3 Dredging and dumping

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Dredging comprises all activities necessary to extract sand, silt and other layers from the bottom of waterbodies, but also in the context of land reclamation and nature development. This theme text will provide more information about the dredging and dumping of sediment for the purpose of maintaining and deepening the maritime access channels. The focus is on dredging and dumping activities in the Belgian part of the North Sea (BNS). The specific situation of these activities in the Scheldt Estuary is discussed in the theme text about the **Scheldt estuary**.

Over 99% of the sediments dumped at sea result from dredging in ports and fairways. Between 1990 and 2007, the total amount of materials dumped at sea in the OSPAR region (North-East Atlantic Ocean and North Sea) varied between 80 and 130 million tons (dry weight). About 90% of all dredged sediments are dredged and dumped in the southern part of the North Sea. This is largely due to the maintenance of the fairways to big ports such as Hull, Zeebrugge, Rotterdam, Bremen, Emden, Hamburg, Esbjerg, etc. In 2007, Germany and France dumped the largest amount of sediments in the OSPAR region, with *10^3 tons and 24.402*10^3 tons (dry weight) (each year) respectively (*OSPAR QSR 2010*). In Belgium, 11.845*10^3 tons (dry weight) were dumped in 2013 (*Lauwaert et al. 2014*). The evolution of the amount of sediment dumped in the BNS has been recorded since 1991 by the Management Unit of the North Sea Mathematical Models (MUMM) (RBINS) (*table dredged material*, figure 1). In the future, the amount of dredged and dumped sediments will probably increase due to the growing vessel size and the probable associated widening and deepening of fairways (*OSPAR QSR 2010*). The most commonly used techniques for dredging and dumping and the nature of the dredged sediments in the BNS are described in more detail in the section about the **Impact**.

3.1 Policy context

The maintenance and deepening of the maritime access channels to ports and the maintenance of the depth in the ports falls under the Flemish Region. The department of Mobility and Public Works (MOW), *Maritime Access Division*, is responsible for the fairways and for ports such as Zeebrugge, while the agency for Maritime and Coastal Services (MDK) - *Coastal division* is responsible for the maintenance of the Flemish marinas of Ostend, Blankenberge and Nieuwpoort. However, the competence with regard to the dumping of dredged materials at sea is a federal matter. Hence, the management of dredged materials in Belgium is a shared competence, for which a cooperation agreement was concluded on 12 June 1990 between the Flemish Region and the federal State. This agreement was modified by the cooperation agreement of 6 September 2000.

The procedure for obtaining a permit to dump dredged materials at sea has been stipulated by the royal decree of 12 March 2000. The maximum amount of dredged material and the location of the dredging and dumping sites of the permits that have been granted to the Maritime Access division and to the MDK agency since 2004, can be found in several ministerial decrees (see *Belgisch Staatsblad*).

3.2 Spatial use

In the Marine Spatial Plan (MSP, royal decree of 20 March 2014, also see *Van de Velde et al. 2014*), 5 sites for sediment dumping have been demarcated: *Bruggen en Wegen*, Zeebrugge Oost, Ostend, Nieuwpoort, S1 and S2 (see figure 2) (*Lauwaert et al. 2014*). In the MSP, an area west of the port of Zeebrugge is reserved as an alternative dumping site to reduce the reflux of dredged sediments.

In 2013, a dumping experiment commissioned by the Marine Access division was conducted to investigate the alternative dumping site west of Zeebrugge. The results of this experiment will be made available in 2015. In *Van Hoey et al. (2014a)*, the impact of a potential new dumping site on shrimp fishing in the region west of Zeebrugge has been investigated.

3.3 Societal interest

The Flemish ports are important economic gateways (see theme **Maritime transport, shipping and ports**). Because of the increase of the scale of the ships, it is necessary to regularly maintain the channels to the ports, as well as to deepen and widen these fairways. Each year, the Flemish government invests about 200 million euros to safeguard the accessibility of the ports (including the Scheldt Estuary, see figure 3, *Merckx & Neyts 2014*). The accessibility of

