping are reviewed in Section 3.11.

4.12 United States

There were no new reports concerning the mapping of offshore sand and gravel resources. There are several new initiatives in habitat mapping by the U.S. Fish and Wildlife Service. These are being applied to the search for ocean disposal sites in the northeast, the identification of borrow areas for beach renourishment projects and, to some extent the need to find sand supplies to cap contaminated sediments. Results of some of these habitat programmes should be available shortly.
5 REVIEW OF APPROACHES TO ENVIRONMENTAL IMPACT ASSESSMENT

5.1 Belgium

An environmental impact assessment was prepared 3 years ago for the existing licensed area since, at that time, several new applications were received.

In Belgium there is only one extraction area for private companies which is defined by law. Thus one EIA was prepared. Any change to the boundaries of the existing extraction area would have to follow a new, more rigorous procedure, making it unlikely to happen in the near future.

No new applications have been received, so no new EIAs have been undertaken.

A permit for extraction of sand is, after a three year trial period, extended to ten years and can be renewed two times. So the maximum permitted period is 30 years. Most of the permits are now in the second ten year period.

The permitting authority however can, if any negative effect to the environment is being demonstrated, at any time:

(i) close parts of the extraction area or even the whole area
(ii) stop extraction for a certain period of time.

5.2 Canada

Since the 1970's any project on federal land, receiving federal funding or requiring a federal decision making authority required screening through the Environment Assessment and Review Process (EARP). This was a self assessment process and although authorised by Order in Council it was not a legal requirement. In January of 1995 the Canadian Environmental Assessment Act was proclaimed and the review process is now mandatory. Many projects can be approved following a simple screening which must be registered but others may proceed to lengthy and costly public reviews as did the Fixed Link between New Brunswick and Prince Edward Island even under the former guidelines. The review process must respect other regulations and policies such as our fish habitat protection policy which operates on the principal of "no net loss" of habitat. Unknown environmental impacts are considered to be just cause to cancel the project or refer it for further study and review. Regardless of environmental concerns or the lack thereof, a proposal could be referred for further review purely because of public concern. Positive decisions must include documentation regarding public consultation. Increasing workloads for review agencies could result in program delays especially as the public becomes more aware of the requirements.

The Canadian Government has recently committed to substantial budget reductions requiring programme reviews and significant reorganisation of departments. Of concern here is the restructuring of Fisheries and Oceans Canada (DFO) Environment Canada (DOE) and Canadian Coast Guard (CCG). All activities with an ocean focus will be transferred to DFO. Consequently, authorities for activities such as channel dredging and Ocean dumping will transfer from DOE to DFO. Although many of the transfers officially took place on 1 April 1995 the mechanics have not been finalised. These changes are expected to result in considerable efficiencies which could have the unfortunate associated cost of the loss of many experienced and highly qualified scientists through early retirement.

A new Canada Oceans Act is currently under development. This will lead to elimination of overlap and duplication in current regulations and refocus efforts on the most critical concerns.

5.3 Denmark

Environmental Impact Assessment in Relation to Marine Aggregate Dredging in Denmark

In Denmark the National Forest and Nature Agency is responsible for the administration and licensing of marine aggregate dredging. All new licensed areas are subjected to a Government View Procedure
including public and private involvement. The Agency prepares an environmental statement and requires if environmental effects may occur a detailed Environmental Impact Assessment.

Recent Environmental Impact Studies

A desk top study reviewing the latest results of environmental impact studies of dredging has been published in 1993 in cooperation with the National Environmental Research Institute.

During the Great Belt bridge and tunnel project the company (A/S Storebaeltsforbindelsen) has prepared a number of very comprehensive environmental impact assessments of the dredging of sand fill and glacial till. The assessments include hydrography, sediment spreading, nutrients, smothering of flora and benthic fauna, settling of mussels and behaviour of birds, especially Eider Ducks. The reports have not been published but information is given on application.

In 1993 the Forest and Nature Agency has prepared a study on sediment spreading from dredging project in the Great Belt. The study compares sediment spreading from different types of potential resources and dredging methods.

In the Sound between Denmark and Sweden impact assessments are being carried out prior to the initiation of the tunnel and bridge project. The consequences of dredging in till and chalk especially have been studied in detail.

Preliminary results from ongoing dredging in glacial till and limestone with a large dipper dredger indicate an average spill of about 4% from dredging and reclamation. The assessment of the environmental impact is based on a feedback monitoring programme based on modelling of sediment spreading and a newly developed eelgrass growth model.

A detailed resource assessment and an environmental impact assessment of dredging of sandfill has been carried out on Kriegers Flak in the Baltic by the Øresund Consortium. The assessment has been prepared in accordance with the EC Directive 85/337.

Preliminary results from the spill monitoring program on Kriegers Flak indicate that the spill is strongly depending on the type of dredger. Spill rates range from 0.7% to 4.8%. The release of fines and nutrients is very low. In August the impact assessment will be updated based on modelling of the spreading of measured sediment spill and bottom fauna samplings.

In 1994 The Forest and Nature Agency initiated a 3 year research project on the consequences of marine dredging in cooperation with the Geological Survey of Denmark and the National Environmental Research Institute. The project include studies of fines in potential resources, computer models for studies of sediment spreading, development of ecological models and field tests. One of the aims of the project is to establish a decision framework (computer aided Expert System) to evaluate the environmental consequences of existing and future dredging projects based on content of fines in the resource, hydrography, spreading of fines and ecological models.

Results from analyses of a very large number of samples from marine resources have shown that the content of fines, i.e. silt and clay, only in a few samples exceed 5%. Although the figures are general they give a natural framework for the evaluation of aggregate dredging. A report has been published in 1995 (in Danish).

A detailed study of the ecological consequences of dredging in coarse sediments will start in May 1996. The effects on the benthic flora and fauna on surrounding stone reefs especially will be evaluated.

The Forest and Nature Agency and the Coastal Protection Agency have initiated a monitoring programme off the west coast of Jutland to study the effects of dredging of sand for coastal protection. The study is based on a new sampling concept. Instead of taking several samples at a few stations, samples are spread over a 200 m grid covering the area of potential impact.

A study of the environmental impact of gravel dredging in the Limfjord area is currently being carried out by the Forest and Nature Agency. During dredging the sediments are screened and sand and finer particles are returned to the sea. Detailed spill measurements have shown that the spill rates vary between 60% and 90%. Analyses of the spill have shown that most of the material is sand and less
than 5% consist of silt and clay. The spreading of sediments have been evaluated by the hydrographic model MIKE 21 and the spreading module PARTICLE developed by DHI. The tests have shown that despite the large spill percent the spreading of sand is restricted to the dredging area and sedimentation of fines outside the area is very limited.

5.4 France

In 1995 a synthesis of baseline information available in the Baie de Seine was published in order to produce an EIA for an experimental dredging site (cfr. appendix VIII, ICES CM 1995/E:5).

A scientific programme was proposed in order to define guidelines for this experiment, with 3 main objectives:

1. the examination of a previous experimental site (souille expérimentale CNEXO; Figure 1) dredged in the 1970’s but without any published conclusions;
2. the definition of dredging recommendations for the new experimental site (site B; Figure 1), in accordance with the experience of the ICES members countries;
3. the methodology for the scientific and technical monitoring of the experimental dredging operations.

Souille expérimentale CNEXO

Prospecting of this site in 1995 enabled the investigation of several questions about its physical and biological restoration, 20 years after the end of dredging operations. A video showed:

- the presence of fine superficial sediments, not exceeding 25 cm in depth, covering the hard substratum of fossil clay, except in the narrowest and deepest part of the dredging area (down to 12 m below bottom level) where strong canalised currents prevent any sedimentation; a few blocks not exceeding 20 cm were also observed;
- the presence of fish (dab, haddock, dragonet), cuttlefish, crustaceans (swimming crabs and edible crabs under the blocks, hermit and spider crabs in silty-sandy areas) and macrobenthic fauna (bivalves, starfish, worms, sea-anemones...).

Samples of superficial sediments and benthic fauna (figure 2) confirmed the existence of two distinct areas:

- the western narrow area where the substratum of fossil clay prevents any benthic recolonisation;
- the eastern area, to be larger and not so deep (maximum of 5 m below the bottom surface). There the fine silty sediments are colonised by benthic communities which are 3 times richer than adjacent areas around the dredging site:
  * with a mean specific richness of 31 species in the control stations against 11 species in the reference stations;
  * with mean abundances of 750 ind/m² inside and 250 ind/m² outside;
  * for biomass, results are more variable but always higher in the dredging site with a mean value of 2 g/m² against 1.5 g/m² outside the dredging site (where it fluctuates from 0.1 to 4.5 g/m² in relation to the presence of sea-cucumbers).

This recent prospecting gave interesting information about the physical impact of various methods of dredging and its consequences for benthic recolonisation as well as for the presence of fish and the accessibility to fishing gear.
RESSOURCES EN GRANULATS MARINS
Souille Expérimentale et Permis d’Extraction de Granulats
(en exploitation, en renouvellement, en cours d’instruction)
Echelle : 1/200 000

Figure 1: Souille experimentale CNEXO, a new experimental site (B) and location of other extraction sites in Baie de Seine
LOCALISATION DE LA SOUille CNEXO 1974
ET DES STATIONS D'ECHANTILLONNAGE DE SEDIMENTS
ET DE MACROFAUNE BENTHIQUE.

Figure 2: Sampling stations in the CNEXO experimental site
Definition of dredging recommendations

This document was elaborated by the GEMEL (in collaboration with IFREMER and the assistance of the Ministry of Industry) on the basis of the experience acquired as well at the French level (dredging sites of CNEXO and Dieppe) as at the international one with the ICES WG reports.

These recommendations will be applied on a new experimental dredging site located in the Baie de Seine, during a 4 year period (1997-2001), in order to test different extraction conditions and select an optimal one, which minimizes both the impact on marine environment and the interference of dredging activity with other legitimate uses of the sea, mainly fishing activity.

Results of this experiment will further help to establish recommendations for dredging activity at a national level.

The following technical characteristics were adopted:

- trailing suction dredging;
- annual dredging volume of 500,000 tonnes;
- selection of an experimental area of 8 km² (site B, Figure 1), on the basis of a good knowledge of its environmental characteristics (bathymetry, superficial sediment, benthic fauna), the absence of spawning and nursery areas and of interference with other uses of the sea (navigation, military zones, cables and pipelines, recreational areas, wrecks, etc);
- in this area (Figure 3), two sites of 0.6 km² will be successively dredged with different intensities:
  * site A will be the “fallow” test with dredging limited to one year (1997-1998) on a maximal depth of 1m; this site will be used to study the recolonisation rate of the local gravel community;
  * site B will be the “intensive” test with dredging during three years (1998-2001) to a maximal depth of 3m; this site will serve to study the spatial impact of intensive dredging activity.
- on-board screening will be prohibited to limit the outwash plume;
- a time-table for the extraction was adopted with cessation of dredging activity from August to October when fishing activity is the most intensive (sole, cuttlefish);
- dredging activity will be controlled by black-boxes according to the minimal ICES recommendations;
- extraction will be orientated perpendicular to the direction of bedload sediment transport to facilitate infilling by mobile sands;
- nivellation of grooves and ridges will be tested on one half of site A to demonstrate the potential interest of such a practice:
  * on the recolonisation rate by benthic macrofauna,
  * on further trawling of such areas after cessation of dredging activity.
Figure 3: The fallow test site A and intensive test site B of the new experimental dredging programme in the Baie de Seine.
Impact monitoring

The scientific monitoring programme of the experimental dredging site is as follows:

- initial baseline studies have already covered:
  * bathymetry, hydrography, turbidity, sediment quality and heavy metals;
  * plankton, benthos (GEMEL), fish and shellfish resources (IFREMER);

- physical monitoring will include every year:
  * bathymetry by echosounding;
  * morphological survey by side-scan sonar (University of Caen);
  * sedimentological survey (GEMEL);
  * continuous recording of turbidity, nutrients and chlorophyll by a MAREL buoy (IFREMER).

- biological monitoring will cover:
  * benthos with a recolonisation survey of site A and an impact survey around site B during 3 years (GEMEL);
  * demersal fish populations, with 2 autumnal campaigns: Channel Ground Fish Survey (IFREMER) and Beam Trawl Survey (MAFF);
  * trophic relationships between fish and benthos with study of stomach contents (IFREMER-GEMEL);
  + fishing activity (IFREMER).

This programme was developed in 1994-1995 in the framework of the “Contrat de Plan Intermunicipal” by the “Commission intermunicipale de concertation pour la gestion de la Baie de Seine”. The programme is funded by the Government and the Regions except for the monitoring programme, which is funded by the dredging companies.

5.5 Germany

In the coastal region the Federal Water and Navigation Administration is the responsible National Agency. Navigation channel dredging is required by law to satisfy requirements for international navigation. For maintenance dredging impact assessment is not required. Where the depth of a channel is to be increased below a licensed depth, however, a formal environmental impact assessment is required. This EIA has to be undertaken once for such a project and has to describe all aspects of considerable impact so that a plan for compensating all the different aspects can be made. It is required, that compensation should be made as near as possible to the area of impact and that the lost or disturbed habitat is re-established as far as possible. Otherwise a habitat has to be selected of which the ecological value can be increased. These projects are subject to a licence to which certain conditions may be attached eg the requirement to monitor the recolonisation of the fauna within a lost habitat to verify the recolonisation rates predicted by the EIA. If recolonisation occurs at a lower rate than predicted, for example, there is a requirement to provide further compensation for additional and considerable impact on the natural environment. Dumpsites at sea for materials deriving from maintenance dredging are selected with the help of a manual developed for the Federal Water and Navigation Administration based on Oslo Commission guidelines (see Annex V). Two studies have been conducted to test the guidelines and similar investigations will be undertaken for other disposal sites in due course.
5.6 Ireland

There was a discussion on the draft protocol being proposed by the Department of Marine for Environmental impact assessment specifically for the Waterford exploratory licence application.

5.7 The Netherlands

The guidelines for extraction of sand, gravel and shells from the Dutch part of the Continental Shelf are set out in the Regional Extraction Plan for the North Sea. These were approved by the Government in 1993. The guidelines are based on the results of an extensive Environmental Impact Assessment. In this EIA all possible applications using extracted materials, the known extraction techniques and other users of the North Sea were taken into account.

Preparations are being made for an update of the Regional Extraction plan for the North Sea. The need for this update arises from the new nourishment techniques by means of temporal borrow-pits landward of the 20 m depthline, shellfishery concerns, new extraction techniques, extraction in exclusion zones and other items that have arisen since the original extraction plan was issued.

5.8 Norway

An environmental investigation regarding the effects of carbonate sand extraction on marine life has been conducted by the Rogaland Research.


5.9 Sweden

Since 1 July 1992 there has been a requirement in the Swedish Act of the Continental Shelf to carry out an EIA in connection with an application for extraction of marine sediments, as well as larger construction works in the marine environment. The EIA has to be paid for by the company applying for an extraction license. The Geological Survey of Sweden is responsible for the administration and licensing of extraction of marine aggregates. Licensing in the EEZ beyond the territorial sea limit is handled by the government. A recent example of modern Environmental Impact Assessment studies and monitoring are those undertaken in connection with the construction of the fixed link between Sweden and Denmark. These are further described in Annex V.

