Present state of marine extraction and scientific control in extraction areas on the Belgian Continental Shelf

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1. Introduction.

The continued decrease in availability of farming and building land, together with the increasing road congestion have led to an increasing demand for marine sand and gravel in the early seventies. In 1974 a Royal Decree was published to regulate the exploitation and exploration of the surface sediments on the Belgian Continental Shelf.

While in 1976 the first extractions took place a second Royal Decree appeared in 1977, containing protective measures on shipping, sea fisheries and environment. The accompaning scientific research started in 1976 with physi chemical and biological monitoring to foresee the possible effects on fisheries. Hydrodynamic and geological research began respectively in 1977 and 1982. In the following years more and more specific fundamental research was set up by the universities.

Although dredging activities concerning the deepening of navigation channels and harbour entrances engages for decades the attention and the concern of the fishermen no specific legislation containing regulations and protective measurements have yet appeared, as it is concerned with works of public utility.
The surveillance of these dredging activities is fully controlled by the Ministry of Public Works and its scientific staff (Haecon, Harbour Engineering Consultants) concerning sedimentology, dredging efficiency and cost price calculations. Ecological studies were set up by the Fisheries Research Station of the State since 1979.

2. Belgian legislation.

2.1. The Continental Shelf (figure 1).

The part of the European Continental Shelf assigned to Belgium is based on the rule of equidistance and falls completely under the jurisdiction of the state.

The relevent clauses were taken up in the law of 13 june 1969 :

The Kingdom of Belgium exercises sovereign rights on the Continental Shelf and on exploration and exploitation of its natural resources.

- The expression "Continental Shelf" designates the sea-bed and the subsoil of the regions adjacent to the coast but outside the territorial waters.
- The "natural resources", comprise the mineral and other non-living resources of the sea-bed and the subsoil as well as the living organisms belonging to the sedentary species, i.e. organisms, which are more or less motionless.
- The exploration and exploitation of the living resources are reserved to the Belgian inhabitants.
- The exploration and exploitation of the mineral and non-living resources of the sea-bed and the subsoil are subordinated to the granting of concessions.

2.2. Sand extraction.

In application of the law of 13 June 1969 two Royal Decrees were published to regulate the exploitation of the surface sediments of the Belgian Continental Shelf :

The Royal Decree of 7 October 1974 recognizes the Minister of Economic Affairs competence over the mineral and non-living resources of the Continental Shelf. The Mines Department is charged to gather advice from other Ministries in order to be able to take the required measures to check any possible pollution and to protect the fish stocks.

The Concession Decree is then made up under the form of a Ministerial Decree, while the concession conditions are recorded in an accompanying Royal Decree.

The Royal Decree of 16 May 1977, concerning the protective measures on shipping sea-fisheries, environment and other essential interests during the exploration and exploitation of the mineral and other non-living resources in the territorial waters and on the Continental Shelf, was also elaborated within the framework of the law of 13 June 1969.

In this Royal Decree two well defined zones are delimited for which exploitation concessions are granted.

2.3. Dredging of navigation channels and harbour entrances.

Complementary to the Royal Decree of 16 May 1977 a third zone is provided for deepening and maintenance dredging work of the channels and port entrances, where apart from mud large quantities of good quality sand are taken up. This supplement, worked out in 1984, will also foresee the possibility to bring this sand ahore.

3. Concession areas.

3.1. Sand exploitation area I (figure 1).

This area is exploited by the Ministry of Public Works. For seven years already (1979-1985) an intensive sand exploitation took place on the Goote Bank. The sediment was mainly used for the extension of the harbour of Zeebrugge and for beach improvement.

A total of circa 40 million tons of sand were taken up, the largest part (25 million tons) had been brought ashore during four years (1979-1982 , table 1) Another 40 million tons will be extracted in the following years.

The Ministry of Public Works is not required to request a concession as it concerns works of public utility.

3.2. Sand exploitation area II (figure 1).

This area is above all the working area of private firms. Up to now approximately 5 million m^3 of sand (1976-1985) has been taken up for road works and housing (table 1).

The quantities taken rised till 1981, than a saturation point was established, partly due to the economic crisis.