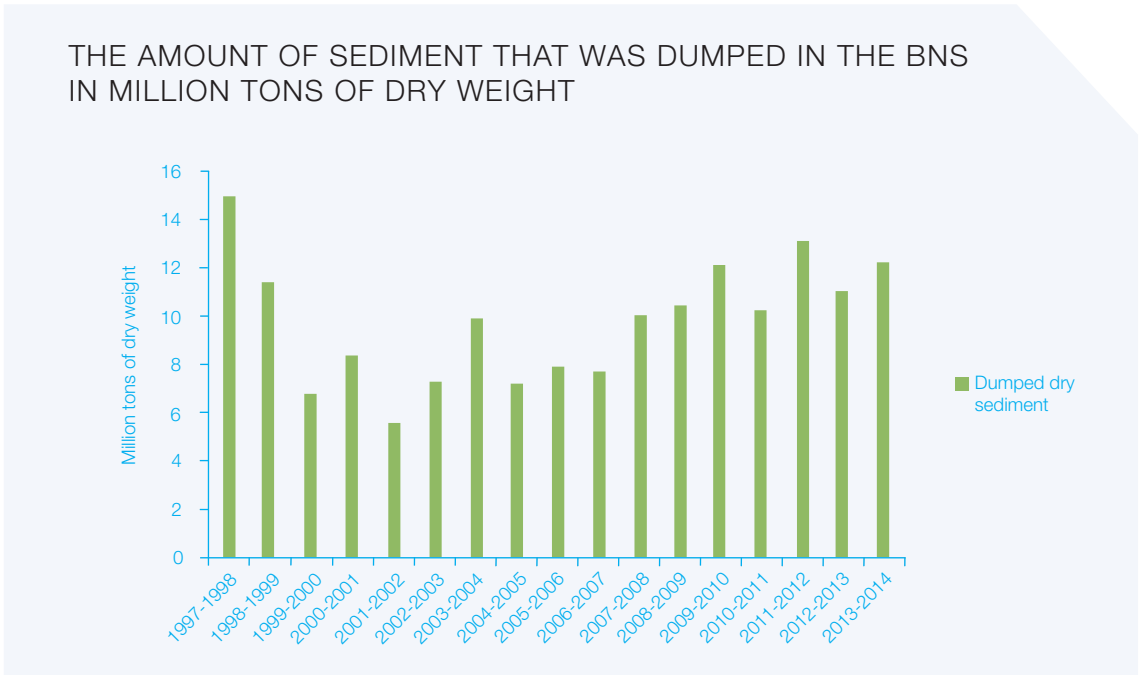

Figure 1. The amount of sediment that was dumped in the Belgian part of the North Sea, in tons of dry weight (Source: MUMM - RBINS).