5.10 United Kingdom

Although not a legislative requirement the dredging companies in the UK marine sand and gravel extraction business have accepted that adequate assessment is needed for the purposes of MAFF's evaluation of the impact on fishing and the marine environment. In general the approach adopted in the UK for environmental effects monitoring follows the guidelines given by Campbell (1993). These guidelines are presently being reviewed and up-dated. Together with the outcome of Hydraulics Research Studies, the agreed Environmental Statement identifies the issues upon which monitoring and mitigation measures are based. These measures form an integral part of the Government View decision and are included as conditions in any Crown Estate Production Licence. Such conditions may include seasonal restrictions upon dredging, a requirement to monitor a range of physical and biological measurements, together with other monitoring conditions. Such conditions are monitored by MAFF and DOE. Those relating to tonnage taken and area dredged are monitored by the Crown Estate as landowner.
5.11 United States

One current issue in the US reported to the Working Group regarding environmental impacts was that of the impact of dredging on sea turtles and other endangered species. The National Marine Fisheries Service requires trained observers on dredges to document encounters with sea turtles and operations can be suspended if the frequency of encounters gets too high. The Corps has been developing an "excluder" to fit over the drag head and keep turtles from the intake but apparently current models are only effective in calm conditions.
6 REVIEW OF DEVELOPMENTS IN NATIONAL AUTHORIZATION AND ADMINISTRATIVE FRAMEWORKS AND PROCEDURES

6.1 Belgium

By Royal Decree of 06.03.96 (see ANNEX V), a black-box on board of each dredging vessel must be installed. The following parameters need to be entered for each trip:
- identification of the concession holder
- serial number of the trip

The following parameters are registered automatically:
- identification of the dredging vessel
- date of the registrations
- time (G.M.T) of the registrations
- position of the dredging vessel
- speed of the dredging vessel
- status of the pumps (on/off)
- status of dredging (yes/no)

The black-box and the registered parameters have to comply to given technical specifications.

The black-box shall be operational with effect from 1st June 1996.

The information coming from the black-boxes will be decoded by the Management Unit of the North Sea Mathematical Model (MUMM, Ministry of the Environment) and will be reported to the Ministry of Economic Affairs.

The black-box will serve two goals:
(i) control of the dredging operations
(ii) input for scientific research, e.g. exact position of the dredging trajectories.

6.2 Canada

Aggregate extraction is presently not permitted in Canada; see section 3.2 for a review of the current situation.

6.3 Denmark

The administration of marine aggregate extraction is based on the Raw Materials Act from 1991. Dredging in EC bird protection areas (SPAs) has been forbidden from December 1994 except in a few areas where dredging will be terminated in 2 - 10 years. The EC-directive 85/337 on environmental impact assessment has been included in The Raw Materials Act through an amendment dated 29 March 1995.

A new Raw Materials Act will come into force from 1 January 1997. From this date all dredging activity will take place only in licensed areas.

All dredging locations are subject to a Government View procedure including public and private involvement. Dredging projects exceeding 250,000 m³ are subjected to special procedures An environmental assessment will be carried out in all areas.

A 10 year transitional period is allowed for dredging in existing areas.

Dredgers must have a permission to dredge in Danish Waters. In order to maintain a sustainable and environmentally justifiable dredging activity the total tonnage of the dredgers is to be held at the present level.

The National Forest and Nature Agency is responsible for the mapping of sand and gravel in Danish Waters. Since 1990 the Geological Survey of Denmark has carried out the mapping projects.
6.4 France

A review of the legislation governing mineral extraction in the French Territorial Sea has been proposed. The aim of such a review will be to simplify the existing procedures. A full report will be given for inclusion in the forthcoming Cooperative Research Report.

6.5 Germany

No new developments were reported (see also Section 5.5).

6.6 Ireland

No new developments were reported.

6.7 The Netherlands

In addition to the six black boxes that were installed in 1994, another six black boxes are ordered in 1995. Due to the increasing sand extraction, black boxes have to be installed on board of suction hopper dredges.

In general a warning will be given to violating dredges before further legal action will be taken.

6.8 Norway

No new developments were reported. From April 1993 the issuing of extraction licenses has been delegated from the Department of Industry and Energy to local authorities (county administration).

6.9 Sweden

Since 1 July 1992 there is a demand in the Swedish Act of the Continental Shelf to carry out an EIA in connection with an application for extraction of marine sediments, as well as larger construction works in the marine environment. The EIA has to be paid by the company responsible for the application of an extraction license. The Geological Survey of Sweden is responsible for the administration and licensing of extraction of marine aggregates. Licensing in the EEZ off the territorial water limit is handled by the government.

6.10 United Kingdom

Regulation/Government View Procedure

Applications to extract marine sand and gravel are subject to a non-statutory Government View procedure. This is effectively a two stage consultation process. Under the first informal stage an applicant approaches the Crown Estate for grant of a licence, and Hydraulics Research, Wallingford, are commissioned to assess the potential effect of the dredging on the coastline. At the same time the informal views of the MAFF, English Nature and other interested parties are sought and where it is expected that the proposal will have significant environmental effects, the applicant is required to produce a full environmental impact assessment. The views of consultees, the environmental statement and the Hydraulic Research study are then submitted to the DOE for formal consultation and determination. The Crown Estate will only issue a licence following a favourable Government View.

However, following the publication of a report by the Environmental Select Committee in 1992, which raised concern about the current licencing arrangements for minerals dredging, and particularly the operation of the Government View Procedure, the DOE sought to review current arrangements and issued a consultation paper in March 1994, setting a number of alternative options. The results of the consultation exercise, and proposals on the preferred way forward where published in November 1995. A full copy of this paper reproduced in Annex V. The proposed changes will require primary legislation.
In summary, the proposals are:

(a) Costs of administrating the new statutory system are to be recovered through dredging application fees.

(b) Despite differing views on the length of dredging permissions DOE propose a 15 year licence term with substantive reviews every fifth year.

(c) The statute is to subsume Section 18 (consent by designated Coast Protection Authority) and Section 34 (navigation) consents required under the Coast Protection Act 1949.

(d) The statutory system is to cover all land below the low water mark regardless of ownership.

(e) A policy of sustainable development and environmental protection is to be ensured through wide consultation with particular emphasis on MAFF’s (Environmental Protection Division) views.

The dredging companies themselves would be required to submit applications directly to DOE having first carried out informal discussions with key consultees, having produced an Environmental Impact Assessment and having advertised the applications. The results would be submitted to Government and a set period of 10 weeks allowed for formal comments from statutory consultees. Particular emphasis will be given to comments from MAFF although the material considerations upon which decisions will be based have yet to be agreed. Under the statute the companies will have a right of appeal in the absence of a decision, which will take the form of a public local enquiry or hearing. The companies will also have a legal right to challenge any decisions within six weeks if they feel they have been unfairly prejudiced or if the Secretary of State has exceeded his powers.

The landowner, mainly the Crown Estate, is to be responsible for monitoring tonnage dredged and for on board Electronic Monitoring System data, from which will be made available to OOE/WO, as “the controlling authority”. MAFF will be responsible for environmental monitoring, directly with the licensee.

Management by the Crown Estate

Since 1990 the Crown Estate has operated an Arc/Info Geographic Information System (GIS) as the primary source of data relating to the management of offshore marine aggregate extraction licences. The GIS essentially links graphical information to database tables and contains information on dredging licences, admiralty features, seabed geology, prospecting surveys and a wide range of other seabed uses and activities offshore.

The system is based on a stand-alone Unix SunSparc station which has been enhanced recently through the addition of a package known as ArcView which allows access to backdrop data and manipulation to create a second tier of reports, maps, statistics and charts for management purposes.

In January 1993 the Crown Estate introduced an electronic monitoring system (EMS) which records the date, time and position of all dredging-like manoeuvres. All vessels dredging on Crown Estate licences must be fitted with the EMS which records time and status of the vessel at 30 minute intervals on standby or 30 second intervals if indicators show the vessel to be dredging. To ensure security information from the various sensors is encrypted on the diskettes which are changed every month. The diskettes are analysed by the Crown Estate within 20 working days of the month end.

In 1995 some 40,000 hours of dredging records were analysed with less than 0.1% of the total hours dredged being out of area, where, in all cases licensees provided adequate explanations.

The Crown Estate has provided information on both the GIS and EMS to various groups and has, where appropriate, made detailed information available.
6.11 United States

There were no new developments in the US legal regime to report.

6.12 International Initiative

Belgium informed the meeting that at SEBA '96 the Working Group on Sea-Based Activities of the OSPAR Convention (Convention for the protection of the Northeastern Atlantic Ocean, Paris 1992), it was agreed that the effects of sand and gravel extraction should be taken into the working programme of SEBA '97 (see extract of the summary record of SEBA '96 in Annex V).

The Netherlands, as a pilot country, will prepare state of the art and draft guidelines documents, which take into account the work which has been done by the ICES-WG on sand and gravel extraction.

It should be noted that the proposal of SEBA still has yet to be approved by the OSPAR Commission which meets in June '96.
7 REVIEW AND REPORT ON BIOTOPE MAPPING AND RESEARCH ON CRITICAL HABITATS FOR FISHERIES.

The Working Group had extensive discussions on the possible effects of marine aggregate extraction activities on fisheries and, in particular, ways in which a better understanding of the possible sources of environmental disturbance on fisheries might be developed. It reviewed its previous work summarised in the ICES Cooperative Research Report No 182 and a number of specific cases where concerns over possible impacts on fisheries from extraction operations were evident. A summary of these is given below:-

a) Race Bank. Permission was sought in 1992 to dredge sand from the Race Bank for the purpose of beach recharge between Mablethorpe and Skegness off the east coast of England. As part of the Government View procedure concern was raised over the potential impact of dredging on an established crab fishery (Cancer pagurus). In particular, the proposed site was known to be an important overwintering ground for ovigerous female crabs which would be especially vulnerable to the effects of dredging. The contract for dredging was subsequently awarded under condition to an existing licensee from an alternative area. If the application for dredging is to be taken forward on Race Bank this concern would be considered in detail.

b) Inner Owers licence application. This occurs within an area where there is an unregulated fishery for black sea-bream (Spondylus canthus). The fishery has increased in recent years and concern from fishermen has led to more detailed studies of the black sea-bream nesting sites in the vicinity. The stock is poorly understood and little fishery data exists, but the nature of the seabed nesting habit close to the proposed licence area has been a matter for further consideration.

c) Ireland - herring spawning grounds. Anecdotal evidence from fishermen reports most of the south coast of Ireland to be a herring spawning ground. The region is believed to extend from the Saltee Islands in the east to Cork harbour in the west. To date no effort has been made to verify this information through mapping and surveys. A project will start in summer 1996 to map these areas using ROXANN and grab sampling. This is particularly important as a prospecting licence has been granted in the area (close to Waterford Harbour). A commercial extraction licence will shortly be applied for and the presence or absence of herring spawning grounds within the licence area will be a major determinant in considering the application.

Similar examples exist and there is clearly a greater pressure on new and proposed aggregate extraction activities to demonstrate the scale of possible effects of such operations on these fish stocks and their fisheries. Having noted these concerns the Working Group was also unequivocal in its assertion that at the present time and in relation to the present scale of extraction activities there is no substantiated evidence of any licensed activity having an observable deleterious effects on the ecology of a fishery. This may be a consequence of the difficulties associated with any study that attempts to investigate such effects. It may be a consequence of their being no effect on the ecology of fisheries or, more simply, that any effects are not discernible against the background noise of variability in such fisheries. The Working Group also noted that, in general, all licensing arrangements in ICES Member Countries required that such considerations were properly investigated prior to any license being granted.

The Working Group adopted two lines of enquiry in re-evaluating these concerns. The first involved an examination of fish species, their ecology and fisheries and the second sought to elaborate further the possibilities of developing benthic ecology approaches. A number of conclusions were drawn, and in addition certain specific tasks which might lead to a clearer understanding of these matters for the next Cooperative Research Report were noted. The Working Group did not feel it was in a position at this meeting to resolve such matters but was able to establish a framework for a more thorough investigation prior to its next meeting. A general agreement was reached on the following points:-

i) In the ICES Cooperative Research Report No 182 the principal focus for concern of effects on fisheries was the major commercially-exploited stocks of fish, most of which were subject to regulatory control. In considering broader ecological attributes and in particular international commitments to biodiversity it was felt that it was no longer sufficient to focus concern solely on commercially exploited stocks. A broader discussion suggested consideration should be given to rarity and the risks posed by minor environmental disturbances to heavily exploited unregulated stocks even where the commercial importance of these might be
considered minor. Working Group members agreed to collaborate on the development of a target list of finfish species of concern in the coming months.

**Recommendation/Action.** A target list of finfish species of greatest concern will be developed and then circulated seeking in particular more detailed information on critical habitats and life histories for these stocks. Further work should supplement this list as appropriate for shellfish species. The Chairman of the Working Group agreed to approach the ICES General Secretary and ACME for contributions, and assistance in obtaining this information.

ii) It was felt that the development of a detailed geographical account of the distribution of such critical habitats was beyond the scope and resources of the Working Group but that generic descriptions of such habitat types and associated communities would be a valuable reference point for Member Countries in considering specific geological areas. As part of this evaluation it was noted that considerable information on the morphology and sedimentology of areas mapped during geological survey was available and that this may provide additional insights into the occurrence of such habitats.

**Recommendation/Action.** Working Group members involved in geological survey should seek to establish prior to the next meeting the extent to which information on seabed characteristics might contribute to the development of critical habitat maps.

iii) Equally it was felt that information gathered as a result of benthic survey activities would provide an important input into the development of critical habitat maps, particularly with regard to fish. Additionally with regard to the fragility of benthic communities it was felt that an evaluation of existing information particularly on natural variability within sand/gravel substrates, and of the range of observed recolonization times recorded in recent studies, might lead to a better understanding and to a general model of ecological response to such disturbance sources.

**Recommendation/Action.** Working Group members involved in benthic survey and by request the Working Group on Benthic Ecology (via its chairman) should be asked to provide a more detailed evaluation prior to the next meeting of the Working Group, identifying any gaps requiring further work.

iv) It was noted that there are substantial areas of sand and gravel sediment which are of insufficient thickness for commercial extraction. These areas may support benthic communities similar to those found in licensed extraction areas, and where geological surveys have been conducted, the precise extent of such areas will be known. Similarly the extent to which these areas provide critical habitat for fishes, at least for major commercial stocks, may be documented.

**Recommendation/Action.** Working Group members should seek to establish a clearer picture of the relative extent of such areas, their benthic ecology and role in supporting critical habitats for fishes and whether there are important differences in this respect between these, and licensed areas and areas containing known reserves.
8 REVIEW AND REPORT ON SAMPLING STRATEGIES

Three points, highlighted in item 8 of the agenda, were addressed, namely:

1. Sampling design. It was considered that the guidelines for monitoring strategies presented in the 1995 report of the Working Group were appropriate for existing and potential future aggregate extraction sites. More specific guidelines on the spatial and temporal frequency of sampling were deemed inappropriate since these should be determined on a case by case basis.

2. Benthic sampling methods. In general the methods recommended by the Benthic Ecology Working Group should be adopted for sampling sand and gravels. However, it was recognised that the Hamon grab has proved to be particularly efficient in quantitatively sampling the infauna of coarse mixed sediments off the UK. The group will recommend the use of the Hamon grab for environmental effects monitoring of aggregate extraction activities subject to further evaluation of its sampling performance and review of the results by the Benthic Ecology Working Group.

3. Finfish sampling strategies. In contrast with the development of pelagic gears the development of demersal gears has hardly changed over the years. Fisheries laboratories use, for their fish surveys, adaptations of the principal commercial fishing gears. This standardisation was regulated under the aegis of ICES (e.g. the young fish trawls - GOV trawl - and standard 4m or 12m beam trawls and ottertrawls. Mesh sizes used vary between 2cm and 9cm). Echo integration techniques used for pelagic fish counts are at present resisted for demersal stocks. It seems unlikely that these sampling methods will change in the foreseeable future.

Other Working Group members were more sanguine with regard to the opportunities that recent development in high performance split beam scientific echo sounder technologies were now able to offer. The difficulty, however, in the development of sampling strategies for finfish observation was largely one of determining:

- what hypotheses for effects might reasonably be investigated
- what temporal and spatial scales needed to be considered
- what intensity/longevity of sampling might be required in order to expect to detect effects against the natural stochastic variation in the fishery.

In this respect the selection of any particular sampling method is probably secondary to the robustness of design of sampling strategy and the hypotheses being tested. Working Group members agreed to give some further consideration to this prior to the next meeting.