3.3. Sand exploitation area III (figure 2).

The sand obtained during construction of new navigation channels and maintenance dredging work is used by the Ministry of Public Works for the extension of the harbour of Zeebrugge and for beach improvement. The sand of inferior quality and the mud are dumped at sea on well defined dumping grounds (see point 4).

3.4. Further development of the offshore sand industry.

The development of an offshore aggregate industry has been relatively slow, despite the expanding demand for material for concrete, roads and fill in civil engineering works. Until recently landbased resources were sufficient to provide an economical supply of both sand and gravel within a short distance of the major markets.

As the pressure on land use for agriculture, housing or other environmental and social needs has become greater due to a more strict environmental policy, extraction has been forced away from the vicinity of large towns. Rising costs, particularly for transport, have increased the demand for alternative sources.

In the second place the most markable mining areas on land are exhausted so that further exploitation becomes more difficult and more expensive.

Thirdly sea-sand lies there for the grabbing. Due to the classifying effect of the bottom currents on the sediments, large quantities of sand of a given quality and composition can be taken from several areas.

In the future the sand will mainly be used as filling material for the construction of highways, for the manufacture of cement and concrete, for engineering works in the harbour of Zeebrugge and beach improvement.

4. Dredging activities.

The yearly dredged quantities give evidence of the high extraction rate of the dredging activities along the Belgian Coast. Each year dredging reaches amounts of more than 30 million tons. These are the highest amounts in Western Europ.

This high dredging rate is due to the structure of the sediments along the Belgian coast. They consist mainly of ~~sand and~~ medium mud.

Therefore deepening of shipping channels and harbour approaches are of a constant concern for the Ministery of Public Works.

Several dumping grounds on the Belgian Continental Shelf are designed for the dumping of dredging spoils. Among these dumping areas, the one located near the navigation channel to the Western Scheldt (Sierra Ventana) had already received more than 164 million m^3 spoil (figure 3).

Smaller deposit sites are located near-shore and received dredged spoils from harbour entrances.

5. Extraction methods.

Anchor suction dredges are only allowed to deepen navigation channels and harbour approaches.

Harbour entrances and channels were deepen with bucket-ladder dredgers.

Private industry uses obligatory trailer suction dredgers.

6. Scientific research sand extraction and dredging.

The research can be divided in four main categories the geological, the hydrodinamic, the physiochemical and the biological research.

6.1. Geological research.

This research can be divided in two categories. The first part is mainly executed by the Ministry of Public Works. This research chiefly contains the study of the erosion powers and sediment mobility that can occur during the realisation of building structures and the deepening of navigation channels. These studies are necessary to prevent the builded structures to be washed away and to prevent the dredging spoils from returning to the same channels.
No publications are available. All reports were internal (Haecon, 1982-1984).

A second part is executed by the geological institutes of the universities and concerns the exploitation of mineral resources.

First of all an inventory is made of the materials that can be gained form the continental shelf. It was as well discoverred that the existence of the sand banks along the coast is due to a strong dynamical balance. A disturbance of this balance because of the exploitation of the banks, could have a negative influence on the division of the coastal area.

By means of a seismic study a map of the superfincial bottom structure has been made. In this way a possible change can be foreseen. Through the use of seismic reflection the inner structure of the banks can be analysed. In this way the stability of the banks can possibly be explained.

References see point 7.1. Geomorphology and sediments.

6.2. Hydrodynamic research.

The hydrodynamic research has been restricted mainly to the measurement of the strengths of the current and their directions. These factors are

important for shipping. Nowadays they are also important in the hydrodynamic models, through which the dispersion and the circulation of discharged dredge spoils and chemical wastes can be traced.

On the other hand, the study of the undulation is also important in connection with the erosion forces and the stability of the banks and coast.

References see point 7.2. : Hydrodynamics.

6.3. Physico-chemical research.

The physical study of the sea bottom and the accompanying chemical analyses are extremely important to get a better view on the interactions between environment and faunal assemblages. Especially grain size analyses, the determination of carbonate and the content of organic matter in the sediments and the analyses of the sea water give important data for further ecological studies.

References see point 7.3. : Physico-chemistry.

6.4. Biological research.

The most important trophic levels of the food chain, in relation tot the extractions were investigated.