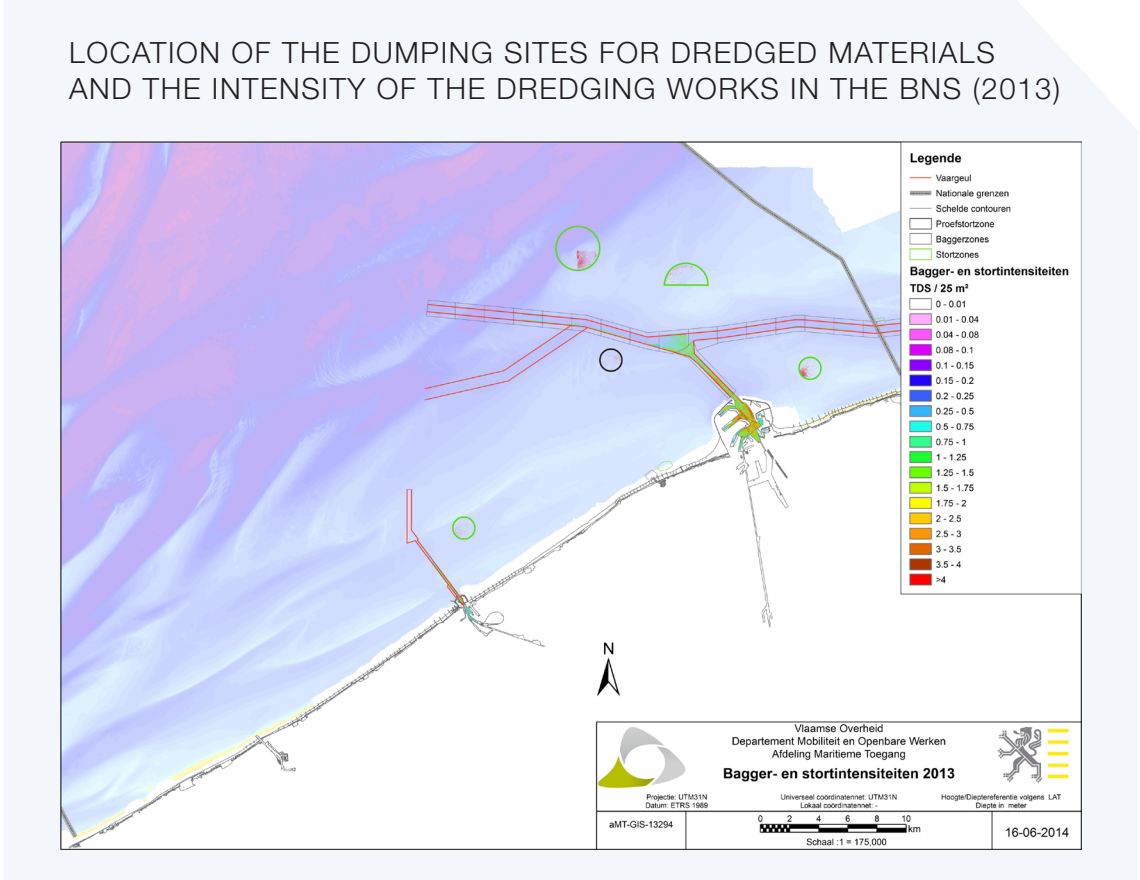

Figure 2. The location of the dumping sites for dredged sediments and the intensity of dredging in the BNS in 2013 (Source: Maritime Access division).

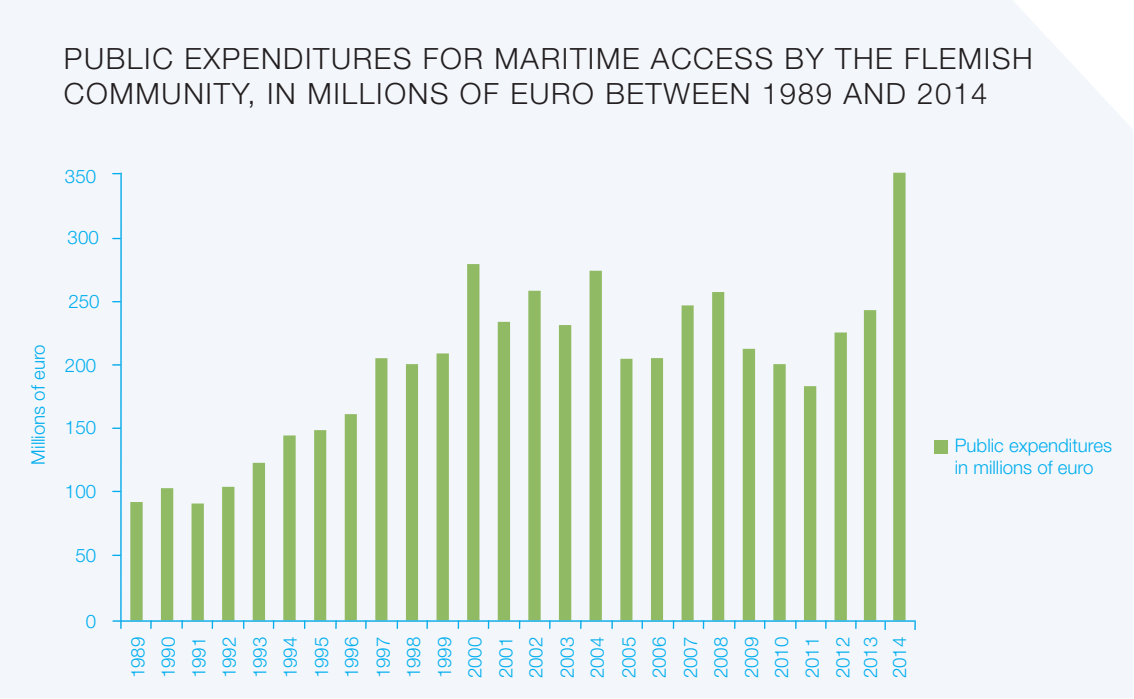

Figure 3. The government spending on maritime access by the Flemish Community in millions of euro between 1989 and 2014 (in 2014 rates) (Source: *Merckx & Neyts 2015*, after: Flemish Community, department MOW, Maritime Access division).