9. SEABED MAPPING

It was agreed that the published sediment maps are insufficient in most member countries both in terms of area coverage and detail necessary to address biological issues such as habitat mapping and resource conflicts. The Working Group stressed the importance of national seabed mapping programmes with the greatest concern for reduction of these activities in some member countries. It was stated that these types of maps are most essential for an understanding of the complex relationships between the fauna, flora, the habitats and mineral resources and associated understanding of seabed processes of erosion, transport and deposition. Additionally, the maps form an essential base for most EIA studies in the marine environments associated with resource development. Furthermore, it was stated that the development of high-resolution mapping technologies and quantitative reflecting measurements such as multibeam bathymetry, high resolution side scan sonar and video systems have opened up new possibilities to undertake detailed surveys of certain seabottom areas (spawning, nursery and feeding grounds) of particular importance to the fisheries and the ecosystem. With the new technologies, we are now poised to address critical problem regarding seabed habitat and resource extraction, and as such, we recommend studies of specific areas where the technology can be most effectively applied.
10. RECOMMENDATIONS FOR FUTURE WORK

The Working Group on the Effects of the Extraction of Marine Sediments on the Marine Ecosystem (WGEXT), Chairman Dr S J de Groot will meet from 15-18 April 1997 in the National Forest and Nature Agency of the Danish Ministry of Environment and Energy in Copenhagen, Denmark to carry out the following tasks at the next meeting:-

a. to review and report the status of marine sediment extraction activities (in relation to use categories) in ICES Member Countries and related environmental research;

b. to review and report the development of seabed resource mapping in ICES Member Countries;

c. to review approaches to Environmental Impact Assessment related to marine extraction operations, and to continue to work on sampling strategies related to impact assessments and environmental monitoring of dredging operations in order to develop reliable and cost-effective evaluations;

d. to review and report developments in legal and administrative frameworks and procedures (particularly electronic monitoring) in accordance with ICES Cooperative Research Report No 182;

e. to continue its work on evaluation of the effects of marine sediment extraction activities on benthos and fisheries, noting in particular the actions agreed at this meeting with regard to the development of concerted approaches to critical habitat classification and mapping, and with a view to including its findings in the forthcoming Cooperative Research Report;

f. to continue its work on the update of the ICES Cooperative Research Report No 182 with the aim of finalising a draft for a new Cooperative Research Report at its next meeting;
11 CLOSE OF MEETING

The Report of the Working Group was agreed by the participants. The Chairman thanked the participants for their contributions and requested that for the next meeting as much material as possible should be supplied in advance and where possible on disk. The Chairman thanked the Rapporteur and the Heriot-Watt University's International Centre for Island Technology for hosting the meeting. The meeting was formally closed by the Chairman.

12 ACKNOWLEDGEMENTS

The Working Group gratefully acknowledges the assistance of the staff of the International Centre for Island Technology for their administrative and secretarial support.
ANNEX I

Agenda: ICES WG On the Effects of the Extraction of Marine Sediments on the Marine Ecosystem

23-26 April 1996, Stromness, Scotland

1. Welcome by ICIT, Heriot-Watt University.
2. Welcome by Chairman.
3. Appointment of Rapporteur.
ad. 3 proposed Dr J Side
4. Terms of Reference (see C Res 1995/2:26, being agenda points 6-11).
5. Adoption of Agenda.
6. Review and report on the status of marine sediment extraction activities (in relation to use categories) in ICES Member Countries and related environmental research.
7. Review and report on the development of seabed resource mapping in ICES Member Countries.
8. Review approaches to Environmental Impact Assessment related to marine extraction operations, and continue to work on sampling strategies related to impact assessments and monitoring of dredging operations in order to develop reliable and cost-effective methods;
9. Review and report on developments in legal and administrative frameworks and procedures in accordance with ICES Cooperative Research Report No. 182;
10. Review and report on requirements for and developments in habitat mapping, with particular reference to fish and shellfish spawning areas and consider research investigations and strategies that will lead to an increased understanding of the effects of aggregate extraction activities on sensitive or critical habitat areas of importance to the early life histories of fish and shellfish stocks spawning on the seabed;
11. Collect material from the work of the Working Group to begin the preparation of a manuscript to be published in the ICES Cooperative Research Report series to update No. 182 of this series.
12. Recommendations.
13. Date and place of next meeting.
ANNEX II

Terms of Reference

The Terms of Reference of the Working Group on the Effects of Extraction of Marine Sediments on the Marine Ecosystem (Chairman: Dr S J de Groot, Netherlands) as set out in the ICES Council Resolution 2:26 (1995) were to:-

a) review and report on the status of marine sediment extraction activities (in relation to use categories) in ICES Member Countries and related environmental research;

b) review and report on the development of seabed resource mapping in ICES Member Countries;

c) review approaches to Environmental Impact Assessment related to marine extraction operations, and continue to work on sampling strategies related to impact assessments and monitoring of dredging operations in order to develop reliable and cost-effective methods;

d) review and report on developments in legal and administrative frameworks and procedures in accordance with ICES Cooperative Research Report No. 182;

e) review and report on requirements for and developments in habitat mapping, with particular reference to fish and shellfish spawning areas and consider research investigations and strategies that will lead to an increased understanding of the effects of aggregate extraction activities on sensitive or critical habitat areas of importance to the early life histories of fish and shellfish stocks spawning on the seabed;

f) collect material from the work of the Working Group to begin the preparation of a manuscript to be published in the ICES Cooperative Research Report series to update No. 182 of this series.
## ANNEX III

### LIST OF CONTRIBUTORS TO THE REPORT

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ANNEX IV

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ANNEX V

SUPPLEMENTARY MATERIALS FOR INCLUSION IN THE REPORT OF THE MEETING

Item 1 Royal Decree concerning the exploration and exploitation conditions related to the concession for the exploration and exploitation of sand and gravel on the Belgium Continental shelf.


Item 3 Review of licensing of minerals dredging in England and Wales: proposed statutory procedure.

Item 4 The dredging operations for the fixed link between Sweden and Denmark.


Item 6 Vyncke W. and Hillewaert H. Colour measurements on marine sediments off the Belgium coast as a means for estimating grain size.

Item 7 Kenny A.J., Greening J. and Rees H. L. Determination of trophic links between macrobenthos and fish in areas of commercial aggregate interest.

Item 8 SEBA 1996 Summary Record: identification of further sea-based activities which give rise to the effects on the marine environment.

Item 9 Draft contents for the forthcoming Cooperative Research Report.

Item 10 Map showing licensed extraction areas on the Dutch Continental Shelf.
ANNEX V

Item 1 Royal Decree concerning the exploration and exploitation conditions related to the concession for the exploration and exploitation of sand and gravel on the Belgium Continental shelf.
Koninklijk besluit betreffende de exploratie- en exploitatievoorwaarden verbonden aan het concessiebesluit voor de exploratie en exploitatie van zand en grind van het continent plat van België.

Albert II, KONING DER BELGEN,
Aan allen die nu zijn en hierna wezen zullen, ONZE GROET.

Gelet op de wet van 13 juni 1969 inzake het continent plat van België, inzonderheid op de artikelen 3 en 5;

Gelet op het koninklijk besluit van 7 oktober 1974 betreffende het verlenen van concessies voor de exploratie en de exploitatie van de minerale en andere niet-levende rijkdommen van het continent plat, inzonderheid op de artikelen 8 en 10;

Gelet op het koninklijk besluit betreffende de exploitatievoorwaarden verbonden aan het concessiebesluit;

Gelet op het ministerieel besluit houdende concessie voor de exploratie en de exploitatie van minerale en andere niet-levende rijkdommen van het continent plat van België;

Op de voordracht van Onze Vice-Eerste Minister, Minister van Economie en Telecommunicatie,

HEBBEN WIJ BESLOTEN EN BESLUITEN WIJ:

Artikel 1. - Voor de toepassing van dit besluit dient te worden verstaan onder:
- de Minister: de Minister tot wiens bevoegdheid de Economische Zaken behoren;
- het Bestuur: het Bestuur Kwaliteit en Veiligheid van het Ministerie van Economische Zaken;
- bevoegde ambtenaren: de ambtenaren die in uitvoering van artikel 18 van dit besluit door de Minister worden aangewezen;
- ontginningsvaartuig: elk vaartuig dat gebruikt wordt voor het baggeren of het ontginnen van grondstoffen van de zeebodem;
- transportvaartuig: elk vaartuig, met uitzondering van de ontginningsvaartuigen, dat gebruikt wordt voor het vervoer van de gebaggerde of ontgonnen grondstoffen.
**Art. 2.** - De grenzen van het ontginningsgebied zoals bepaald in artikel 1 van het ministerieel besluit van 27 november 1995 houdende concessie voor de exploratie en de exploitatie van mineraal en andere niet-levende rijkdommen van het continentale plat van België moeten strikt worden nageleefd.

De ontginning van zand en grind mag slechts gebeuren met ontginningsvaartuigen van het type "sleepzuiger". Het ontginnen moet gebeuren over een aaneensluitend gebied in lagen van maximaal 0,5 m. De ontginning moet onderbroken worden indien de gemiddelde verplaatsingssnelheid van het ontginningsvaartuig ten opzichte van de zeebodem kleiner is dan 1,5 knopen. De totale ontginningsdiepte mag niet dieper gaan dan 5 m beneden de bodemligging zoals aangegeven op de meest recente nautische kaart "De Vlaamse Banken", uitgegeven door het Ministerie van de Vlaamse Gemeenschap.

Indien verschillende ontginningsvaartuigen werken in dezelfde zone moet men tijdens de ontginning steeds een minimum afstand van 500 meter tussen de vaartuigen behouden.

**Art. 3.** - Het scheiden van zand en grind op zee kan op bepaalde plaatsen door de bevoegde ambtenaren verboden worden.

**Art. 4.** - Aan boord van de ontginningsvaartuigen moeten volgende documenten ter beschikking zijn:

1° een afschrift van het concessiebesluit en het daarbijhorend koninklijk besluit;
2° een nautische kaart "De Vlaamse Banken", uitgegeven door het Ministerie van de Vlaamse Gemeenschap, waarop de grenzen van de concessie zijn aangegeven;
3° het register zoals bepaald in artikel 14;
4° de akte van keuring en verzegeling van het registreertoestel zoals voorzien in artikel 5 § 3.

**Art. 5.** - § 1 Aan boord van elk ontginningsvaartuig moet op kosten van de concessiehouder een automatisch registreertoestel geplaatst worden waarmee tenminste de volgende gegevens worden opgenomen. Door het boordpersoneel voor elke reis in te stellen parameters:

1° Identificatie van de concessiehouder;
2° Volgnummer van de reis.

Automatisch te registreren parameters:
3° Identificatie van het ontginningsgebied zoals bepaald in artikel 1 van het ministerieel besluit van 27 november 1995 houdende concessie voor de exploratie en de exploitatie van mineraal en andere niet-levende rijkdommen van het continentale plat van België moeten strikt worden nageleefd.

L’exploitation de sable et de gravier sera effectuée exclusivement au moyen de bateaux d’exploitation du type "bateaux de dragage équipés de suceuses". L’exploitation doit avoir lieu dans une zone continue en couches de 0,5 m au maximum. L’exploitation doit être interrompue lorsque la vitesse de déplacement moyenne du bateau d’exploitation par rapport au fond marin est inférieure à 1,5 nœud. La profondeur d’exploitation totale ne peut aller au-delà de 5 m en-dessous de la situation du fond comme indiqué sur la plus récente carte nautique "De Vlaamse Banken", éditée par le Ministère de la Communauté flamande.

Lorsque plusieurs bateaux d’exploitation opèrent dans la même zone, une distance minimale de 500 mètres sera maintenue entre les bateaux pendant l’exploitation.

**Art. 3.** - Les fonctionnaires compétents peuvent interdire à certains endroits la séparation du sable et du gravier en mer.

**Art. 4.** - Les documents suivants doivent se trouver à bord des bateaux d’exploitation :

1° une copie de l’arrêté de concession et de l’arrêté royal y afférent ;
2° une carte nautique "De Vlaamse Banken" éditée par le Ministère de la Communauté flamande, indiquant les limites de la concession ;
3° le registre comme décrit à l’article 14 ;
4° l’acte de vérification et de scellement de l’enregistreur de position comme prévu à l’article 5 § 3.

**Art. 5.** - § 1er A bord de chaque bateau d’exploitation sera placé, aux frais du concessionnaire, un enregistreur automatique de position pouvant au moins enregistrer les données suivantes.

Les paramètres que le personnel de bord introduira pour chaque voyage :

1° Identification du concessionnaire ;
2° Numéro d’ordre du voyage.

Paramètres à enregistrer automatiquement :
3° Identification du bateau d’exploitation ;
vaaruit;
4° Datum van de registraties;
5° Tijd (G.M.T.) van de registraties;
6° Positie van het ontginningsvaaruit;
7° Snelheid van het ontginningsvaaruit;
8° Status van de pompen (aan/uit);
9° Status van het ontginnen (ja/nee).
§ 2 Het registreertoestel en de geregistreerde parameters moeten voldoen aan de in bijlage opgelegde technische specificaties.

§ 3 Na de installatie worden het registreertoestel en de ermee verbonden sensoren op aanwijzing van het Bestuur gekeurd en verzegeld. Van deze keuring en verzegeling wordt een akte opgesteld in viervoud. Eén exemplaar van deze akte is bestemd voor het Bestuur, het tweede exemplaar voor het Ministerie van Sociale Zaken, Volksgezondheid en Leefmilieu, Beheerszaken van het Mathematisch Model Noordzee en Schelde-estuari, het derde exemplaar voor de concessiehouder en het vierde exemplaar moet aan boord van het ontginningsvaaruit ter inzage gehouden worden van de met het toezicht belaste ambtenaren.

§ 4 Het beheer van het registreertoestel en de verwerking van de geregistreerde gegevens gebeurt door het Bestuur dat een derde hiermee kan belasten.

De concessiehouder dient de door het Bestuur opgelegde richtlijnen betreffende het beheer van het registreertoestel en de ermee verbonden sensoren strikt na te leven.

De kosten verbonden aan het onderhoud van het registreertoestel en de ermee verbonden sensoren zijn ten laste van de concessiehouder.


De concessiehouder wordt hiervan door het Bestuur zo snel mogelijk en uiterlijk vijftien dagen op voorhand ingelicht.

De minimumvergoedingen die bepaald worden in artikel 2 van het voormalige ministerieel besluit van 27 november 1995 zijn niet ver舒schuldigd voor de periodes waarvoor een volledig exploitatieverbod werd vastgesteld.

4° Date des enregistrements;
5° Temps (G.M.T.) des enregistrements;
6° Position du bateau d’exploitation;
7° Vitesse du bateau d’exploitation;
8° Etat des pompes (marche/arrêt);
9° Etat de l’exploitation (oui/non).

§ 2 L’enregistreur de position et les paramètres enregistrés doivent répondre aux spécifications techniques imposées dans l’annexe.


§ 4 La gestion de l’enregistreur de position et le traitement des données enregistrées sont assurés par l’Administration qui peut en donner la charge à un tiers.

Le concessionnaire est tenu de respecter strictement les directives imposées par l’Administration, relatives à la gestion de l’enregistreur de position et des détecteurs y reliés.

Les frais liés à l’entretien de l’enregistreur de position et des détecteurs y reliés sont à charge du concessionnaire.

Art. 6. - L’exploitation peut être limitée ou interdite temporairement dans certaines zones dans l’intérêt de la conservation du milieu marin et/ou de la pêche maritime. La limitation ou l’interdiction est communiquée, au moins un mois à l’avance, dans une note motivée, aux instances mentionnées à l’article 9, par l’instance qui la décrète.

L’Administration en informera le concessionnaire le plus rapidement possible et au plus tard quinze jours à l’avance.

Les indemnités minimales définies à l’article 2 de l’arrêté ministériel précité du 27 novembre 1995 ne sont pas dues pour les périodes pour lesquelles a été exprimée une interdiction totale d’exploitation.
Art. 7. - Rekening houdend met het landsbelang kunnen beperkingen opgelegd worden inzake de ontginning in de grote schietsector van de Zee-macht, te Lombardzijde. De instructies van de Militaire Overheid terzake moeten stipt nageleefd worden. In elk geval moet de concessiehouder zich houden aan de terzake gegeven onderrichtingen in het "Bericht aan Zeevarenden".

