OSPAR COMMISSION

Assessment of the environmental impact of land reclamation

Biodiversity Series

2008

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the "OSPAR Convention") was opened for signature at the Ministerial Meeting of the former Oslo and Paris Commissions in Paris on 22 September 1992. The Convention entered into force on 25 March 1998. It has been ratified by Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, Netherlands, Norway, Portugal, Sweden, Switzerland and the United Kingdom of Great Britain and Northern Ireland and approved by the European Community and Spain.

La Convention pour la protection du milieu marin de l'Atlantique du Nord-Est, dite Convention OSPAR, a été ouverte à la signature à la réunion ministérielle des anciennes Commissions d'Oslo et de Paris, à Paris le 22 septembre 1992. La Convention est entrée en vigueur le 25 mars 1998. La Convention a été ratifiée par l'Allemagne, la Belgique, le Danemark, la Finlande, la France, l'Irlande, l'Islande, le Luxembourg, la Norvège, les Pays-Bas, le Portugal, le Royaume-Uni de Grande Bretagne et d'Irlande du Nord, la Suède et la Suisse et approuvée par la Communauté européenne et l'Espagne.

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Executive Summary

Land reclamation is the gain of land from the sea, or coastal wetlands *e.g*. for agricultural purposes, industrial use or port expansions. The most notable historic land reclamation sites in the OSPAR Maritime Area are the polders of the Netherlands. Today land reclamation is normally carried out to increase ports and associated industrial and logistical zones. In general, this activity is sufficiently managed by national regulations of OSPAR Contracting Parties including EU legislation; however, the environmental effects on species and habitats and ecosystem processes are still poorly understood and require further monitoring and assessment.

Land reclamation activities are often closely related to coastal defence projects and the extraction of sand and gravel. The environmental impacts of these activities are covered by other OSPAR assessments (OSPAR 2008/2009b and c).

In the OSPAR Maritime Area there are only a limited number of land reclamation sites but individual projects can have adverse impacts

There are only a limited number of land reclamation sites in the OSPAR Maritime Area and most are relatively small scale. There are no clear trends for numbers or sizes of land reclamation projects. Most sites and also the largest sites are located in OSPAR Region II (Greater North Sea). They can have adverse effects on the marine environment on a local or regional scale. Considering the growth in world trade and shipping activities it can be assumed that in future there will be a continued need for land reclamation for port development projects.

Land reclamation can have adverse effects on the marine environment. Those activities normally take place along the coast and mainly influence coastal and near-shore marine habitats, *e.g.* sandbanks, estuaries, mudflats, salt marshes and halophytic habitats, as well as species occurring in these habitats, *e.g.* grey seals, terns and black sea ducks. Marine habitats are permanently lost where land is reclaimed from the sea. Land reclamation may also influence habitat types of coastal and terrestrial origin such as sand dunes or freshwater bodies. Some impacts of land reclamation activities are comparable to the impacts of disposal of dredged material at sea, *e.g.* increased turbidity, changes to benthos habitats and sediment structures (OSPAR 2008/2009a).

The impacts of land reclamation activities are adequately covered by national regulations of OSPAR Contracting Parties

No specific measures on land reclamation have been developed by OSPAR apart from this assessment of the activity. Knowledge on environmental effects of land reclamation activities is very limited at present and it is therefore difficult to assess whether national regulations are sufficient.

In general, OSPAR Contracting Parties regulate land reclamation through permits from both national and regional authorities. Minimisation and compensation of environmental effects are taken into account through national regulations. National environmental laws and regulations are implemented both during the planning phase and the realisation of land reclamation projects (Port of Rotterdam, 2007a). Relevant legislation includes public works acts, environmental acts, planning acts, nature protection and conservation acts. Relevant EU legislation, such as the Environmental Impact Assessment (EIA), Birds and Habitats Directives, and international conventions also have to be considered. EIAs are the most common instruments for the consideration of environmental issues regarding land reclamation projects.

At present it can be assumed that, in most cases, the existing national regulations of OSPAR Contracting Parties together with EU legislation are sufficient to minimise the adverse effects of land reclamation activities on marine ecosystems.