the Flemish ports of Ostend, Zeebrugge, Ghent and Antwerp is guaranteed by the *Martime Access division* of the MOW department. The tasks of this department include maintenance dredging works, wreck salvage, deepening of the channels and sludge processing (also see decision of the Flemish Government of 13 July 2001). The ministerial decrees of 28 December 2011 granted 4 permits for the dumping of 26.450 million tons of dry weight at 4 dumping sites in the BNS to the Maritime Access division from 1 January 2012 until 31 of December 2013. In addition, the agency for Maritime and Coastal Services was granted 4 permits for the dumping of a total of 1,970,000 tons of dry weight during this period (also see ministerial decree of 15 September 2012). Both permit holders together dumped 10,349,961 and 11,845,573 tons of dry weight in 2012 and 2013 respectively. The above-mentioned permits regarding the amount of dredged materials the Maritime Access division and the Coastal division are allowed to dump, (ministerial decrees of 28 December 2011 and the ministerial decree of 15 September 2012) have been prolonged until 31 December 2016 by the ministerial decree of 19 December 2013.

Belgium and the Netherlands together have access to the largest and most modern dredging fleet in the world. The feasibility study (*haalbaarheidsstudie, 2010*) of the non-profit organization Flanders Marine (the current Flanders Marine Cluster) indicates that in 2008, 2.9% of the total direct employment in the marine/maritime sector in the Flemish Region was situated in the dredging sector.

3.4 Impact

The most common type of dredging ship which is used for the maintenance of fairways is the trailing suction hopper dredger. This ship is equipped with big suction pipes and a large dredge head that functions as an enormous hoover, sucking the sediment out of the channels. In this process, the sediment is removed until the minimum guaranteed nautical depth is achieved, including a small margin to anticipate sudden sedimentation. The sediment ends up in the hopper of the ship and can be dumped at the licensed dumping sites by opening the doors or slides. In certain cases the sediment can be taken ashore. Besides the trailing suction hopper dredger, the cutter suction dredger is also commonly used for deepening work. This is a stationary or autonomous vehicle that removes material from the seabed by using a rotating cutting head.

The nature of the dredged sediment varies according to the location along the coast. The dumping site in Nieuwpoort is characterized by a large fraction of sand and a small fraction of silt. The site *Bruggen en Wegen* Ostend and *Bruggen en Wegen* Zeebrugge have the lowest average grain size (< 200 µm) and the highest concentration of silt (30-40%). The dredged materials are checked for heavy metals, PCBs and pesticides. Between 2009 and 2010, the lead and PCB levels were exceeded at a few sites (*Van Hoey et al. 2012*).

The dredging and dumping activities have a physical, chemical and biological impact on the marine environment (*Lauwaert et al. 2014* and table 1). The impact of dredging and dumping activities on other users is discussed in *Verfaillie et al. 2005* (*GAUFRE project BELSPO*) and *Van Hoey et al. (2014a)*.

Table 1. An overview of the environmental effects of dredging and dumping activities.

ENVIRONMENTAL IMPACT	LITERATURE
Physico-chemical impact: changes in seabed morphology and composition (grain size) and sedimentological effects (sediment plumes, turbidity, release of contaminants, etc.)	*Lauwaert et al. 2002*, *Fettweis et al. 2003 (MOMO)*, *Fettweis et al. 2004a (MOMO)*, *Fettweis et al. 2004b (MOMO)*, *Lauwaert et al. 2004*, *Fettweis et al. 2005a (MOMO)*, *Fettweis et al. 2005b (MOMO)*, *Verfaillie et al. 2005* (*GAUFRE project BELSPO*), *Fettweis et al. 2006a (MOMO)*, *Fettweis et al. 2006b (MOMO)*, *Lauwaert et al. 2006*, *Fettweis et al. 2007a (MOMO)*, *Fettweis et al. 2007b* (*MOCHA project BELSPO*), *Goffin et al. 2007*, *Du Four & Van Lancker 2008*, *Fettweis et al. 2008a (MOMO)*, *Fettweis et al. 2008b (MOMO)*, *Lauwaert et al. 2008*, *Fettweis et al. 2009a (MOMO)*, *Fettweis et al. 2009b (MOMO)*, *Fettweis et al. 2009c (MOMO)*, *Lauwaert et al. 2009*, *Van Hoey et al. 2009*, *Fettweis et al. 2010 (MOMO)*, *André et al. 2010*, *Fettweis et al. 2011a (MOMO)*, *Fettweis et al. 2011b (MOMO)*, *Fettweis et al. 2011c*, *Lauwaert et al. 2011*, *Fettweis et al. 2012 (MOMO)*, *Fettweis et al. 2013a (MOMO)*, *Fettweis et al. 2013b (MOMO)*, *Fettweis et al. 2014a (MOMO)*, *Fettweis et al. 2014b (MOMO)*, *Lauwaert et al. 2014*, *Vanhellemont & Ruddick 2015*, *Fettweis et al. 2015 (MOMO)*
Biological impact: effects on fauna and flora (disruption of benthos, influence of released contaminants, etc.)	*Seys 2002*, *Lauwaert et al. 2002*, *Lauwaert et al. 2004*, *Verfaillie et al. 2005* (*GAUFRE project BELSPO*), *Lauwaert et al. 2006*, *Lauwaert et al. 2008*, *Lauwaert et al. 2009*, *Van Hoey et al. 2009*, *André et al. 2010*, *Lauwaert et al. 2011*, *Van Hoey et al. 2012*, *De Witte et al. 2013a*, *De Witte et al. 2013b*, *Lauwaert et al. 2014*