Art. 8. - De Staat behoudt zich het recht voor om binnen de zone waarvoor de concessie geldt, zand en grind te winnen en/of onderzoeken te verrichten alsmede om concessies voor de exploitatie of exploratie te verlenen aan derden.

Onderzoeken of ontginningen, verricht door of in opdracht van de Staat, mogen niet gehinderd worden.

De concessiehouders kunnen in dit verband tegenover de Staat geen aanspraken doen gelden op enigerlei schadevergoeding.

Art. 9. - Vooraleer met de ontginning te beginnen moet de concessiehouder in uitvoering van artikel 5 van de wet van 13 juni 1969 inzake het continentaal plat van België, voor specifieke aanwijzingen contact opnemen met:

1° het Ministerie van Economische Zaken, Bestuur Kwaliteit en Veiligheid;
2° het Ministerie van Landsverdediging te Brussel, betreffende het gebruik van de grote schietsector;
3° het Ministerie van Verkeerswezen en Infrastructuur te Brussel, betreffende de scheepvaart in het algemeen, de scheepvaartroutes, de navigatiemiddelen, de telecommunicaties, de onderzeese kabels en pijpleidingen;
4° het Ministerie van Landbouw, Rijkstation voor Zeevisserij te Oostende, betreffende de visbestanden;
5° het Ministerie van Sociale Zaken, Volksgezondheid en Leefmilieu, Beheersseenheid van het Mathematisch Model Noordzee en Schelde-estuarium te Brussel, betreffende het mariene milieu;
6° het Ministerie van de Vlaamse Gemeenschap, Departement Leefmilieu en Infrastructuur, Administratie Waterwegen en Zeezaken te Oostende, betreffende de waterwegen en hun aanhorigheden, de havens en hun aanhorigheden, de loods-
diensten en de bebakeningsdiensten van en naar de havens, evenals de reddings- en sleepdiensten op zee.

De door de in alinea 1 genoemde instanties gegeven aanwijzingen moeten stipt worden opgevolgd.

Art. 10. - Jaarlijks moeten aan het Bestuur volgende gegevens worden meegedeeld:

1° De namen of benaming en adres van de eigenaar en/of exploitant van de vaartuigen en/of installaties, die gebruikt worden voor de ontginning en het vervoer van het zand en/of grind;

2° De namen, de thuis- en/of exploitatiehavens, het land van registratie en de registratie- of teboekstellingsnummers van de vaartuigen en/of vlootende installaties.

Maandelijks moet aan het Bestuur een overzicht van de effectief ontgonnen hoeveelheden meegedeeld worden, met aanduiding van:

1° data van laden en lossen;

2° laad- en losplaatsen;

3° namen van de beladen vaartuigen;

4° laadvermogen van de vaartuigen volgens de meetbrief;

5° effectief geladen en geloste hoeveelheden.

Art. 11. - De concessiehouder moet de nodige maatregelen treffen om te beletten dat vaartuigen, die het opgehaalde zand en/of grind vervoeren, overdag de reglementaire uitwaterings- of jikmerken worden beladen, zoals aangegeven in het certificaat van uitwatering of in de meetbrief.

Art. 12. - De concessiehouder moet het Bestuur zo snel mogelijk en uiterlijk binnen een week verwittigen indien bij de ontginning voorwerpen, sporen of overblijfselen worden gevonden, die van historisch, oudheidkundig, wetenschappelijk of militair belang zijn of kunnen zijn.

Indien de concessiehouder het desbetreffende voorwerp of overblijfsslord onder zijn hoede heeft, moet hij het ter beschikking stellen van de bevoegde Overheden.

Art. 13. - De bevoegde ambtenaren hebben de bevoegdheid om na te gaan of de opgegeven hoeveelheden zand en grind overeenkomen met de effectief ontgonnen en geloste hoeveelheden.

Art. 10. - Les renseignements ci-dessous seront communiqués chaque année à l’Administration:

1° Les noms ou dénomination et adresse du propriétaire et/ou de l’exploitant des bateaux et/ou installations utilisés pour l’exploitation et le transport de sable et/ou de gravier ;

2° les noms, les ports d’attache et/ou d’exploitation, le pays d’enregistrement et les numéros d’enregistrement ou d’immatriculation des bateaux et/ou installations flottantes.

Chaque mois un aperçu des quantités exploitées effectivement doit être communiqué à l’Administration en indiquant :

1° les dates de chargement et de déchargement ;

2° les lieux de chargement et de déchargement ;

3° les noms des bateaux chargés ;

4° la charge utile des bateaux selon le certificat de jaugeage ;

5° les quantités effectivement chargées et déchargées.

Art. 11. - Le concessionnaire est tenu de prendre les mesures nécessaires pour éviter que les bateaux qui transportent le sable et/ou le gravier extraits soient chargés au-dessus des marques de franc-bord ou de jaugeage telles qu’elles sont mentionnées dans les certificats.

Art. 12. - Le concessionnaire est tenu d’informer l’Administration le plus tôt possible et endéans la semaine en cas de découverte, à l’occasion de l’exploitation, d’objets, de traces ou de restes qui ont ou peuvent avoir un intérêt historique, archéologique, scientifique ou militaire.

Si le concessionnaire a la garde de l’objet ou du reste précité, il le mettra à la disposition des Autorités compétentes.

Art. 13. - Les fonctionnaires compétents ont la compétence de vérifier si les quantités indiquées de sable et de gravier correspondent aux quantités effectivement exploitées.
Indien uit ten minste 3 tegensprekelijke metingen blijkt dat er een systematisch verschil bestaat, wordt dit verschil geëxtrapolleerd tot de volledige jaarproduktie en is de aldus vastgestelde hoeveelheid bindend voor de concessiehouder. De vergoedingen die verschuldigd zijn op basis van artikel 2 van het concessiebesluit worden dan berekend op basis van deze vastgestelde hoeveelheid.

Indien blijkt dat minder is verschuldigd dan als voorschot werd betaald, wordt het te veel betaalde teruggestort.

**Art. 14.** - De concessiehouder is verplicht om aan boord van elk ontginningsvaartuig een register met genummerde bonnen in drievoud bij te houden waarvan de vorm en inhoud door de bevoegde ambtenaar worden bepaald.

Onmiddellijk na de belading van het ontginningsvaartuig moet één bon worden ingevuld en door de kapitein ondertekend.

Indien het ontgonnen zand en/of grind wordt overgeslagen in een transportvaartuig wordt op de bon de naam van het ontginningsvaartuig en van het transportvaartuig vermeld en wordt de bon medeondertekend door de kapitein van dit transportvaartuig.

Het eerste exemplaar van de bon blijft in het register, het tweede wordt eventueel meegegeven aan de kapitein van het transportvaartuig. Bij het invullen van het register mogen er geen bladzijden worden overgeslagen.

Per ontginningsvaartuig mag gelijktijdig slechts één register in gebruik zijn. Indien het register vol is, moet het doorgezonden worden aan het Bestuur en mag een vervolgregister in gebruik genomen worden.

**Art. 15.** - De Inspecteur-generaal der mijnen kan de concessiehouder, na hem te hebben gehoord, een administratieve geldboete van 4.000 BEF opleggen indien wordt vastgesteld dat:
- een ontginningsvaartuig met een lading zand en/of grind dan wel een transportvaartuig wordt aangetroffen waarvan de kapitein de voorgeschreven bon niet kan of niet wil tonen aan de bevoegde ambtenaren;
- indien blijkt dat het register niet juist of

*Si au moins 3 mesurages contradictoires font apparaître une différence systématique, celle-ci est extrapolée à la production annuelle totale et le tonnage ainsi fixé liera le concessionnaire. Les redevances dues sur base de l'article 2 de l'arrêté de concession seront dès lors calculées sur base de ce tonnage.*

*Si la redevance due est inférieure aux sommes payées à titre d'avance, la différence sera remboursée.*

**Art. 14.** - Le concessionnaire est tenu de tenir à bord de chaque bateau d'exploitation un registre à bons numérotés en trois exemplaires dont la forme et le contenu seront définis par le fonctionnaire compétent.

Immédiatement après le chargement du bateau d'exploitation, un de ces bons sera rempli et signé par le capitaine.

Dans le cas où le sable et/ou le gravier est transbordé dans un bateau de transport, le bon portera le nom du bateau d'exploitation et du bateau de transport et il sera contresigné par le capitaine de ce bateau de transport.

Le premier exemplaire du bon sera conservé dans le registre, le deuxième sera éventuellement remis au capitaine du bateau de transport qui le tiendra à disposition pour un contrôle éventuel. Le troisième exemplaire sera conservé par le concessionnaire.

Aucune page ne pourra être sautée lors du remplissage du registre.

Il ne peut être fait usage que d'un seul registre par bateau d'exploitation. Si le registre est rempli, il est envoyé à l'Administration et un registre complémentaire peut être utilisé.

**Art. 15.** - Après avoir entendu le concessionnaire, l'Inspecteur général des Mines pourra lui imposer une amende administrative de 4.000 FB lorsque :
- l'on remarque un bateau d'exploitation contenant une quantité de sable et/ou de gravier ou un bateau de transport dont le capitaine ne peut ou ne veut pas montrer le bon prescrit aux fonctionnaires compétents ;
- il apparaît que le registre n'est pas rem-
ART. 16. - De bevoegde ambtenaren hebben te allen tijde vrije toegang tot de terreinen, de vaartuigen, zuig- en overslaginstallaties, die voor de ontginning en verwerking van zeezand en/of grind worden gebruikt. De concessiehouder is verplicht alle ophelderingen en toelichtingen te verschaffen, welke door deze ambtenaren worden gevraagd en inzage te verlenen in alle boeken, registers en bescheiden die op de ontginning betrekking hebben.

De Staat kan door de concessiehouder nimmer en in geen geval worden aangewezen voor schade die de concessiehouder mocht ondervinden door de aanwezigheid van wrakken, mijnen of explosieve stoffen en voorwerpen, in, op of boven het continentaal plat.

De concessiehouder vrijwaart de Staat voor alle vorderingen, welke derden jegens de Staat mochten doen gelden tot vergoeding van schade, welke met het gebruik van deze concessie in enigerlei verband staat.

ART. 18. - De Minister duidt de ambtenaren aan die gemachtigd worden de naleving van dit besluit en van de toepassing van genomen maatregelen na te gaan en de overtredingen ervan door proces-verbaal vast te stellen.

ART. 19. - De concessiehouder kan aan de concessie verzaken mits een voorzeg van zes maanden. De opzeg dient gericht aan de Minister.

Bij het niet naleven van de bepalingen of termijnen waarin dit besluit voorziet, zal de Minister pli correctement of à temps ;

les bons ne sont pas remplis ou signés selon les prescriptions ;

les bons relatifs à une même charge ne correspondent pas entre eux ;

des bons font défaut dans le registre ou qu'il existe des bons en blanc parmi les bons remplis ;

l'exploitation a lieu lorsque l'enregistreur de position n'est pas en service ;

les prescriptions prévues à l'article 5 § 4 ne sont pas respectées.

Si plusieurs infractions sont constatées en même temps, l'amende précitée est due pour chaque infraction constatée.

ART. 16. - Les fonctionnaires compétents ont en tout temps libre accès aux terrains, aux bateaux et aux installations de dragage et de transbordement qui sont utilisés pour l'exploitation de sable de mer et/ou de gravier de mer. Le concessionnaire doit fournir tous renseignements et toutes explications demandées par ces fonctionnaires : ceux-ci pourront consulter les registres et les documents concernant l'exploitation.

ART. 17. - Les dommages causés à l'Etat ou à des tiers à l'occasion de l'utilisation de la concession seront réparés ou indemnisés par le concessionnaire.

L'Etat ne peut jamais et en aucune manière être rendu responsable par le concessionnaire des dégâts occasionnés à ce dernier par la présence d'épaves, de mines ou matières et objets explosifs, dans, sur ou au-dessus du plateau continental.

Le concessionnaire garantit l'Etat de toute demande introduite par des tiers à son égard en réparation des dommages qui auraient un rapport quelconque avec l'utilisation de la concession.

ART. 18. - Les fonctionnaires désignés par le Ministre sont autorisés à vérifier le respect des dispositions du présent arrêté et l'application des mesures prises et à constater les infractions par procès-verbal.

ART. 19. - Le concessionnaire peut renoncer à la concession, moyennant un préavis de six mois. Le préavis doit être adressé au Ministre.

En cas de non-respect des dispositions ou des délais prévus par le présent arrêté, le Minis-
minister, na de concessiehouder te hebben gehoord, de concessie ambtshalve schorsen of geheel of ge­deeltelijk intrekken.

Art. 20. - Een afschrift van onderhavig besluit zal gezonden worden aan de concessiehouder, de indiener van een verzetschrift of een aanvraag tot mededinging, en aan de Ministers die vermeld worden in artikel 3 van het bovenvermelde koninklijk besluit van 7 oktober 1974.


Art. 22. - Dit besluit treedt in werking op 1 maart 1996, met uitzondering van artikel 5 dat in werking treedt op 1 juni 1996.

Art. 23. - Onze Minister tot wiens bevoegdheid de Economische Zaken behoren, is belast met de uitvoering van dit besluit.

Gegeven te

Van Koningswege:
De Vice-Eerste Minister, Minister van Economie en Telecommunicatie,

Par le Roi:
Le Vice-Premier Ministre, Ministre de l’Econo­mie et des Télécommunications,

Elio DI RUPO
ANNEX V

BIJLAGE BIJ HET KONINKLIJK BESLUIT VAN [BESLUITSTREKTAAL] BETREFFENDE DE EXPLORATIE- EN EXPLOITATIEVOORWAARDEN VERBONDEN AAN HET CONCESSIEBEZLUIT [BELANGRECHTEN] VOOR DE EXPLORATIE EN EXPLOITATIE VAN ZAND EN GRIND VAN HET CONTINENTAAL PLAT VAN BELGIÉ.

1. Het registreertoestel moet geschikt zijn voor het gebruik aan boord van de zand- en grindontginningsschepen en zodoende over een hoge betrouwbaarheid beschikken. Inzonderheid moet het toestel bestand zijn tegen de zilte zeelucht, trillingen, acceleraties, schokken en de boordspanningsvariaties welke optreden aan boord van deze schepen.

2. Het registreertoestel dient autonoom de in tabel 1 vermelde gegevens te registreren:
   - op automatisch geselekteerde tijdstippen de in artikel 5 § 1 van het besluit vermelde gegevens;
   - ogenblikkelijk de interventies verricht in uitvoering van het in artikel 5 § 4 voorziene beheer alsook de foutmeldingen opgegeven in punt 12 hierna.

3. De registratie van de gegevens gebeurt automatisch met volgende intervallen:
   - 1 uur wanneer het ontginningssvaartuig minstens 15 minuten niet vaart en de baggerpomp(en) niet in bedrijf is (zijn);
   - 15 minuten wanneer het ontginningssvaartuig vaart en de baggerpomp(en) niet in bedrijf is (zijn);
   - 10, 30 of 60 seconden, naargelang het door het Bestuur ingestelde registreerinterval, wanneer de baggerpomp(en) in bedrijf is (zijn).

4. De registraties dienen te gebeuren op een statische RAM kaart, hierna genoemd "gegevenskaart", met JEIDA vs. 4.0 PCMCIA Type I (Japanese Electronic Industry Association/Joint Electronic Device Engineer Council versie 4.0 standaard voor PCMCIA (Personal Computer Memory Card International Association) kaarten) aansluiting. De gegevenskaart dient een voldoende capaciteit te hebben zodat de gegevens van ten minstens 3 maanden, bij maximale inzet van het ontginningssvaartuig bij een registreerinterval van 60 seconden wanneer de baggerpomp(en) in bedrijf is (zijn), kunnen opgeslagen worden.

5. De gegevens dienen binaar (IEEE (Institute of Electrical and Electronic Engineers)-formaat) te worden opgeslagen volgens het formaat opgegeven in tabel 1 en met toevoeging van CRC (Cyclic Redundancy Check) bytes volgens de CCITT (Comité Consultatif International de Télégraphie et Téléphonie) norm 16-bit V.41.