Land reclamation can have negative impacts on marine ecosystems

The effects of land reclamation depend on the size, the characteristics and the sensitivity of the areas and on the techniques applied. There is only very limited information available on the actual effects of land reclamation activities on ecosystems and it is therefore difficult to determine how land reclamation affects the overall quality status of the marine environment in the OSPAR Maritime Area. Some valuable information is available from the EIAs of individual land reclamation projects. The EIA summary reports (Port of Rotterdam, 2007a and b) of the Maasvlakte 2 project in the Netherlands for example identified various impacts of this project on marine species and habitats including the permanent loss of protected habitats, significant negative effects on the common tern and black duck, changes in coastal currents, increased noise and reduced air quality (increased NO_2, SO_2 and PM10 concentrations) during the construction phase as well as adverse effects on benthos organisms and habitats from sand extraction, elevated fine silt concentrations. The reclaimed land will also reduce coastal fishing grounds, mainly for local fishermen.

More efforts are needed to monitor and assess the effects on the marine ecosystems

Whereas the present regulatory system seems to be adequate to reduce negative impacts on the marine environment, further information is needed for the assessment of the actual impacts of land reclamation activities in the OSPAR Maritime Area particularly on the effects on species, habitats and ecosystem services and the effectiveness of existing actions and measures. EIAs and monitoring studies provide a valuable source of information on the effects of land reclamation projects. The results should be analysed and made available to the public.

In conclusion, the OSPAR Commission should assess and analyse the effects of land reclamation activities on the marine environment, exchange and assess information from EIAs, monitoring programmes and measured environmental impacts, and use the Maasvlakte 2 project as an international test case to acquire knowledge on the environmental impacts of large scale land reclamation projects.

Récapitulatif

La conquête des terres sur la mer s'effectue grâce à l'assèchement des mers, et ce – entre autres - à des fins agricoles ou industrielles ou pour l'agrandissement des ports. L'exemple le plus connu historiquement d'assèchement des mers dans la zone maritime OSPAR est la région des polders aux Pays-Bas. De nos jours, l'assèchement des mers a pour but principal d'agrandir les zones portuaires et les zones industrielles et logistiques correspondantes. Dans l'ensemble, les réglementations nationales des Parties contractantes OSPAR, et notamment la législation de l'UE, encadrent suffisamment ce type d'activité ; cependant les effets environnementaux sur les espèces, les habitats et les fonctionnements de l'écosystème étant encore mal connus, une surveillance et une évaluation plus poussées seront nécessaires.

Les activités de récupération des terres sur la mer sont souvent étroitement liées aux projets de défense côtière ainsi qu'à l'extraction du sable et du gravier. OSPAR évalue également les impacts environnementaux de ces activités (voir OSPAR 2008/2009b et c).

La zone maritime OSPAR ne comporte qu'un nombre limité de sites de récupération des terres sur la mer mais des projets individuels peuvent avoir des effets préjudiciables

Il n'existe qu'un nombre limité de sites de récupération des terres sur la mer dans la zone maritime OSPAR et la majorité sont relativement à petite échelle. Le nombre ou la taille des projets de récupération ne présentent pas de tendances claires. La plupart des sites et ceux de plus grande envergure se trouvent dans la Région II OSPAR (mer du Nord au sens large). Ils peuvent avoir des effets préjudiciables sur le milieu marin, au niveau local ou régional. Vu l'accroissement du commerce et de la navigation dans le monde, il est à supposer que la nécessité de récupérer des terres sur la mer pour des projets d'agrandissement de ports persistera à l'avenir,

La récupération des terres sur la mer peut avoir des effets préjudiciables sur le milieu marin. Généralement le long des côtes, ces activités affectent surtout les habitats marins côtiers et près des côtes, par exemple les bancs de sable, les estuaires, les vasières, les marais salés et les habitats halophytiques, ainsi que les espèces présentes dans ces habitats, dont le phoque gris, le sterne et la macreuse noire. L'assèchement des mers équivaut à la disparition permanente d'habitats marins. Il risque également d'affecter les types d'habitats d'origine côtière et terrestre, tels que les dunes de sable ou les plans d'eau douce. Certains impacts des activités de récupération des terres sur la mer sont comparables à ceux de l'élimination des matériaux de dragage en mer : turbidité accrue, modification des habitats benthiques et de la structure des sédiments par exemple (OSPAR 2008/2009a).