3.5 Sustainable use

In order to address the impact of the dumping of dredged materials on the marine environment, this activity is globally governed by the *London Convention (1972)* and the London Protocol (1996) on pollution due to the dumping of materials at sea. In our region, these activities are also covered by the *OSPAR convention (1992)*, which aims to protect the marine environment in the northeastern part of the Atlantic Ocean (including the North Sea). OSPAR has also issued guidelines for the sustainable use of dredged materials (*OSPAR Guidelines for the management of Dredged Material 2009*).

On the European level, the Water Framework Directive (WFD) and the Marine Strategy Framework Directive (MSFD) identify the changing concentration of sediments in the water column due to human intervention as one of the important pollutants. In the MSFD, some of the descriptors for a good environmental status (GES) of the marine environment are relevant for dredging and dumping: seafloor integrity (more information: *Rice et al. 2010*), underwater noise and other forms of energy (more information: *Tasker et al. 2010*), concentrations of contaminants (more information: *Law et al. 2010*) and the permanent alteration of the hydrographical conditions. In the Marine Strategy Framework Directive (MSFD), changes in siltation due to dredging and dumping activities are incorporated in the list of pressures and impacts. The implementation of the MSFD in Belgian legislation is provided by the royal decree of 23 June 2010 (see theme **Nature and environment**). In addition, the Birds Directive (2009/147/EC) and the Habitats Directive (92/43/EEC) constitute an important framework for the reduction of the impact of dredging and dumping activities, given the obligation of an assessment before the execution of a project. *Van Hoey et al. (2014b)* elaborates on the Benthic Ecosystem Quality Index (BEQI) in the framework of the WFD, MSFD and Habitats Directive which can be applied to assess the dumping of dredged matter.

In the BNS, dredging and dumping is governed by the law of 20 January 1999. The royal decree of 12 March 2000 stipulates that a synthesis report must be presented to the competent minister every five years. In this report, the effects of the dredging and dumping activities are discussed, and recommendations supporting the development

of a stronger environmental policy are formulated (synthesis reports: *Lauwaert et al. 2002*, *Lauwaert et al. 2004*, *Lauwaert et al. 2006*, *Lauwaert et al. 2008*, *Lauwaert et al. 2009*, *Lauwaert et al. 2011*). Moreover, the dredged material that is dumped needs to meet certain sediment quality criteria (*website MUMM*, *Goffin et al. 2007*, *OSPAR national action levels for dredged material 2008*). If the limits of three criteria are exceeded, the dredged material cannot be dumped in the sea. If the result of the analysis is situated between the target and the limit value, further analysis is required. About every 10 years, a large-scale monitoring programme is established to determine the sediment quality of dredging areas (*website MUMM*).

In the context of the permits, the license holder is subject to a monitoring and scientific programme. In the MOMO-programme, MUMM is responsible for the monitoring and modelling of cohesive sediment transport and the evaluation of the effects of dredging and dumping on the marine ecosystem (see *inter alia* *Fettweis et al. 2015 (MOMO)*). The Institute for Agricultural and Fisheries Research (*ILVO*) investigates the biological and chemical aspects and works on the optimization of the monitoring programme.