6. Het registreertoestel moet zodanig beveiligd zijn dat, zoals voorzien is in artikel 5 § 1, enkel de parameters a. identificatie van de concessiehouder en b. volgnummer van de reis door het boordpersoneel kunnen ingesteld of gewijzigd worden.

Wat de andere parameters betreft, deze mogen slechts ingesteld of gewijzigd worden door de personen die hiermee door het Bestuur overeenkomstig artikel 5 § 4 van het besluit belast zijn. Hiervoor dient de toegang van het toestel elektronisch beschermd te zijn door een statische RAM-kaart, met JEIDA vs. 4.0 PCMCIA Type 1 aansluiting, met toegangscode, verder "interventiekaart" genoemd. Elke interventie moet zowel op de interventiekaart zelf als op de gegevenskaart genoteerd worden.

8. Het Bestuur moet volgende instellingen van het registreertoestel kunnen verrichten:

- invoer van de code welke het Bestuur toegang verstrekt na installatie en keuring van het registreertoestel;
- invoer van de codes overeenstemmende met de verleende concessievergunningen;
- invoer van het jaartal, de maand, de dag en de tijd in uren, minuten en seconden;
- invoer van het registreerinterval overeenkomstig punt 3.


De differentiële correcties dienen afkomstig te zijn van een IALA (International Association of Lighthouse Authorities) referentie station dat het differentieel bericht uitzendt onder het RTCM-SC104 (Radio Technical Commission for Maritime Services - Special Committee 104) formaat. Het differentiële radiobereit moet continu op het gehele Continentaal Plat van België te ontvangen zijn.

10. De nodige sensoren en/of meetsystemen dienen geïnstalleerd te zijn om de status van het ontginnen ontegensprekelijk vast te stellen.

11. Het registreertoestel dient minstens volgende ingangskanalen te bevatten:

- 4 statuslijnen met beveiliging tegen lijnonderbreking en lijkorte-sliuwing voor elke statuslijn;
- 1 EIA RS-232C (Electronic Industries Association fysische interface, 1969) seriële communicatie interface.

12. Volgende foutmeldingen dienen gevisualiseerd en geregistreerd te worden:

- lijnonderbreking of lijkorte-sliuwing per status lijn;
- door het boordpersoneel ingevoerde code van de concessiehouder niet opgenomen in de lijst met codes ingesteld door het Bestuur;
- door het boordpersoneel ingevoerd niet sequentieel reisnummer;
- onderbreking of kortsluiting van de verbinding met het DGPS plaatsbepalingssysteem;
- GPS plaatsbepaling niet beschikbaar of niet correct;
- differentiële correctie van het DGPS plaatsbepalingssysteem niet beschikbaar of niet correct;
- afwezigheid van de correcte externe voedingsspanning gedurende minstens 20 uur;
- registreertoestel terug automatisch herstart door gelijk welke reden behoudens door een interventie van het Bestuur;
- de gegevenskaart voor 90 % vol;
- de gegevenskaart voor 100 % vol.

13. Het registreertoestel moet, door middel van een interne back-up batterij, minstens 24 uur autonoom functioneren bij afwezigheid van een externe voedingsspanning. Nadat de back-up batterij uitgeput is, moet het registreertoestel binnen een periode van 1 minuut zijn normale werking hernemen indien de externe voedingsspanning terug aanwezig is.
Tabel 1. Te registreren gegevens en registratie formaat.

<table>
<thead>
<tr>
<th>Parameter + visualisatie in ASCII (American Standard Code for Information Interchange)</th>
<th>Nauwkeurigheid</th>
<th>Aantal bytes</th>
<th>Data type (')</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identificatie code van het vaartuig (00-99)</td>
<td></td>
<td>2</td>
<td>int</td>
</tr>
<tr>
<td>Identificatie code concessiehouder (000-999)</td>
<td></td>
<td>2</td>
<td>int</td>
</tr>
<tr>
<td>Volgnummer van de reis (0000-9999)</td>
<td></td>
<td>2</td>
<td>int</td>
</tr>
<tr>
<td>Datum van de registraties (DDMMYY) (')</td>
<td></td>
<td>4</td>
<td>long</td>
</tr>
<tr>
<td>Tijd (HHMMSS) van de registraties (')</td>
<td></td>
<td>4</td>
<td>long</td>
</tr>
<tr>
<td>Positiedata van het plaatsbepalingssysteem in Europese coördinaten ED-50 (in graden, minuten, tienduizendsten min.) (')</td>
<td></td>
<td>4</td>
<td>long</td>
</tr>
<tr>
<td>Snelheid van het vaartuig (in tienden kn)</td>
<td></td>
<td>2</td>
<td>int</td>
</tr>
<tr>
<td>Status van de pompen (aan: 1 / uit: 0)</td>
<td></td>
<td>2</td>
<td>int</td>
</tr>
<tr>
<td>Status van het ontginnen (ja: 1 / nee: 0)</td>
<td></td>
<td>2</td>
<td>int</td>
</tr>
<tr>
<td>Foutmeldingen volgens punt 12</td>
<td></td>
<td>2</td>
<td>int</td>
</tr>
<tr>
<td>Interventiekaart identificatiecode (0000-9999)</td>
<td></td>
<td>2</td>
<td>int</td>
</tr>
<tr>
<td>CRC (Cyclic Redundancy Check)</td>
<td></td>
<td>2</td>
<td>int</td>
</tr>
</tbody>
</table>

(') Data type 'int': 2 byte integer, data type 'long': 4 byte long integer volgens ANSI-C (American National Standards Institute - computeraal standaard voor IBM of compatibele PC).

(') De datum (DDMMYY) wordt geregistreerd als YYYY*10000+MM*100+DD.

(') De tijd (HHMMSS) wordt geregistreerd als HH*10000+MM*100+SS.

(') De posities worden geregistreerd als DD*100000+MM.MMMM*10000.

Gezien om te worden gevoegd bij Ons besluit van

Van Koningswege:
De Vice-Eerste Minister, Minister van Economie en Telecommunicatie,

Elio DI RUPO
ANNEX V

ITEM 1

Annexe à l’arrêté royal du relatif aux conditions de recherche et d’exploitation liées à l’arrêté de concession pour la recherche et l’exploitation de sable et de gravier du plateau continental de la Belgique.

1. L’enregistreur de position doit être conçu pour être utilisé à bord de navires d’exploitation de sable et de gravier et ainsi présenter une grande fiabilité. L’enregistreur de position doit en particulier supporter l’air salin de la mer, des vibrations, des accélérations, des secousses et les variations de tension de bord qui surviennent à bord de ces navires.

2. L’enregistreur de position doit enregistrer de façon autonome les données mentionnées au tableau 1 :
   - à des moments choisis automatiquement, les données mentionnées à l’article 5 § 1 de l’arrêté ;
   - immédiatement, les interventions effectuées en exécution de la gestion prévue à l’article 5 § 4 ainsi que les mentions d’erreurs indiquées au point 12 ci-après.

3. Les données sont enregistrées automatiquement aux intervalles suivants :
   - 1 heure lorsque le bateau d’exploitation ne navigue pas pendant au moins 15 minutes et que la (les) pompe(s) de dragage n’est (ne sont) pas en fonctionnement ;
   - 15 minutes lorsque le bateau d’exploitation navigue et que la (les) pompe(s) de dragage n’est (ne sont) pas en fonctionnement ;
   - 10, 30 ou 60 secondes, selon l’intervalle d’enregistrement choisi par l’Administration, lorsque la (les) pompe(s) de dragage est (sont) en fonctionnement.

4. Les enregistrements doivent être faits sur une carte RAM statique, ci-après appelée "carte de données", avec raccordement à JEIDA vs. 4.0 PCMCIA type I (Japanese Electronic Industry/Association/Joint Electronic Device Engineer Council version 4.0 standard pour cartes PCMCIA (Personal Computer Memory Card International Association)). La carte de données doit avoir une capacité suffisante pour que les données d’au moins 3 mois, en cas d’utilisation maximale du bateau d’exploitation à un intervalle d’enregistrement de 60 secondes lorsque la (les) pompe(s) de dragage est (sont) en fonctionnement, puissent être stockées.

5. Les données doivent être stockées de façon binaire (format IEEE (Institute of Electrical and Electronic Engineers) selon le format décrit au tableau 1 et en ajoutant des bytes CRC (Cyclic Redundancy Check) selon la norme CCITT (Comité Consultatif International de Télégraphie et Téléphonie) 16-bit V.41.

6. L’enregistreur de position doit être protégé de façon à ce que, comme prévu à l’article 5 § 1, seuls les paramètres a. identification du concessionnaire et b. numéro d’ordre du voyage puissent être introduits ou modifiés par le personnel de bord.

En ce qui concerne les autres paramètres, ils peuvent seulement être introduits ou modifiés par les personnes qui en ont reçu la charge de l’Administration, conformément à l’article 5 § 4 de l’arrêté. A cet effet, l’appareil doit être protégé électriquement par une carte RAM statique, avec raccordement à JEIDA vs. 4.0 PCMCIA Type I, et code d’accès, dénommée plus loin "carte d’intervention". Toute intervention doit aussi bien être notée sur la carte d’intervention que sur la carte de données.

7. L’Administration et le personnel de bord compétent du bateau d’exploitation doivent toujours pouvoir constater le bon fonctionnement de l’enregistreur de position et des détecteurs qui y sont reliés, y compris le système de localisation. A cet effet, les données enregistrées et les interventions effectuées par l’Administration ainsi que les mentions d’erreurs doivent être visualisées sur le panneau de devant de l’enregistreur de position.
8. L'Administration doit pouvoir effectuer les opérations suivantes sur l'enregistreur de position :

- introduction du code qui donne accès à l'Administration après installation et vérification de l'enregistreur de position ;
- introduction des codes correspondant aux permissions de concession octroyées ;
- introduction de l'année, du mois, du jour et du temps en heures, minutes et secondes ;
- introduction de l'intervalle d'enregistrement conformément au point 3.


10. Les détecteurs et/ou les systèmes de mesure nécessaires doivent être installés pour constater incontestablement l'état de l'exploitation.

11. L'enregistreur de position doit au moins avoir les canaux d'entrée suivants :

- 4 lignes d'état protégées chacune contre une interruption de la ligne et un court-circuit sur la ligne ;
- 1 interface de communication sériele EIA RS-232C (*Electronic Industries Association interface physique, 1969*).

12. Les erreurs suivantes doivent être visualisées et enregistrées :

- interruption de la ligne ou court-circuit sur la ligne par ligne d'état ;
- code du concessionnaire introduit par le personnel de bord et non repris dans la liste des codes établie par l'Administration ;
- numéro de voyage non séquentiel introduit par le personnel de bord ;
- interruption ou court-circuit de la liaison avec le système de localisation DGPS ;
- localisation GPS non disponible ou incorrecte ;
- correction différentielle du système de localisation DGPS non disponible ou incorrecte ;
- absence de tension correcte d'alimentation externe pendant au moins 20 heures ;
- enregistreur de position redémarré automatiquement pour n'importe quelle raison sauf par une intervention de l'Administration ;
- carte de données pleine à 90 % ;
- carte de données pleine à 100 %.

13. L'enregistreur de position doit fonctionner de manière autonome pendant au moins 24 heures au moyen d'une batterie interne de back-up, en cas d'absence de tension d'alimentation externe. Lorsque la batterie de back-up est épuisée, l'enregistreur de position doit reprendre son fonctionnement normal dans une période d'1 minute si la tension d'alimentation externe est revenue.
Tableau I. Données à enregistrer et enregistrement du format.

<table>
<thead>
<tr>
<th>Paramètre + visualisation en ASCII (American Standard Code for Information Interchange)</th>
<th>Précision</th>
<th>Nombre de bytes</th>
<th>Type de données ('')</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identification du code du bateau (00-99)</td>
<td></td>
<td>2</td>
<td>int</td>
</tr>
<tr>
<td>Identification du code du concessionnaire (000-999)</td>
<td></td>
<td>2</td>
<td>int</td>
</tr>
<tr>
<td>Numéro d’ordre du voyage (0000-9999)</td>
<td></td>
<td>2</td>
<td>int</td>
</tr>
<tr>
<td>Date des enregistrements (DDMMYY) (')</td>
<td></td>
<td>4</td>
<td>long</td>
</tr>
<tr>
<td>Temps (HHMMSS) des enregistrements (')</td>
<td>1 sec/jour</td>
<td>4</td>
<td>long</td>
</tr>
<tr>
<td>Données de position du système de localisation en coordonnées européennes ED-50 (en degrés, minutes, dix millièmes de min.) (')</td>
<td>&lt; 10 m</td>
<td>4</td>
<td>long</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>long</td>
</tr>
<tr>
<td>Vitesse du bateau (en dixième de noeud)</td>
<td>0.1 noeud</td>
<td>2</td>
<td>int</td>
</tr>
<tr>
<td>Etat des pompes (on:1/ off:0)</td>
<td></td>
<td>2</td>
<td>int</td>
</tr>
<tr>
<td>Etat de l’exploitation (oui:1 /non:0)</td>
<td></td>
<td>2</td>
<td>int</td>
</tr>
<tr>
<td>Mentions des erreurs selon le point 12</td>
<td></td>
<td>2</td>
<td>int</td>
</tr>
<tr>
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(') La date (DDMMYY) est enregistrée sous YYYY*10000+MM*100+DD.

(') Le temps (HHMMSS) est enregistré sous HH*10000+MM*100+SS.

(') Les positions sont enregistrées sous DD*10000000+MM.MMMM*10000.

Vu pour être annexé à Notre arrêté du

Par le Roi :
Le Vice-Premier Ministre, Ministre de l’Économie et des Télécommunications,

Elio DI RUPO
ANNEX V


Dr. H. Bergmann\(^1\) and D. Aster\(^2\)

1. International Guidelines on Dredged Material

Over the past few years, the international discussion about environmental problems in coastal and marine areas has inevitably touched upon the issue of dredging. The crucial question has been that about the ecological impacts of dredging and, in particular, of the disposal of dredged material in coastal regions. In this context, three international conventions pertaining to the prevention of marine pollution are of relevance for Germany [1]:

- the OSLO Convention of 1972 on the North Sea;
- the HELSINKI Convention of 1974 on the Baltic Sea; and
- the LONDON Dumping Convention of 1972 on the marine environment in general.

Following the revision of an earlier recommendation, the OSLO Commission (i.e. the supreme decision-making body for the OSLO Convention) published in 1986 the first "Guideline for the Disposal of Dredged Material" which is today valid in a revised version dating from 1991 [2]. A more detailed description can be found in [3]. A German translation has been published in [5].

Substantially the same information is presented in the Guidelines for the Disposal of Dredged Spoils adopted in 1992 by the HELSINKI Commission [4]. The LONDON Dumping Commission is reviewing its guideline for dredged material to present the new version by 1994. In its present form it was of no relevance for Germany because of its general character.

Dredging on the North Sea and Baltic coasts falls under these conventions insofar as the scope of the guidelines has been extended by international agreement to include also the so-called internal waters [3, 5]. In the North Sea estuaries, this zone reaches upstream to the seawater/freshwater limit, as shown in Figure 1 below. Article 3b of the PARIS Convention defines the freshwater limit as "the place in the watercourse where, at low tide and in a period of low freshwater flow, there is an appreciable increase in salinity due to the presence of seawater".

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\(^2\) Federal Ministry of Transport of Germany (BMV), Division of Inland Navigation and Waterways
2. The Manual of the Federal Water and Navigation Administration of Germany

2.1. Background

Although both the OSLO and HELSINKI Conventions are very comprehensive, they are characterized by a number of compromises, owing to their international origin, and have a strong scientific orientation, while their practical applicability ranks second. This was the reason why the Federal Ministry of Transport took the decision to compile an action guideline in form of a manual for the Federal Water and Navigation Administration (WSV) to facilitate and render uniformly the practical implementation of these two international guidelines.
This manual was compiled by the Federal Institute of Hydrology (Bundesanstalt für Gewässerkunde) in close cooperation with the Federal Ministry of Transport. It was completed in 1992 and introduced by decree of 31 August 1992 in the WSV under the title "Manual for the Application of the Guidelines on Dredged Material of the OSLO and HELSINKI Conventions in the Federal Water and Navigation Administration of Germany" (in brief: Manual for Coastal Dredged Material = MCDM).