Les impacts des activités de récupération des terres sur la mer sont couverts de manière adéquate par les règlementations nationales des Parties contractantes OSPAR

OSPAR n'a développé aucune mesure spécifique sur la récupération des terres sur la mer en dehors de la présente évaluation de cette activité. Les connaissances actuelles des effets des activités de récupération des terres sur la mer sur l'environnement sont très limitées et il est donc difficile de juger si les règlementations nationales sont suffisantes.

D'une manière générale, les Parties contractantes d'OSPAR règlementent la récupération des terres sur la mer grâce à des permis délivrés aussi bien par les autorités nationales que régionales. Les réglementations nationales tiennent compte de la minimisation et de la compensation des effets sur l'environnement. Les législations et les règlementations nationales sont appliquées tant lors de la phase de planification que lors de la réalisation des projets de récupération des terres sur la mer (Port de Rotterdam, 2007a). Les législations pertinentes comprennent notamment des lois sur les travaux publiques, des lois environnementales, des lois sur l'aménagement, des lois sur la protection et la conservation de la nature. La législation de l'UE correspondante, telle que la directive concernant l'évaluation des incidences de certains projets publics et privés sur l'environnement, et les directives « Oiseaux » et « Habitats », doit être prise en compte, ainsi que les conventions internationales. Les évaluations de l'impact sur l'environnement (EIE) représentent les instruments les plus courants permettant d'étudier les questions environnementales relatives aux projets de récupération des terres sur la mer.

On peut présumer, pour l'instant, que dans la plupart des cas les règlementations nationales existantes des Parties contractantes d'OSPAR ainsi que la législation de l'UE suffisent à minimiser les effets préjudiciables des activités de récupération des terres sur la mer sur les écosystèmes marins.

La récupération des terres sur la mer peut avoir des impacts négatifs sur les écosystèmes marins

Les effets de la récupération des terres sur la mer dépendent de la taille, des caractéristiques et de la sensibilité de la zone et des techniques utilisées. Les informations disponibles sur les effets réels des activités de récupération des terres sur la mer sur les écosystèmes sont très limitées et il est donc difficile de déterminer comment ces activités affectent l'état de santé général du milieu marin de la zone maritime

OSPAR. Les EIE de projets individuels de récupération des terres sur la mer fournissent des informations précieuses. Les rapports récapitulatifs d'EIE (Port de Rotterdam, 2007a et b) du projet Maasvlakte 2 aux Pays-Bas par exemple identifient divers impacts de ce projet sur les espèces et les habitats marins. Il s'agit notamment de la disparition permanente d'habitats protégés, des effets négatifs significatifs sur la sterne et la macreuse noire, de la modification des courants côtiers, de l'augmentation du bruit et de la réduction de la qualité de l'air (teneurs accrues de NO_2, SO_2 et PM10) lors de la phase de construction. Il s'agit également des effets préjudiciables sur les organismes et habitats benthiques causés par l'extraction du sable et les teneurs accrues de sable fin. Les terres récupérées engendrent également une réduction des sites de pêche côtière, essentiellement pour les pêcheurs locaux.

La surveillance et l'évaluation des effets sur les écosystèmes marins demandent des efforts supplémentaires

Bien que le système actuel de réglementation semble permettre de réduire les impacts négatifs sur le milieu marin, des informations supplémentaires sont nécessaires pour pouvoir évaluer les impacts réels des activités de récupération des terres sur la mer dans la zone maritime OSPAR. Il s'agit en particulier d'informations sur les effets sur les espèces, les habitats et les processus d'écosystème et sur l'efficacité des mesures existantes. Les EIE et les études de surveillance constituent une source précieuse d'informations sur les effets des projets de récupération des terres sur la mer. Il faudrait en analyser et en publier les résultats.

En conclusion, la Commission OSPAR devrait évaluer et analyser les effets sur le milieu marin des activités de réclamation des terres sur la mer. Elle devrait échanger et évaluer les informations provenant des EIE, des programmes de surveillance et des impacts environnementaux mesurés et utiliser le projet Maasvlakte 2 comme étude de cas international pour s'informer des impacts environnementaux des projets de récupération sur les terres à grande échelle.

1. Introduction

This assessment is a contribution to the series of assessments of human activities under the OSPAR Joint Assessment and Monitoring Programme (JAMP) and focuses on the impacts on the marine environment of land reclamation. It has been prepared as a contribution to the Quality Status Report 2010 – the QSR 2010 – which provides a holistic assessment of the OSPAR maritime area and its Regions (see box).