Currently, there is a movement in the dredging industry (in cooperation with research institutions) to adapt dredging activities to natural processes or to deliberately construct certain ecosystems (see *inter alia* the so-called 'Building with Nature concept'). Furthermore, alternative feeding methods are developed for the construction of beaches in the context of coastal security, accommodating rivers to increase discharge and storage capacity, land reclamation, nature development, etc. (*Temmerman et al. 2013*, *de Vriend 2014*, *de Vriend et al. 2014*, *de Vriend et al. 2015*).

Legislation reference list

Table with international agreements, conventions, etc.

INTERNATIONAL AGREEMENTS, CONVENTIONS, ...			
Abbreviations (if available)	Title	Year of conclusion	Year of entering into force
London Convention	Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter	1972	1975
London Protocol	Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter	1996	2006
OSPAR Convention	Convention for the protection of the Marine Environment of the North-East Atlantic	1992	1998

Table with European legislation. The consolidated version of this legislation is available on *Eurlex*.

EUROPEAN LEGISLATION			
Abbreviations (if available)	Title	Year	Number
Directives			
Habitats Directive	Directive on the conservation of natural habitats and of wild fauna and flora	1992	43
Water Framework Directive	Directive establishing a framework for Community action in the field of water policy	2000	60
Marine Strategy Framework Directive	Directive establishing a framework for Community action in the field of marine environmental policy (Marine Strategy Framework Directive)	2008	56
Birds Directive	Directive on the conservation of wild birds	2009	147

Table with Belgian and Flemish legislation. The consolidated version of this legislation is available on *Belgisch staatsblad* and the *Justel-databases*.

BELGIAN AND FLEMISH LEGISLATION		
Date	Title	File number
Laws		
Wet van 20 januari 1999	Wet ter bescherming van het mariene milieu in de zeegebieden onder de rechtsbevoegdheid van België	1999-01-20/33
Royal Decrees		
KB van 12 maart 2000	Koninklijk besluit ter definiëring van de procedure voor machtiging van het storten in de Noordzee van bepaalde stoffen en materialen	2000-03-12/40
KB van 23 juni 2010	Koninklijk besluit betreffende de mariene strategie voor de Belgische zeegebieden	2010-06-23/05
KB van 18 oktober 2013	Koninklijk besluit tot wijziging van het koninklijk besluit van 12 maart 2000 ter definiëring van de procedure voor machtiging van het storten in de Noordzee van bepaalde stoffen en materialen	2013-10-18/20
KB van 20 maart 2014	Koninklijk besluit tot vaststelling van het marien ruimtelijk plan	2014-03-20/03

BELGIAN AND FLEMISH LEGISLATION (continuation)		
Date	Title	File number
Ministerial Decrees		
MB van 28 december 2011	Machtiging tot het storten in zee van baggerspecie door de Vlaamse overheid, Departement Mobiliteit en Openbare Werken, afdeling Maritieme Toegang en voor Maritieme Dienstverlening en Kust, afdeling Kust	
MB van 28 december 2011	Machtiging voor het storten van baggerspecie bij ministeriële besluiten van 28 december 2011	
MB van 19 december 2013	Machtiging voor het storten van baggerspecie Verlenging Bij ministerieel besluit van 19 december 2013	
Other		
Besluit van de Vlaamse Regering van 13 juli 2001	Besluit van de Vlaamse Regering betreffende de aanduiding van de maritieme toegangswegen en de bestanddelen van de haveninfrastructuur	2001-07-13/90
Samenwerkingsakkoord van 12 juni 1990	Samenwerkingsakkoord tussen de Belgische Staat en het Vlaamse Gewest ter vrijwaring van de Noordzee van nadelige milieu-effecten ingevolge bagger-specielossingen in de wateren die vallen onder de toepassing van de Conventie van Oslo	1990-06-12/38
Samenwerkingsakkoord van 6 september 2000	Samenwerkingsakkoord tot wijziging van het Samenwerkingsakkoord van 12 juni 1990 tussen de Belgische Staat en het Vlaamse Gewest ter vrijwaring van de Noordzee van nadelige milieu-effecten ingevolge bagger-specielossingen in de wateren die vallen onder de toepassing van de Conventie van Oslo.	2000-09-06/31