2.2 Contents

Part 1 of the MCDM is a general backgrounder to the Conventions in question referring, inter alia, to their legal frameworks and defining the terminology used. Moreover, it delineates the respective scope of applicability by defining the landward boundaries of North Sea and Baltic Sea (see Figure 1). In the case of the Baltic Sea, the information has preliminary character and is presently under review.

Part 2 is the actual guideline for action. It starts with a chapter on the sequence of activities and the scope and frequency of sampling and analysis provided for in the dredging Guidelines. Then there are check-lists, information and recommendations for the necessary physical, chemical, and biological examinations which are derived in summarized form from the two original Guidelines. Where it deemed necessary, they have been supplemented by specific technical regulations tailored to the situation in the Federal Water and Navigation Administration.

A comprehensive list of annexes contains e.g. the original wordings of the OSLO and HELSINKI Dredging Guidelines and an extensive glossary of technical terms. A detailed index completes the manual.

2.3 Reference values

The definition of reference values for the assessment of the contamination status of dredged material is of special practical importance (Annex 4 to [5]). Since there is neither an internationally nor a nationally agreed procedure for determining such reference values, as an interim solution, reference values were derived from the presently available contaminant concentration values (c [in mg/kg]) in the North-Sea Wadden sediments. For better practicality the c values were multiplied by a factor of 1.5 to provide for accidental uncertainties in sampling and chemical analysis:

\[
\text{Reference value} = c \times 1.5 \text{ [mg/kg]}.\]
Following a proposal submitted by an international working group on dredged material of the OSLO Commission [7], two concentration levels were defined to facilitate the classification of the contamination in dredged material in three cases:

**Case 1:** The contaminant concentrations are below or equal to the reference values: Such material is considered to be uncontaminated or slightly contaminated.

**Case 2:** The concentration of at least one heavy metal exceeds the reference value up to the five-fold value: The material is considered to be moderately contaminated.

**Case 3:** The concentration of at least one heavy metal in the dredged material is higher than the 5-fold reference value: This material is characterized as considerably contaminated.

The reference values for heavy metals in dredged material from the North Sea coast (concentration in mg/kg dry matter in the grain-size fraction <20μm) are:

- Arsenic: 30
- Cadmium: 2.5
- Chromium: 150
- Copper: 40
- Mercury: 1.0
- Nickel: 50
- Lead: 100
- Zinc: 350

Similar lists on organic contaminants and for the Baltic Sea area are under preparation.

### 3. Implementation of the MCDM regulations

It is understandable that those who are charged with implementing such a comprehensive set of new regulations are first concerned about its practicality. In response to this reaction and for the purpose of gathering first experience, the Federal Ministry of Transport initiated a "pilot application" of the MCDM regulations in two Water and Navigation Boards in cooperation with the Federal Institute of Hydrology. The Water and Navigation Boards at Brunsbüttel and Emden were chosen as "testing institutions" because - on the one hand - the two concerned Water and Navigation Directorates "North" (at Kiel) and "North-West" (at Aurich) thus had one of their subordinated boards involved in gathering experience and - on the other hand - in both areas very interesting issues had to be solved. The pilot project was also supported by the Working Group on Dredging of the Federal Water and Navigation Administration. This cooperation ensured the input of practical expertise.

The expected outcome of these two pilot projects will be, on the one hand, experience in the application of the MCDM regulations, i.e. the fulfilment of the obligations adopted under the OSLO and HELSINKI Conventions, in the Federal Water and Navigation Administration, and on the other hand, suggestions for a revision and improvement of these Guidelines. A further, more long-term result
is also expected: The intensive study of the interactions between dredging operations, relocation and/or dumping of dredged material and ecological issues will render the theoretical knowledge and the practical experiences in the Water and Navigation Administration more profound and comprehensive and promote the interdisciplinary character of the work.

With the profounder knowledge it will be possible to make a more reliable assessment whether and how strongly coastal dredging impairs the coastal ecosystem in the long run. Convincing answers to these recurring questions are welcome and necessary as a contribution to the ongoing discussion of environmental issues.

References


Figure 2: Maritime area under the Helsinki Convention off the German Baltic coast (1+2) and "internal waters" (3)
Figure 1: Maritime area under the Oslo Convention off the German North Sea coast (1+2) and "internal waters" (3+4)
ANNEX V

Item 3  Review of licensing of minerals dredging in England and Wales: proposed statutory procedure.
REVIEW OF THE LICENSING ARRANGEMENTS FOR MINERALS DREDGING IN ENGLAND AND WALES:

PROPOSED STATUTORY PROCEDURE FOR MINERALS DREDGING

1. On the basis of the comments received in response to the consultation exercise and the majority support for a statutory system modelled on the Town and Country Planning procedures the Government proposes to introduce a statutory system similar to the Town and Country Planning procedures with DOE/WO as the regulatory authority. The MAFF also has a particularly important role in the decision making process and should be responsible for environmental monitoring. The Secretaries of State of DOE/WO will take on responsibility for enforcement.

2. The costs of administering the new statutory system should be recovered through dredging application fees. It is proposed that the legislation introduced should provide for this.

3. There are different views about the appropriate period for permission to dredge. The industry argue on grounds of commercial viability for permissions which run for 20 - 25 years subject to regular review and automatic renewal if appropriate. On the other hand environmental groups and the fishing industry argue that due to the nature of the information base permissions should be issued for a maximum period of 5 years and that these should also be subject to regular review. The Government proposes that a 15 year permission to dredge with substantive reviews every fifth year to determine renewal should be introduced. There must however be room for flexibility to apply different periods if circumstances warrant this.

4. Minerals dredging may also require approvals under Ss 18 and 34 of the Coast Protection Act 1949, which respectively deals with coast protection and the effect on navigation of works in the sea. Consideration has been given to whether s18 and s34 consents should be subsumed within the new statutory procedure. The Government has decided that s18 Orders in so far as they relate to areas seaward of the low water mark should be subsumed. Existing Section 18 Orders would be revoked in so far as they relate to areas seaward of the low water mark. In respect of s34 consents it was agreed that minerals dredging could be added to s35 exemptions. The Department of Transport will, however, be among the statutory consultees (see para 12 below).

5. It is proposed that the new statutory system will cover all areas of the seabed below the low water mark regardless of ownership or current jurisdiction.

6. The purpose of the new statutory system is to ensure that before minerals dredging is permitted full regard is had to the potential impacts on the marine environment and sea fisheries and to the potential effects on the coastline. The Government considers that dredging should take place against a policy of sustainable development and environmental protection.

Proposed Statutory Procedure
Permission to dredge for minerals

7. Permission would be required for minerals dredging (sand, gravel, calcified seaweed and waste coal) from areas of the seabed below the low water mark. As a matter of administration, applications would be directed to the Secretary of State for the Environment or the Secretary of State for Wales as appropriate.

Pre-application (i) discussions

8. Informal discussion would take place between the applicant and landowner, DOE/WO, MAFF, statutory consultees and interested parties. One of the purposes of these discussions is to establish that the landowner's consent is likely to be forthcoming. This stage of the process would not be a legislative requirement, but would be encouraged in policy guidance.

Pre-application (ii) activity

9. It would be for the applicant to engage appropriate consultants to examine coast protection interests including cumulative impact. DOE will publish and circulate guidance on the standard of report required and the criteria to be addressed.

10. The applicant would be required to prepare an Environmental Statement where the proposal is likely to have significant environmental effects. Regulations based on SI 1988/1199 will be necessary.

Application

11. The applicant would apply directly to the Secretary of State DOE/WO for permission to dredge. The application would be made on a standard form and a licence fee would be enclosed to cover administration of the system. Each application would be accompanied by a report on coastal erosion, including consideration of the cumulative effect of dredging all existing licensed areas within the relevant coastal cell on the marine environment, copies of notices and advertisements to publicise application, a schedule of proposed conditions, and where appropriate by an Environmental Statement. If an ES has not been prepared and the view is taken that the extraction would be likely to have significant effects on the environment, the Secretaries of State DOE/WO will direct the applicant to produce one before progressing the application.

Publicity

12. The applicant would be responsible for advertising the proposals and would enclose copies of the advertisement with their application (see above). Advertisements would be placed in two local newspapers, to be determined by DOE/WO, and in a journal such as "Fishing News". The advertisement as well as giving details on the proposals would also name a place within the locality, probably the local planning authority, where a copy of the dredging application and supporting documents could be inspected by the public. The address of DOE/WO would also be
provided and anyone wishing to make representations would forward their comments to DOE/WO within a specified time period.

Statutory Consultations

13. The Secretary of State DOE/WO would consult statutory consultees (to be defined). There would be a period of 10 weeks for comment. All responses would be copied to the applicant to enable them to address any outstanding difficulties.

Determination of dredging application

14. The Secretaries of State DOE/WO would be required to determine applications having regard to all material considerations [to be determined]. Advice on the timescales involved will be provided in a new Guidance Note on Minerals Dredging. Special regard could be given to the interests of coastal protection and fisheries. The Secretaries of State would determine how to proceed taking particular note of comments from the Minister of Agriculture Food and Fisheries. The options available would be to:

(i) issue a decision directly: appropriate where application is straightforward with no substantive objections or where it is apparent that the application raises issues which cannot be resolved by conditions and where it must therefore be refused;

(ii) invite further written representations: along the lines of the Town and Country Planning (Appeals) (Written Representations Procedures) Regulations 1987 (S.I.1987 No 701);

(iii) set up a hearing: along the lines of (DOE Circular 10/88 (WO 15/88); or


15. Decisions will be issued by DOE/WO after any necessary consultation with other Government Departments, except the Crown Estate.

16. Permission for dredging may be granted subject to conditions.

Notification of Decision

17. A full decision letter explaining the reasons for the decision would be issued by the Secretary of State DOE/WO to the applicant in respect of the area applied for, and would be copied to the landowner, MAFF and other interested parties.

Right to Challenge: High Court

18. A person aggrieved by the decision could challenge the Secretary of State's decision within a six week period in the
High Court on the basis that:

a) the decision is not within the powers of the legislation and the Secretary of State has exceeded his powers; or

b) any of the relevant requirements have not been complied with, and the applicant's interests have been substantially prejudiced by the failure to comply.

Redetermination

19. As decisions may be challenged in the High Court there will be provision for decisions being referred back to the Secretaries of State DOE/WO for redetermination. The Inquiries Procedures Rules could provide a model for this.

Monitoring

20. The landowner would be responsible for monitoring tonnages dredged and any unauthorised dredging via electronic monitoring systems (EMS). Data from EMS would be made available to the Secretaries of State DOE/WO who would become the controlling authority. MAFF would be responsible for supervising environmental monitoring. To facilitate this the licence would be conditional, inter alia, on the production of an annual monitoring report on compliance with conditions.

Enforcement

21. Enforcement would be the responsibility of the Secretaries of State DOE/WO. Details of the enforcement procedure will be worked up when preparing the proposed legislation.

Revocation, Suspension, and Modification powers

22. DOE/WO will take powers to revoke, suspend or modify the permission to such an extent as they consider expedient, if it appears to them that it is expedient to do so on evidence before them. Details of these procedures will be worked up when preparing the proposed legislation.

Interim procedure

23. Until an opportunity arises to introduce primary legislation to introduce the new procedures, the Government proposes to adopt the GV procedure in the interim, applying by analogy the Town and Country Planning Act procedures on a non-statutory basis. The interim, non-statutory, arrangements will be as close as possible in spirit and method of operation to the long term statutory arrangements.

24. A further announcement will be made about the introduction of the interim procedures.
ANNEX V

Item 4  The dredging operations for the fixed link between Sweden and Denmark.
The Dredging Operations for the Fixed Link between Sweden and Denmark

Dr I Cato gave a short presentation of the large Sound fixed link project, which will connect Sweden and Denmark with a bridge and tunnel combination. In connection with the construction about $7 \times 10^6$ m$^3$ of the sea bottom has to be dredged, mainly chalk and clay till. One part is related to the bridge- and tunnel construction, and one part to ensure the inflow of salt bottom water to the Baltic in order to reach a "zero-solution" regarding the water exchange between the Kattegat and the Baltic proper. All dredged material will be used as filling material in connection with the construction of the artificial peninsula at Kastrup on the Danish side and the artificial island constructed south of the Saltholm island.

Prior to the filling of the planned artificial islands a stone wall will be constructed around the filling area. To prevent sediment leaching and erosion from the islands the inner stone walls are covered with geo-textils. However, it is not possible to avoid sediment spill in connection with the above mentioned operations. The spill affects the marine environment in different ways according to the EIA made for the project. Therefore the spill has to be limited. According to the Swedish and Danish Environmental Authorities the spill has to be limited to 5% on average of the total masses dredged. In order to monitor this spill and other environmental effects three monitoring programmes have been set up by the authorities and the Sound Fixed Link Consortium.

The link constructor continuously has to monitor the sediment spill. This programme activity will be controlled by the Consortium. The Consortium is also responsible for the second programme - the Feedback Monitoring Programme - carried out every fortnight off the primary construction areas. This programme is focused on organisms that react quickly to environmental changes for example eelgrass (Zostera marina) and common mussel (Mytilus edule) have been chosen as such fast reacting organisms. The idea behind this programme is to give the constructor the possibility to make necessary changes to minimise the effects of the dredging and construction operations during the whole building period.

The third monitoring programme deals with the environmental effect control carried out by the authorities in Sweden and Denmark. The target for this programme is to ensure that the parameters measured is in agreement with the terms of reference of EIA, which will regulate the development of the project. This programme is focused on the biology and embraces the following parameters:

- Eelgrass (Zostera marina) - biomass and distribution
- Macro algae (Laminaria saccharina) - biomass and distribution
- Ruppia (Rupia sp.) - biomass and distribution
- Shallow bottoms (the distribution, abundance and biomass of the bottom fauna Macoma assemblage)
- Deeper bottoms (the distribution of Abramys, Amphipura- and Hoplophyes assemblage)
- Common mussels (Mytilus edule) - biomass, size and distribution
- Coastal morphology (search for morphological changes sedimentation rates, grain size, loss of ignition)
- Water quality (Heavy metals, tributhyl-Sn, PCB, nutrients, oxygen, suspended matter)
- Fish (Herring migrations)
- Birds (Breeding eiders and waders, molting swans and geese, resting and overwintering seabirds).

The environmental changes will be detected statistically by the aid of the BACI computer model (COWI-VKI Joint Venture 1994). The Consortium has developed an environmental information system EAGLE, among others embracing a database containing all measurements carried out within the above mentioned EIA programme as well as a test function ensuring that all environmental requirements are fulfilled.

Dr Cato continued with a presentation of Dr Westerbergs studies concerning the effects of suspended sediments on fish and fish eggs. A short summary written by Dr Westerbergs is enclosed below.

Effects of suspended sediments on fish and fish eggs

by Håkan Westerberg, Inst Coastal Res, Nya Varvet 31, S-426 71 V Frölunda, SWEDEN (h.westerberg@fiskriverket.se)

As part of the EIA of the Sound Fixed Link project studies have been done of the effects of spillage of chalk and glacial clay sediments.
The Sound is an important breeding place for cod and flatfish; having pelagic eggs that in this area become suspended in the halocline below the brackish Baltic surface water. Laboratory studies were made of how sediment particles raining down on cod eggs adhere and decrease their buoyancy. The long hatching period makes it probable that this process controls the sinking of eggs to the bottom. There were also an increased mortality of yolk-sack larvae at moderate to high sediment concentrations.