This assessment was developed by the Netherlands through a questionnaire for the collection of information from Contracting Parties on their legislation, experiences and further regulatory needs. Its aim was to consider the extent, intensity, and changes of the activities, and to assess related pressures and impacts. It also provides the basis for deciding whether OSPAR should develop further programmes and measures to control land reclamation activities.

Land reclamation is defined as: the gain of land from the sea or coastal wetlands *e.g.* for agricultural purposes, industrial use and harbour expansions. The most notable historic land reclamation sites in the OSPAR Maritime Area are the polders of the Netherlands. Famous examples outside the OSPAR Maritime Area include the City of Washington (DC), Hong Kong, Singapore and Dubai.

Land reclamation is also closely related to coastal defence projects and to the extraction of sand and gravel and other ancillary human activities. The environmental impacts of these activities are covered by other OSPAR assessments which also contribute to the Quality Status Report 2010 (see box).

Electronic navigator to complementary QSR assessments

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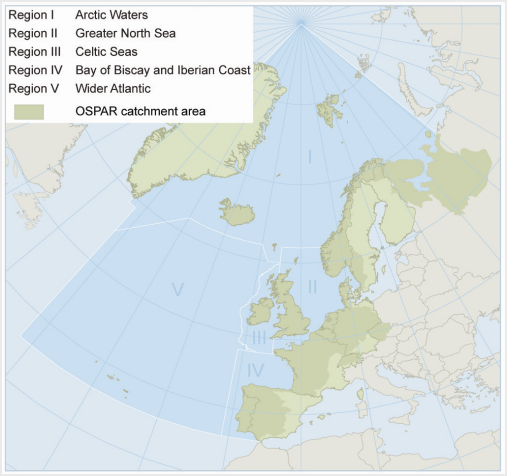
- ➥ Extraction of sand and gravel (OSPAR 2008/2009c)
- ➥ Dredging for navigational purposes (OSPAR 2008)
- ➥ Dumping of wastes at sea (OSPAR 2008/2009a)



Map: OSPAR maritime area and its five Regions.

2. What are the problems?

Land reclamation can have adverse effects on the marine environment. It mainly influences coastal and near-shore habitats and species. Most land is reclaimed in OSPAR Region II (Greater North Sea). There are no clear trends with regard to numbers or sizes of land reclamation projects in the OSPAR Maritime Area. Today land reclamation mainly takes place for port expansions and associated industrial developments. With regard to the growth in world trade and shipping activities it can be assumed that also in future there will be a continued need for land reclamation projects for port development projects.

2.1 Extent and trends in land reclamation activities

The majority of the land reclamation projects in the OSPAR maritime area are relatively small scale. There are great differences in the number and the sizes of land reclamation projects in the different OSPAR Contracting Parties[1].

The United Kingdom (England, Wales and Scotland) is the OSPAR Contracting Party with most land reclamation sites; there are 26 in total, which vary from small to medium scale (see Table 2.1 and Figure 2.1). The surface area and quantity of used construction materials vary from small to medium scale land reclamation activities. The United Kingdom has planned some small to medium scale land reclamation activities in Scotland for the near future. The surface area of these new sites is estimated to be 4 – 12 ha.

[1] An overview of the extent in terms of surface area and quantity of construction materials, and duration of land reclamation projects in the OSPAR Contracting Parties, is presented in Annex 1. An overview of the extent of planned land reclamation sites (after 2007) is presented in Annex 2.

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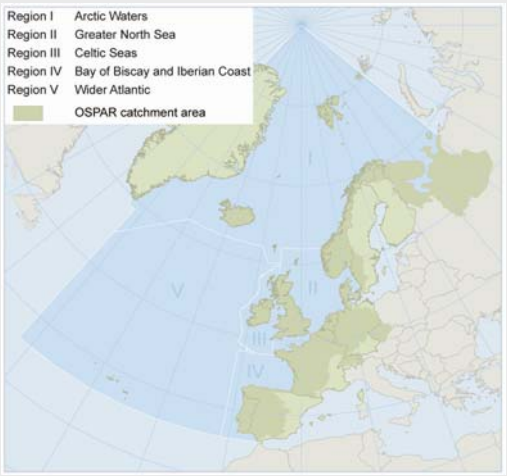

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The United Kingdom (England, Wales and Scotland) is the OSPAR Contracting Party with most land reclamation sites; there are 26 in total, which vary from small to medium scale (see Table 2.1 and Figure 2.1). The surface area and quantity of used construction materials vary from small to medium scale land reclamation activities. The United Kingdom has planned some small to medium scale land reclamation activities in Scotland for the near future. The surface area of these new sites is estimated to be 4 – 12 ha.