The Fisheries Research Station studies the macrobenthic- and epibenthic fauna and the demersal fish, while the universities investigate the micro- and meiobenthic communities.

References see point 7.4. : Biology.

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Table 1 - Quantities of dredged sand in m^3 on the Belgian Continental Shelf (sand extraction areas I and II).

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Private industry (area II)	44.241	335.429	430.366	580.174	663.275	694.745	573.183	581.316	488.357	502.239
Ministry of Public Works (area I)	(*)	(*)	11.154	1.395.000	2.822.797	5.211.028	5.073.908	-	(*)	(*)

(*) Exact quantities unknown.

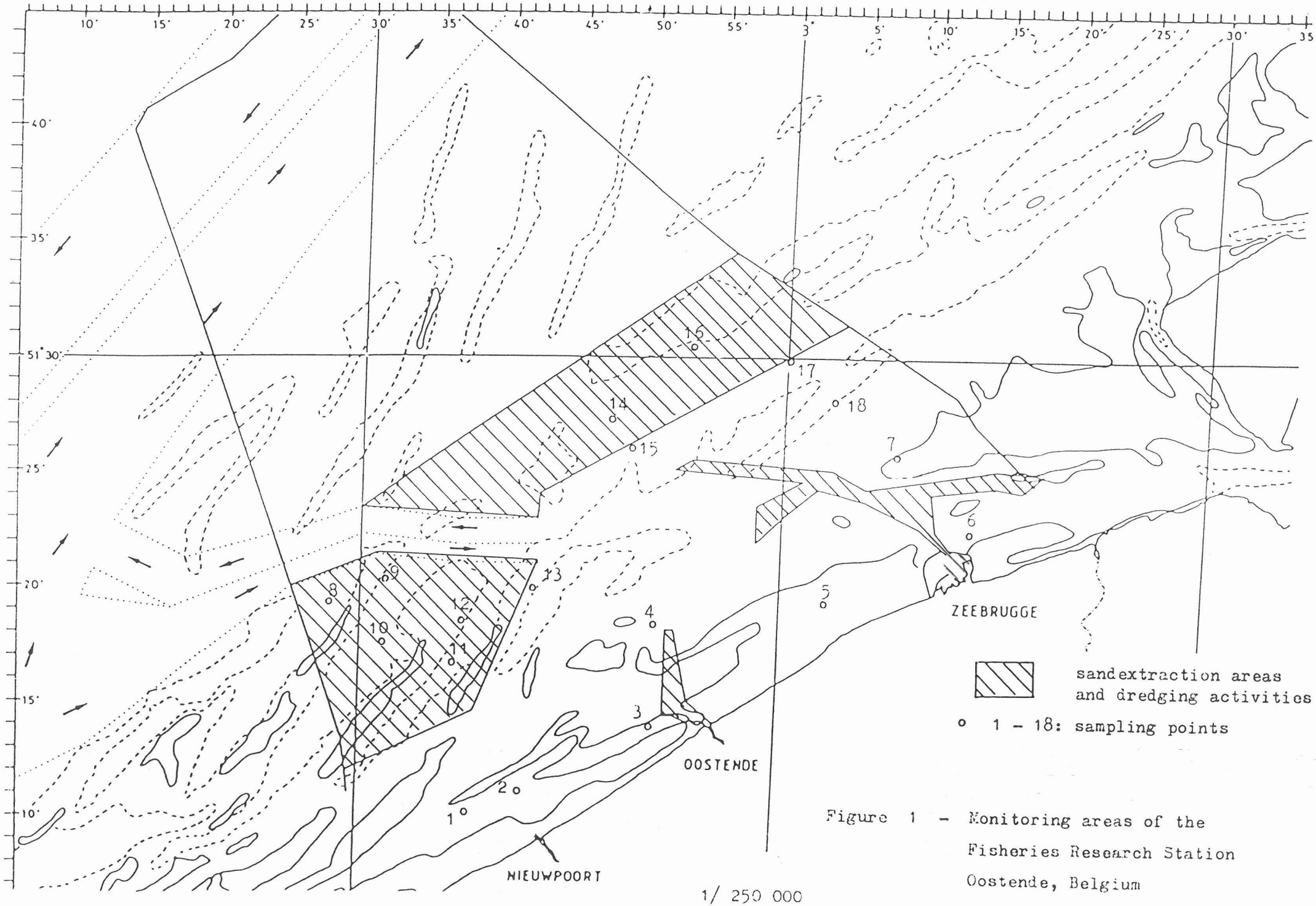

Figure 1 – Monitoring areas of the Fisheries Research Station Oostende, Belgium

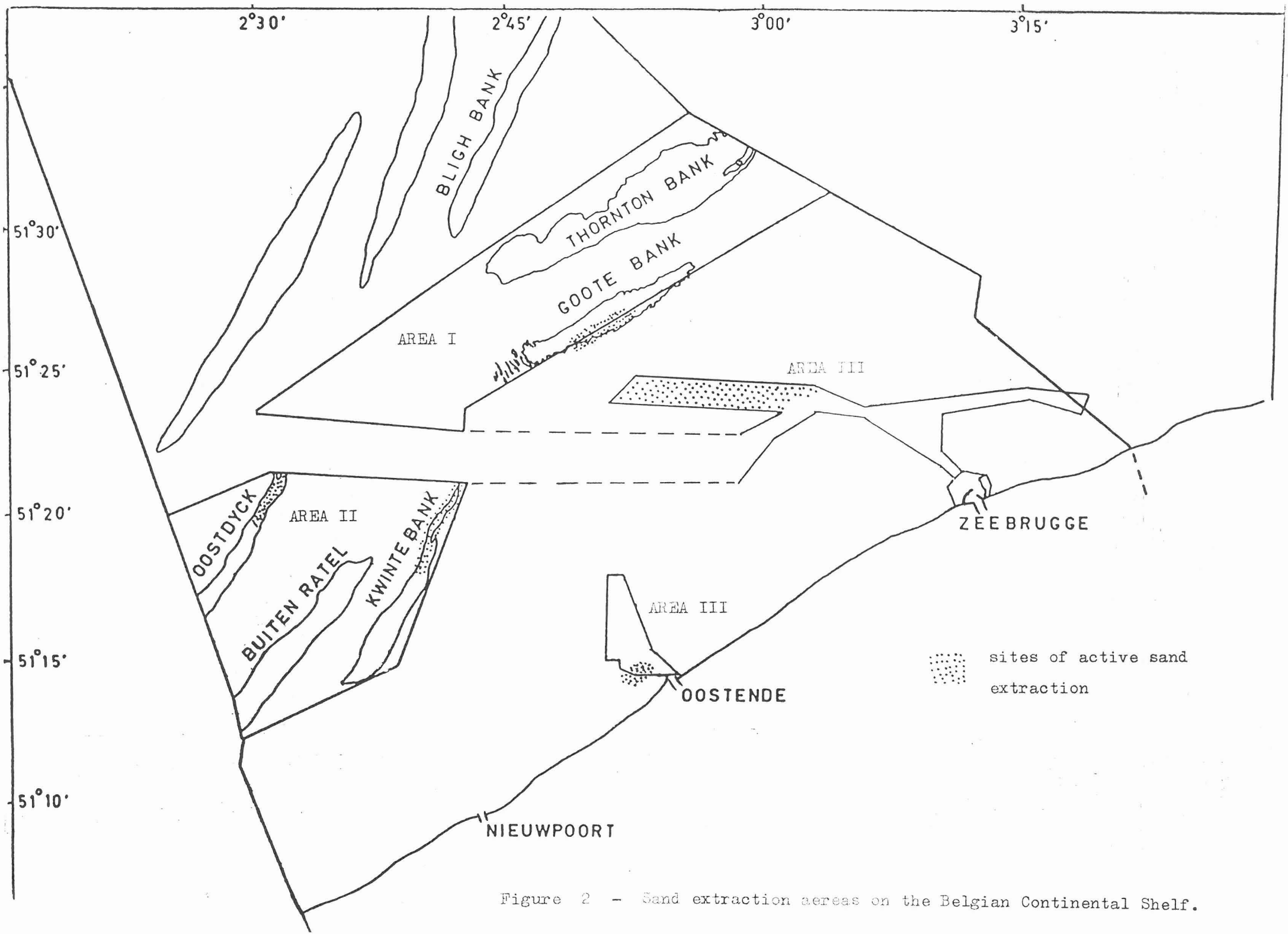

Figure 2 - Sand extraction aereas on the Belgian Continental Shelf.