The avoidance reactions of adult cod and herring to sediment plumes were studied in a 15 x 6 m flume with saltwater and an arrangement to produce a sediment plume on one or the other side of the basin. The avoidance threshold was established for plumes of clay or glacial silt originating from the dredging work in the Sound. For cod the observations were made both in daylight and in the dark. The avoidance threshold of herring (illustrated below) was approximately 5 mg/l, the same for both types of sediments. Cod avoided the sediment side at lower concentrations, approximately 2 mg/l. The threshold was more variable and possibly higher in the dark.
Cod, avoidance to chalk
Night observations

Cod, avoidance to chalk
Daylight observations

Herring, avoidance to chalk
Daylight observations

Herring, avoidance to clay
Daylight observations
ANNEX V

ANNEX V

ITEM 5

Total extracted

* * * * * The Netherlands
* * * * * Belgium
* * * * * United Kingdom

Marine extraction for land use

* * * * * The Netherlands
* * * * * Belgium
* * * * * United Kingdom

Marine extraction for land use

* * * * * Denmark
* * * * * Germany
* * * * * Norway

Dredging (capital and maintenance)

* * * * * The Netherlands
* * * * * Belgium
* * * * * United Kingdom
ANNEX V

Item 6  Vyncke W. and Hillewaert H. Colour measurements on marine sediments off the Belgium coast as a means for estimating grain size.
Colour measurements on marine sediments off the Belgian coast as a means for estimating grain size.

WILFRIED VYNCKE and HANS HILLEWAERT
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Median grain sizes of marine sediments from seven inshore and four offshore stations were compared with the colour co-ordinates L*, a* and b*. There was a good correlation with the parameter a*. The colour of the sediments appeared to be mainly determined by the relative percentages of the 125-250 and 250-500 µm fractions. In most cases, a* could be used instead of grain size analyses to follow trends in sediment composition.

Besides fisheries, two main anthropogenic activities related to the seabed are taking place in Belgian coastal waters. In the western part (sand banks off Nieuwpoort), important sand dredging operations are carried out. In the eastern part (Zeebrugge area) large quantities of dredge spoils from harbours and navigation routes are dumped. These operations, which disturb bottom sediments, can endanger marine life, especially bottom dwelling species and hence cause harm to commercial fisheries. It should be emphasised that Belgian coastal waters are important nursery grounds for several fish species.

In order to evaluate the risks for the marine ecosystem, monitoring programmes are being conducted comprising physicochemical analysis of the sediments and determination of possible detrimental biological effects. In the framework of the physicochemical programme of our Research Station it was decided to include colour measurements, as recommended by ICES (1994). The aim of this paper is to evaluate the usefulness of these measurements for the monitoring programme more specifically as a possible alternative to the grain size analysis.

MATERIALS AND METHODS

Sediment samples were taken from 1979 to 1994 two to three times per year with a Van Veen sampler in eleven sites (Fig. 1). Stations Dumping Oostende, Zeebrugge 1, Zeebrugge 2 and Zeebrugge East are dumping areas for dredge spoils. Stations Westdiep, Steendiep and Oostende bank are situated near the coast. Sediments in both categories of areas consist of varying mixtures of sand and silt. Stations Schar bank, Bligh bank, Goote bank and East Dyck are offshore sites with a high percentage of sand. The last station is situated in a sand extraction area.

All samples were kept at -28°C until analysis.
Grain size

The <63 μm fraction was separated by wet sieving. The other fractions (63–125; 125–250; 250–500; 500–1000; 1000–2000 μm) were separated by dry sieving. The fraction >2000 μm (mostly less than 1 %) was discarded. The median value was computed from the cumulative curve of these fractions (Inman, 1952).

Colour

Colour measurements were performed on the dry sediments with a portable colorimeter Minolta CR 2000 using the co-ordinates L*, a* and b* of the "Commission Internationale de l'Eclairage" (CIE). These parameters represent respectively the black-white chromaticity ("lightness"), the red-green ("redness") and the yellow-blue chromaticity ("yellowness"). Munsell values often used by geologists can automatically be computed from these parameters.

Statistical analysis

Linear or non-linear correlations, according to the best fit, were calculated with the computer programme Prism (Graphpad Software, San Diego, USA).

RESULTS AND DISCUSSION

As the composition of the sediments appeared to change slowly over the years in most sites (Table 1), the whole set of data from 1979 on was not appropriate for calculating mean values and variation. Instead, the pooled data of the last five campaigns covering a two years' period (September 1992, March and October 1993, March and September 1994) were considered to be representative of the present mean composition of the sediments.

Figure 2 shows the mean values and standard deviations of the colour parameters and of the two main parameters defining sediment composition, i.e. the silt fraction (< 63 μm) and the median grain size.

L* values were not markedly different among the stations under investigation, indicating this colour component to be less valuable. With both a* and b* values, a quite similar pattern as the median value could be observed, especially between the offshore and inshore sampling stations. Co-ordinate a* however appeared to be more sensitive, the difference between the lowest and the highest measurements being about 4 against 1.5 for b*. The good relationship between the median and a* was further shown by a correlation analysis performed on 275 data gathered in the period 1979–1994. The correlation coefficient r was 0.870 (p< 0.001) (Fig. 3).
The large standard deviations of the sediment parameters measured should be stressed. This is due to the fact that in the shallow parts of the North Sea, sediment movements occur frequently, owing to strong wind-induced and tidal currents (North Sea Task Force, 1993). This means that for monitoring purposes, frequent sampling and the use of a sufficient number of replicates are necessary. In this respect, colour measurements, which take only a few minutes, are advantageous.

Data on Fig. 3 are individual measurements. Although there is a good relationship, the scatter of these data makes it difficult to “predict” median grain size from $a^*$ values with an acceptable accuracy. This is however possible with a fair approximation when enough replicates are taken. Figure 4 illustrates this. The average values of the five measurements made in 1992–1994 (Fig. 2) were plotted against the average median particle size of the sediments.

To gain a better understanding of the influence of each grain size fraction on sediment colour, correlations with $a^*$ were calculated ($n = 275$; Fig. 5). The $<63$ and 63–125 $\mu$m fractions contributed to a decrease of the $a^*$ values. This influence however was limited to about 5 % of the respective fractions. The opposite effect was noted for the upper grain size categories 500–1000 and 1000–2000 $\mu$m also limited to about 5 % of the fraction. The colour of the sediments appeared to be mainly determined by the relative percentages of the 125–250 and 250–500 $\mu$m fractions, which respectively decreased and increased $a^*$.

The use of colour parameter $a^*$ also allowed to follow temporal changes in the seabed sediments. Two examples are described here. In most areas off the Belgian coast, a decrease in grain size was noted the last fifteen years. This is probably caused by intensified dredging operations to deepen navigation channels but further discussion on this issue is not within the scope of this paper. Time trends were observed mainly in the 125–250 and 250–500 $\mu$m fractions (Table 1). The dumping site Zeebrugge 1 formed an exception. Here the 125–250 $\mu$m fraction also augmented, but at the cost of the silt fraction, resulting in an increase of the average grain size.

On the majority of sites, the same trend could be seen, except on Zeebrugge 1, where $a^*$ decreased notwithstanding an increase in median particle size. A possible explanation is that the 125–250 $\mu$m fraction influences $a^*$ more than the others. Whatsoever, when a significant relationship is established between grain size and colour parameter $a^*$ for a particular site, $a^*$ could be used instead of grain size analysis.

The second example relates to the sand extraction area East Dyck. From 1981 to 1988, a significant increase in median grain size was noted, probably due to the washing out effect followed by sedimentation of coarser particles during the sand extraction operations. From 1989 on, these activities became more irregular. This was reflected in large fluctuations in grain size of the
seabed sediments (Fig. 6). The same pattern however was obtained with
colour component a*, showing that this parameter could be used for
monitoring that particular area.

Table 2 shows the Munsell values for the last monitoring campaign
(September 1994). Averaging data is not possible with this colour annotation
method. A clear distinction between inshore and offshore stations could be
observed. All inshore sites were in the hue category Y (yellow) whilst the
offshore areas were in YR (yellow-red). Variations among values were also
less pronounced in the latter stations.

Colour measurements, especially component a*, appear to be a useful tool
for monitoring sediment characteristics. Further work however is necessary to
investigate if this is valid for all types of marine sediments.

REFERENCES

ICES (1994). Guidelines for the use of sediments in marine monitoring in the
context of Oslo and Paris commissions programmes. In Report of the
ICES Advisory Committee on the Marine Environment, 1993. ICES Co­
the Exploration of the Sea, Copenhagen.


Captions to figures

Fig. 1. Sampling stations

Fig. 2. Median grain size, < 63 μm fraction and colour parameters 1992-1994 (average and standard deviation). DO = dumping Oostende, Z1 = Zeebrugge 1, Z2 = Zeebrugge 2, ZE = Zeebrugge East, We = Westdiep, Ste = Steendiep, Sch = Schar bank, OB = Oostende bank, Bli = Bligh bank, Go = Goote bank, ED = East Dyck. Filled bars: inshore stations; unfilled bars: offshore stations.

Fig. 3. Correlation between median grain size and colour value a*(individual data)

Fig. 4. Correlation between median grain size and colour value a*(average of five replicates).

Fig. 5. Correlation between particle size fractions and colour a*.

Fig. 6. Temporal trend 1981-1994 of median grain size and colour a* on sand extraction area East Dyck.
Table 1. Temporal trends 1979-1994 for grain size fractions and colour a* (a)

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<tr>
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<td>-0.430*</td>
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</tr>
<tr>
<td>Schar bank</td>
<td>+0.485</td>
<td>-0.873***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oostende bank</td>
<td>+0.840***</td>
<td>-0.803***</td>
<td>-0.651***</td>
<td>-0.428*</td>
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</tr>
<tr>
<td>Bligh bank</td>
<td>+0.625***</td>
<td>-0.511**</td>
<td>-0.422*</td>
<td>-0.349*</td>
<td></td>
</tr>
<tr>
<td>Goote bank</td>
<td>+0.731***</td>
<td>-0.298</td>
<td>-0.486**</td>
<td>-0.622**</td>
<td></td>
</tr>
</tbody>
</table>

(a) no asterisk: p<0.1, * : p<0.05, ** : p<0.01, *** : p<0.001
Table 2. Munsell values (September 1994)

<table>
<thead>
<tr>
<th>Location</th>
<th>Munsell Values</th>
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<tbody>
<tr>
<td>Dumping Oostende</td>
<td>0.6 Y/5.6/1.7</td>
</tr>
<tr>
<td>Zeebrugge 1</td>
<td>3.0 Y/5.6/1.3</td>
</tr>
<tr>
<td>Zeebrugge 2</td>
<td>1.6 Y/5.6/1.4</td>
</tr>
<tr>
<td>Zeebrugge East</td>
<td>2.2 Y/6.2/1.3</td>
</tr>
<tr>
<td>Westdiep</td>
<td>2.8 Y/5.6/1.4</td>
</tr>
<tr>
<td>Steendiep</td>
<td>0.9 Y/5.9/1.6</td>
</tr>
<tr>
<td>Oostende bank</td>
<td>1.0 Y/5.4/1.7</td>
</tr>
<tr>
<td>Schar bank</td>
<td>8.9 YR/5.8/2.5</td>
</tr>
<tr>
<td>Bligh bank</td>
<td>8.4 YR/6.0/2.6</td>
</tr>
<tr>
<td>Goote bank</td>
<td>8.6 YR/5.9/2.3</td>
</tr>
<tr>
<td>East Dyck</td>
<td>9.9 YR/5.8/2.2</td>
</tr>
</tbody>
</table>
Fig. 1. Sampling stations
Fig. 2. Median grain size, < 63 μm fraction and colour parameters 1992-1994 (average and standard deviation). DO = dumping Oostende, Z1 = Zeebrugge 1, Z2 = Zeebrugge 2, ZE = Zeebrugge East, We = Westdiep, Ste = Steendiep, Sch = Schar bank, OB = Oostende bank, Bli = Bligh bank, Go = Goote bank, ED = East Dyck. Filled bars: inshore stations; unfilled bars: offshore stations.
Fig. 3. Correlation between median grain size and colour value $a^*$ (individual data)
Fig. 4. Correlation between median grain size and colour value a*(average of five replicates).
Fig. 5. Correlation between particle size fractions and colour a*.
Fig. 6. Temporal trend 1981-1994 of median grain size and colour a* on sand extraction area East Dyck.
ANNEX V

Item 7 Kenny A.J., Greening J. and Rees H. L. Determination of trophic links between macrobenthos and fish in areas of commercial aggregate interest.
DETERMINATION OF TROPHIC LINKS BETWEEN MACROBENTHOS AND FISH IN AREAS OF COMMERCIAL AGGREGATE INTEREST

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Fisheries Laboratory
Remembrance Avenue
Burnham-on-Crouch
Essex, UK.
CM08HA

Introduction

A major concern frequently expressed by the fishing industry is the potential loss of habitat and associated benthic food available for fish as a result of marine aggregate extraction. One method of assessing the 'value' of gravel macrofauna as a source of food for fish is to conduct an analysis of stomach contents from fish sampled in and around commercial aggregate areas.

This report summarises the preliminary findings from such analyses.

Methods

A total of 18 beam trawl samples for demersal fish species were taken off the English coast in areas of coarse aggregate over a period of about 18 months (Fig. 1). Each trawl lasted about 30 minutes covering a distance of about 3 nautical miles. All fish (commercial and non-commercial species) were identified, measured, killed and their stomachs removed and preserved in 15% formaldehyde solution. Preserved stomach contents were identified and enumerated in the laboratory.

Results and Discussion

An examination of the total catch data across all gravel regions (Table 1) shows that the dominant fish species caught are the Dover Sole (Solea solea), Whiting (Merlangius merlangus) and Dab (Limanda limanda). Identifiable prey items within the stomachs of the gadoids, flatfish and shrimps (taken from 5 beam trawls) is shown in Table 2. It highlights, not surprisingly, the importance of predominantly pelagic organisms in the diets of gadoids whereas the diets of flatfish are dominated by macrobenthic infaunal species. Shrimps also appear to have a greater overall abundance of predominantly benthic prey species in their stomach contents.

By examining the proportion of sand, gravel and mixed sediment dwelling organisms in the diets of fish an assessment of the significance of dredging on the prey items for fish can be made. For example, infaunal organisms associated with predominantly mobile sandy sediments may be expected to recover more rapidly from the effects of dredging compared to epifaunal organisms associated with stable gravels. Table 2 indicates that sand dwelling benthos are particularly important in the diets of flatfish, notably, Ampelisca sp. (Sand Hopper) and Lagis koreni (Trumpet worm).

Whilst these results suggest that sand dwelling taxa are the most abundant prey items in the diets of fish found on coarse mixed sediment habitats, it remains to be seen if the same conclusion can be made following the analyses of additional stomach contents from other aggregate areas.