[1] An overview of the extent in terms of surface area and quantity of construction materials, and duration of land reclamation projects in the OSPAR Contracting Parties, is presented in Annex 1. An overview of the extent of planned land reclamation sites (after 2007) is presented in Annex 2.

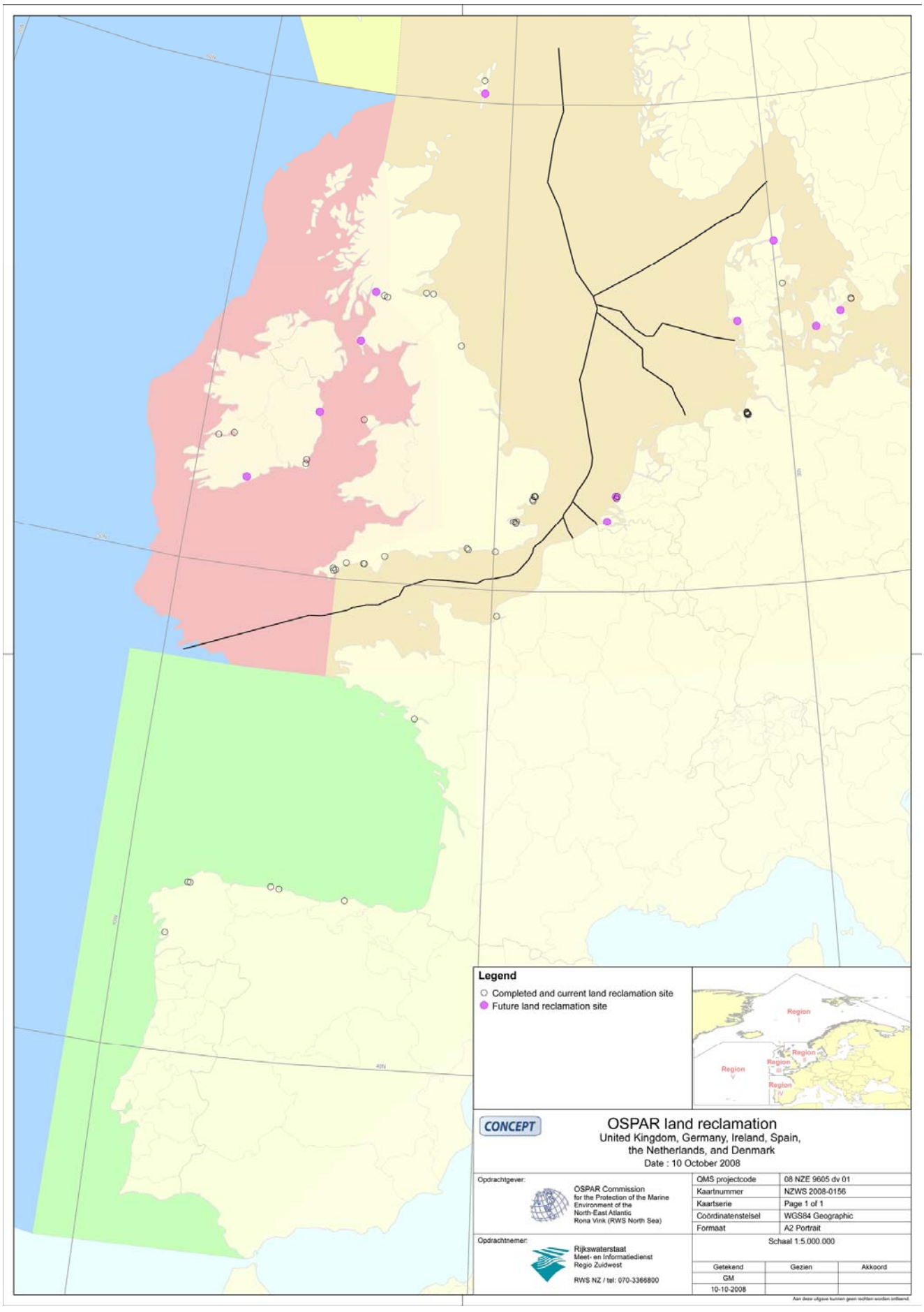

Figure 2.1 Overview of land reclamation sites in the OSPAR Maritime Area.