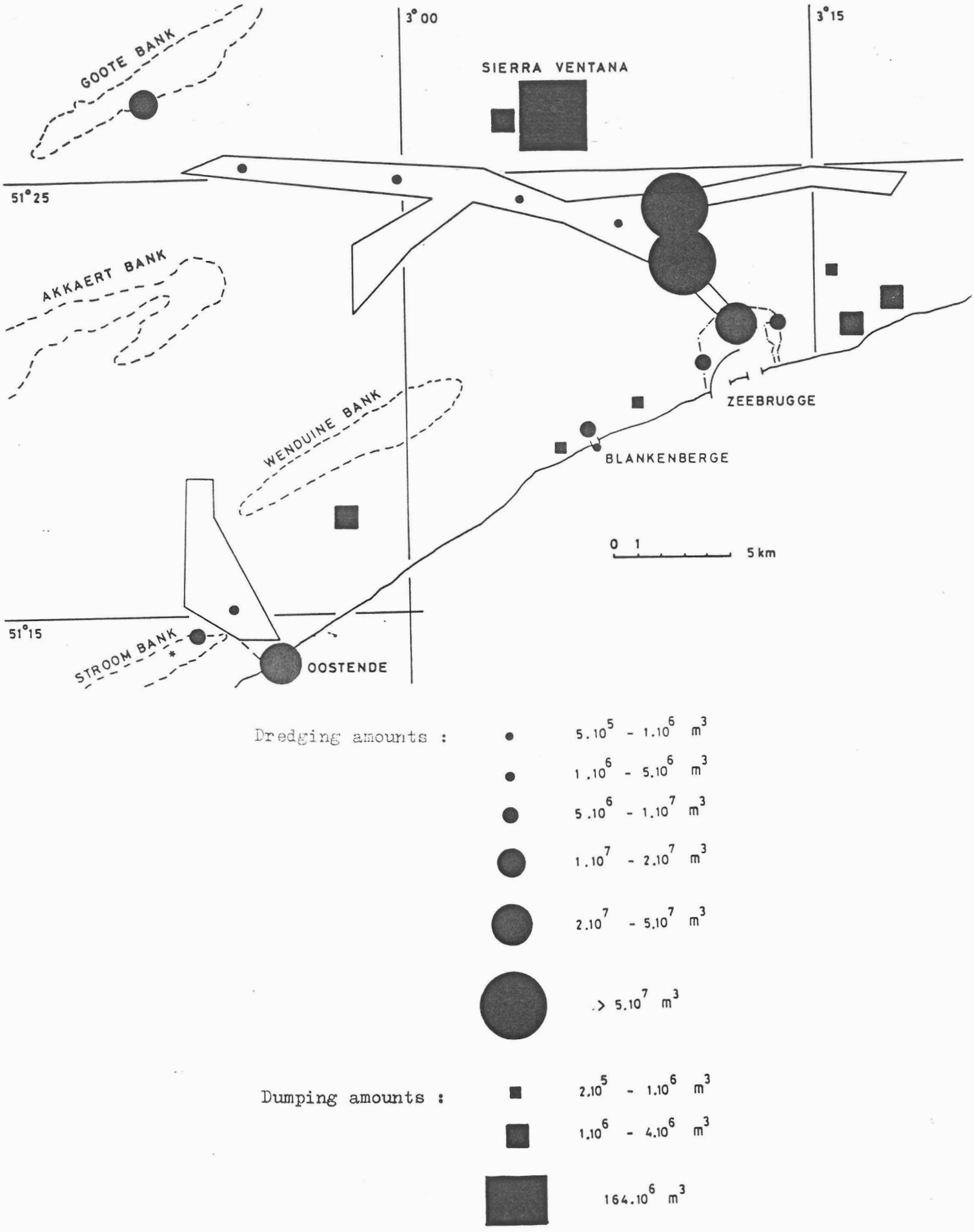

Figure 3 - Belgian Continental Shelf : Quantities of sewage sludge and dredging spoils (1970 - 1981) Dredging areas and dumping sites.