In addition, further analysis of fish stomachs from trawls already taken off Norfolk and Lowestoft off the east coast of England will help to clarify the above suggested interactions between fish and the macrobenthos. The results of these findings will be reported at a later date.
## FISH TRAWLS

<table>
<thead>
<tr>
<th>Dredged</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humber</td>
<td>3*</td>
</tr>
<tr>
<td>Outer Wash</td>
<td>1</td>
</tr>
<tr>
<td>Norfolk</td>
<td>0</td>
</tr>
<tr>
<td>Lowestoft</td>
<td>2*</td>
</tr>
<tr>
<td>Hastings</td>
<td>1</td>
</tr>
<tr>
<td>Bristol</td>
<td>0</td>
</tr>
</tbody>
</table>

Total Trawls = 18  
Processed Trawls* = 8
Fish species from all regional gravel trawls

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>Abundance</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solea solea (Dover Sole)</td>
<td>125</td>
<td>100%</td>
</tr>
<tr>
<td>Merlangius merlangus (Whiting)</td>
<td>141</td>
<td>91%</td>
</tr>
<tr>
<td>Limanda limanda (Dab)</td>
<td>74</td>
<td>64%</td>
</tr>
<tr>
<td>Callionymus lyra (Dragonet)</td>
<td>52</td>
<td>55%</td>
</tr>
<tr>
<td>Pleuronectes platessa (Plaice)</td>
<td>27</td>
<td>45%</td>
</tr>
<tr>
<td>Raja clavata (Thornback Ray)</td>
<td>16</td>
<td>45%</td>
</tr>
<tr>
<td>Trisopterus luscus (Bib, Pouting)</td>
<td>46</td>
<td>45%</td>
</tr>
<tr>
<td>Myoxocephalus scorpius (Scorpion Fish)</td>
<td>52</td>
<td>36%</td>
</tr>
<tr>
<td>Agonus cataphractus (Armed Bullhead)</td>
<td>54</td>
<td>36%</td>
</tr>
<tr>
<td>Pomatoschistus minutus (Sand Goby)</td>
<td>10</td>
<td>36%</td>
</tr>
<tr>
<td>Microstomus kitt (Lemon Sole)</td>
<td>43</td>
<td>27%</td>
</tr>
<tr>
<td>Liparis liparis (Sea Snail)</td>
<td>11</td>
<td>27%</td>
</tr>
<tr>
<td>Ammodytes sp (Sand Eel)</td>
<td>6</td>
<td>27%</td>
</tr>
<tr>
<td>Gadus morhua (Cod)</td>
<td>3</td>
<td>18%</td>
</tr>
<tr>
<td>Scophthalmus rhombus (Brill)</td>
<td>2</td>
<td>18%</td>
</tr>
<tr>
<td>Trachinus draco (Greater Weever)</td>
<td>9</td>
<td>18%</td>
</tr>
<tr>
<td>Arnoglossus laterna (Scaldfish)</td>
<td>6</td>
<td>9%</td>
</tr>
<tr>
<td>Dicentrarchus labrax (Bass)</td>
<td>4</td>
<td>9%</td>
</tr>
<tr>
<td>Trisopterus minutus (Poor-cod)</td>
<td>55</td>
<td>9%</td>
</tr>
<tr>
<td>Scyliohinus caniculus (Dogfish)</td>
<td>36</td>
<td>9%</td>
</tr>
<tr>
<td>Eutrigla gurnardus (Grey Gurnard)</td>
<td>1</td>
<td>9%</td>
</tr>
</tbody>
</table>

| Total Abundance                             | 773       |           |

Total stomachs analysed: 373
### Table 2

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>Humber Drilled '66</th>
<th>Humber Reference</th>
<th>Lowestoft Drilled '76</th>
<th>Lowestoft Reference</th>
<th>North Norfolk Reference</th>
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<tbody>
<tr>
<td></td>
<td>Garkish</td>
<td>Flatfish</td>
<td>Shrimp</td>
<td>Garkish</td>
<td>Flatfish</td>
</tr>
<tr>
<td>Pandalus montagui (Pink Shrimp)</td>
<td>12</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>.</td>
</tr>
<tr>
<td>Sepiola sp</td>
<td>1</td>
<td>.</td>
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<td>.</td>
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<tr>
<td>Terebras longicornis (copepods)</td>
<td>2</td>
<td>.</td>
<td>15</td>
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<tr>
<td>Sangro longicorn (Brown Shrimp)</td>
<td>2</td>
<td>.</td>
<td>22</td>
<td>19</td>
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<td>Gastroccus spinifer (mysid)</td>
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<td>.</td>
<td>.</td>
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</tr>
<tr>
<td>Pomatoschistus minutus (Sand Goby)</td>
<td>2</td>
<td>.</td>
<td>.</td>
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</tr>
<tr>
<td>Anemones sp (Sand Eel)</td>
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</tr>
<tr>
<td>Total</td>
<td>53</td>
<td>6</td>
<td>9</td>
<td>15</td>
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<tr>
<td>Predominantly Benthic</td>
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<td>Molgula sp</td>
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<td>Clea Ascidians</td>
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<td>Scrobiculatella scorpiosa (Bryozoa)</td>
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<td>Phalaria fuscica</td>
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<td>Psola longicornia (crab)</td>
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<td>Galathea sp</td>
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<td>Ophioclavus fragilis</td>
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<td>Tabularia indivisa (hydroid)</td>
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<td>Octocorals</td>
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<td>Sagartia sp</td>
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<tr>
<td>Unders Hydroids (c.f. Sertulariidae)</td>
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<td>Serularia cespitosa</td>
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<tr>
<td>Undent milticus c.f. Modiolus foot</td>
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<td>Maculana marmorata</td>
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<td>Lucina borealis</td>
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<tr>
<td>Schellaria spinulosa (Bass-reef worm)</td>
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<td>Scholla sp</td>
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<td>Hermit crab</td>
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<td>Sponges sp (Sand Hoppers)</td>
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<td>Leptosymphysa sp</td>
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<td>Spicula elliptica</td>
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<td>Sand dwelling</td>
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<td>Pectinaria coreni (Trumpet worm)</td>
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<td>Cancer pagurus</td>
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<td>Peperello</td>
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<td>Mixed grain</td>
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<td>1</td>
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</tr>
<tr>
<td>Unders Hydroids Fragments</td>
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<td>Phydomatix</td>
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</tr>
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<td>Nereis sp (flag worm)</td>
<td>.</td>
<td>1</td>
<td>1</td>
<td>.</td>
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</tr>
<tr>
<td>Nephrys sp</td>
<td>.</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>5</td>
<td>104</td>
<td>33</td>
<td>38</td>
<td>18</td>
</tr>
<tr>
<td>Stomachs analysed</td>
<td>12</td>
<td>27</td>
<td>50</td>
<td>14</td>
<td>34</td>
</tr>
<tr>
<td>Stomachs with identifiable prey</td>
<td>11</td>
<td>22</td>
<td>20</td>
<td>14</td>
<td>18</td>
</tr>
</tbody>
</table>
ANNEX V

Item 8  SEBA 1996 Summary Record: identification of further sea-based activities which give rise to the effects on the marine environment.
Agenda Item 12 - Identification of Further Sea-based Activities which Give Rise to Effects on the Marine Environment

Sand and Gravel Extraction
SEBA 96/12/1

12.1 Following the agreement reached at SEBA 1995, the delegation of the Netherlands presented information to justify guidelines for sand and gravel extraction to be developed by SEBA (SEBA 96/12/1) and pointed out that the activities regarding sand and gravel extraction, which were carried out by Contracting Parties, would fall under Article 2.1 of the new OSPAR Convention and would therefore need consideration, coordination and regulation within OSPAR. To this end, the Netherlands were prepared to take the lead for the development of draft guidelines concerning sand and gravel extraction for examination at SEBA 1997.

12.2 The Secretariat pointed out that the issue 'How and to what extent do dredging and sand and gravel extraction affect communities (particular benthic communities), coastal habitats and spawning areas?' had been included in the JAMP (cf. SEBA 96/13/1, issue 6.4) to be addressed on a Convention-wide basis in the framework of OSPAR. This issue had been discussed at IMPACT 1995, which had agreed, inter alia, that IMPACT 1996 should further develop a work strategy and that Denmark, as the prospective lead country for this issue under IMPACT, should contact the Netherlands with a view to coordinating work carried out within the framework of IMPACT and SEBA.

12.3 In discussion the following points were made:

a. the effects of extraction operations would be different depending on whether or not the material was removed from the environment (eg. for construction purposes or as beach nourishment);

b. the aspect of the total amounts of material extracted together with the environmental impact of the extraction operations should be covered by guidelines concerning sand and gravel extraction;

c. the existing ICES guidelines relevant to sand and gravel extraction should be used as a basis for OSPAR guidelines;

d. the work carried out within IMPACT should be considered for the justification, and in the preparation, of OSPAR guidelines for sand and gravel extraction within the framework of SEBA;

e. the UK delegation expressed the view that it was premature for SEBA 1997 to consider draft guidelines on sand and gravel extraction until IMPACT had completed its work on this issue. This delegation further stated that there was no basis under the OSPAR Convention to adopt programmes and measures on the extraction of sand and gravel.

12.4 In conclusion SEBA agreed:

a. that the Netherlands would take the lead as regards the issue of sand and gravel extraction;

b. to invite Contracting Parties to submit relevant information on this issue to the Netherlands by 30 June 1996;
c. that the Netherlands should take this information, and the work carried out within IMPACT, into account when preparing:
   (i) a background document containing information concerning sand and gravel extraction and further justification for guidelines;
   (ii) draft OSPAR guidelines for sand and gravel extraction;

d. that SEBA 1997 would examine the documents submitted by the Netherlands and decide on a further line of action as regards the issue of sand and gravel extraction.

Agenda Item 13 - Cooperation with ASMO and ASMO’s Working Groups
SEBA 96/13/1; SEBA 96/13/Add.1, SEBA 96/13/Info.1

13.1 OSPAR 1995 had agreed to include a separate item in the agendas for PRAM, ASMO and the third-tier working groups in order to strengthen the coordination between PRAM and ASMO.

13.2 The delegation of the UK stated that it should not be necessary for second and third-tier working groups to request information from each other as they were all part of the same body with a common Secretariat.

13.3 The Secretariat presented SEBA 96/13/1 which drew the attention of SEBA to relevant issues and work regarding sea-based activities which had been carried out, or was being planned, in the framework of ASMO and ASMO’s third tier working groups, e.g.:
   a. the Joint Assessment and Monitoring Programme (JAMP) including an overview of issues and requests which had been addressed to SEBA by INPUT, IMPACT and ACG. The requests from IMPACT concerning dumping of fish waste from industrial fish processing operations and concerning dredging and sand/gravel extraction had been taken into account in the discussions under Agenda Items 11 (cf. §§11.4-11.7) and 12 (cf. §§12.2-12.4) respectively.
   b. an ASMO workshop on the use of models in environmental risk assessments of accidents in the shipping and offshore industries, held on 15-17 November 1995 in the Netherlands. The terms of reference and the agenda of this workshop were given in SEBA 96/13/Info.1.

13.4 The Secretariat further informed SEBA about issues arising from SIME 1996 (SEBA 96/13/1 Add.1) with regard to the information exchange concerning:
   a. discharges from the offshore industry, including discharges of harmful substances;
   b. the work on PAHs and oil carried out in both working groups.

13.5 SEBA noted the information presented by the Secretariat on work regarding sea-based activities which had been carried out, or was being planned in the framework of ASMO and agreed that the Secretariat should present similar overviews to future meetings of SEBA.

13.6 As regards the requests from ASMO and/or ASMO’s working groups SEBA agreed that the Secretariat should forward:
   a. to INPUT 1996: the most recent reports on the Use and Discharge of Chemicals from Offshore Installations and on Dumping at Sea for information regarding inputs of heavy metals, PAHs and nutrients, together with
<table>
<thead>
<tr>
<th>Disposal of Offshore Platforms</th>
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<tbody>
<tr>
<td>To contact Iceland, Portugal and Switzerland regarding their participation in the intersessional contact group.</td>
</tr>
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<table>
<thead>
<tr>
<th>Guidelines for the Disposal/Placement of Matter at Sea</th>
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<tbody>
<tr>
<td><strong>Inert materials of natural origine</strong></td>
</tr>
<tr>
<td>To submit comments on the draft guidelines for inert materials of natural origin to the UK.</td>
</tr>
<tr>
<td>To prepare a further revision of the assessment guidelines for PRAM 1996.</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>Fish waste from industrial fish processing operations</th>
</tr>
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<tbody>
<tr>
<td>To act as lead country for the preparation of draft guidelines concerning fish waste from industrial operations for SEBA 1997.</td>
</tr>
<tr>
<td>To forward relevant information to Norway.</td>
</tr>
<tr>
<td>To forward a request for clarification and an explanation of their position to PRAM 1996.</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>Artificial reefs</th>
</tr>
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<tbody>
<tr>
<td>To prepare a further revised draft of the guidelines for the construction of artificial reefs for examination at SEBA 1997.</td>
</tr>
</tbody>
</table>

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<tr>
<th>Sand and Gravel Extraction</th>
</tr>
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<tbody>
<tr>
<td>To take the lead as regards the issue of sand and gravel extraction.</td>
</tr>
<tr>
<td>To submit relevant information on this issue to the Netherlands.</td>
</tr>
<tr>
<td>To prepare a background document containing information concerning sand and gravel extraction and further justification for guidelines.</td>
</tr>
<tr>
<td>To prepare draft OSPAR guidelines for the sand and gravel extraction.</td>
</tr>
</tbody>
</table>
ANNEX V

ANNEX V

DRAFT CONTENTS PAGES/ACTIONS FOR THE FORTHCOMING COOPERATIVE RESEARCH REPORT.

1. INTRODUCTION.

2. AGGREGATE DREDGING, COASTAL ENGINEERING AND RELATED ACTIVITIES IN THE COASTAL AND CONTINENTAL SHELF OF ICES. (Andy Morrison).

2.1. Extraction of marine sediments.
[General overview of industry].

2.1.1. Status of the marine aggregate extraction industry and related environmental research in ICES countries.
[Statistics, specific details of extraction by country and related environmental research in context of licences ie monitoring requirements].

2.1.2. Demand and supply of marine aggregates.
[Commercial commentary dealing with supply/demand, exports. Scale of economic importance, land and marine].

2.2. Use of marine sediments.
[Overview of use i.e. % contract fill, C.P. works, construction].

2.2.1. Construction aggregates for concrete.
[% extracted, concrete specification].

2.2.2. Contract fill/reclamation.
[% extracted, details of large scale projects].

2.2.3. Coastal Protection.
[Replenishment/Recharge/Beach Management].

2.2.4. Other uses
[Use of shell/other minerals/navigation/maintenance dredging, details of large scale construction projects].

3. EFFECTS OF EXTRACTION ACTIVITIES ON LIVING RESOURCES AND FISHERIES.


3.1.1. Biological In fauna, Epi fauna.

3.1.2. Physical
[Annexes of standard operating procedures].


3.2.1. Regional assessment of aggregate fauna.

3.3. Environmental effects of dredging. (Michelle Desprez).

3.3.1. Nature of physical impacts on seabed and water column. (Michelle Desprez).

3.3.2. Nature of biological impacts on seabed and water column. (Michelle Desprez).
DRAFT CONTENTS PAGES/ACTIONS FOR THE FORTHCOMING COOPERATIVE RESEARCH REPORT.

3.3.3. Case Histories of environmental responses to dredging.
   - CNEXO site. (Michelle Desprez).
   - Dieppe. (Michelle Desprez).
   - North Norfolk. (Andy Kenny).
   - Klaverbank. (Chris Dijkshoorn).
   - Borrow pits. (Chris Dijkshoorn).

3.4 Scale of effects and consequences. (Jon Side/Andy Kenny).

3.4.1. Living resources.

3.4.2. Benthos.

3.4.3. Fisheries.

4. MANAGEMENT.


4.1.1. Update of legislation and administration procedures. (Brigitte Lauwaert).

4.1.2. Environmental Impact Assessment (Tom Simpson).
   Approaches to EA. Guidelines for the use of EIA.

4.2. Resource Management/Planning. (Cees Laban).

4.3. Surveillance & Monitoring. (Chris Dijkshoorn).

4.3.1. Electronic monitoring devices. (Chris Dijkshoorn).

4.3.2. Physical monitoring. (Andy Morrison).

4.3.3. Biological monitoring. (Andy Morrison).

5. SEABED SEDIMENT MAPPING PROGRAMMES OF ICES MEMBER COUNTRIES.
   (Ingemar Cato/Cees Laban).
   - To make an update of ICES report 182 p 54-79.
   - To indicate the map content of all maps for areas surveyed.
     - Scale, classification, morphology, projection, side scan sonar records of details, seismic record examples.
     - Printed and/or digital available.
     - Accompanying chemical analyses.
     - Description related to the map available.
     - Are the samples used still available?
ANNEX V

ITEM 9

DRAFT CONTENTS PAGES/ACTIONS FOR THE FORTHCOMING
COOPERATIVE RESEARCH REPORT.

- To make overview charts with areas mapped of each member country.
- Include other member countries like Poland etc and non-member countries where this
can be readily achieved.
- Possible chart showing surveyed areas.

Structure of section for discussion. (Ingemar Cato/Cees Laban).

6. DISCUSSION.

7. CONCLUSIONS/SUMMARY.

Annexes.
ANNEX V

Item 10  Map showing licensed extraction areas on the Dutch Continental Shelf.