The Netherlands has the largest land reclamation sites, both completed and planned, in terms of surface area and quantity of used construction materials. In 1970 the Maasvlakte site was developed as an extension of the harbour of Rotterdam. It is the largest land reclamation project in the OSPAR maritime area to date with a surface area of 2000 ha and 170 million m^3 of construction materials that were used during the development. By 2033 the Maasvlakte will be extended by another 2000 ha of reclaimed land (Maasvlakte 2). The EIA for the Maasvlakte 2 project provides valuable information on environmental effects of land reclamation projects and was selected as a case study for this assessment (see Textbox 1 and Annex 3).

Germany (Bremen) reclaimed land at seven sites in Bremerhaven (Table 2.1). All seven sites were small scale. The surface area of these land reclamation sites is ≤ 1 ha. No land reclamation projects are foreseen in the near future by Germany (Table 2.1).

Table 2.1 The number of land reclamation sites and the extent of the sites in the OSPAR maritime area by Contracting Party and OSPAR Region for the period 1845 – 2007 as well as planned sites after 2007.

Contracting Party	OSPAR Region	Land reclaimed 1845 – 2007		Planned land reclamation after 2007	
		No. Sites	Surface Area	No. Sites	Surface Area
Norway	I-II	-	-	-	-
The Netherlands	II	2	1860 ha	2	2141 ha
Germany	II	7	1941 ha	-	-
Denmark	II	3	125 ha	4	NI
France	II	2	NI	-	-
Sweden	II	-	-	-	-
UK	II	22	9 ha	1	4 ha
UK	III	4	9 ha	2	17 ha
Ireland	III	4	8375 ha	2	50 ha
Spain	IV	6	NI	-	-

Spain reclaimed land at six sites (Table 2.1). The quantity of used construction materials varied from 12 565 to 4 250 547 tonnes of dry sediment. There is no information available on land reclamation projects in the near future in Spain (Table 2.1).

Ireland reclaimed land at four sites (Table 2.1). Land reclamation and improvement of land below the high water mark took place between the 1850s and the 1970s. The surface area of the reclaimed land varies from 925 ha to 6500 ha, which can be considered as large scale. Two proposals for future land reclamation projects were being considered in Ireland. The surface area of each of these new sites is estimated to be 25 ha.

Denmark reclaimed land at three sites, mostly medium scale (Table 2.1). The surface area of the reclaimed land varies from 35 to 55 ha. Denmark has planned some small to medium scale land reclamation activities for the near future. Detailed information is not available.

In Sweden there were no land reclamation projects along the Kattegat and Skagerrak coast.

In France land reclamation is almost limited to the management of harbours, recreational and mainly transport purposes. The two most important recent projects are the Nantes-Saint-Nazaire harbour in the estuary of the river Loire and Le Havre (Port 2000) in the estuary of the river Seine. Detailed information on the effects of these harbour projects is not yet available.

Approximately 71% of all land reclamation sites are located in OSPAR Region II (Greater North Sea) (Table 2.1). Other land reclamation sites are located in Region III (Celtic Seas) (approximately 17%) and in Region IV (Bay of Biscay and Iberian Coast) (approximately 12%). No land reclamation has been carried out in Region I (Arctic Waters) and in Region V (Wider Atlantic). After 2007 approximately 64% of the planned land reclamation sites are located in Region II (Greater North Sea) and approximately 34% in Region III (Celtic Seas). In the other three OSPAR Regions no land reclamation activities are foreseen in the near future. There are no clear trends in the number or extent of land reclamation activities (Figure 2.2 and 2.3). The total number of land reclamation sites increased from 0 to 2 sites per year in the period 1850 – 2000, to four to ten sites per year in the period 2002 – 2005 (Figure 2.2). The total number decreased again after 2005 (Figure 2.2).

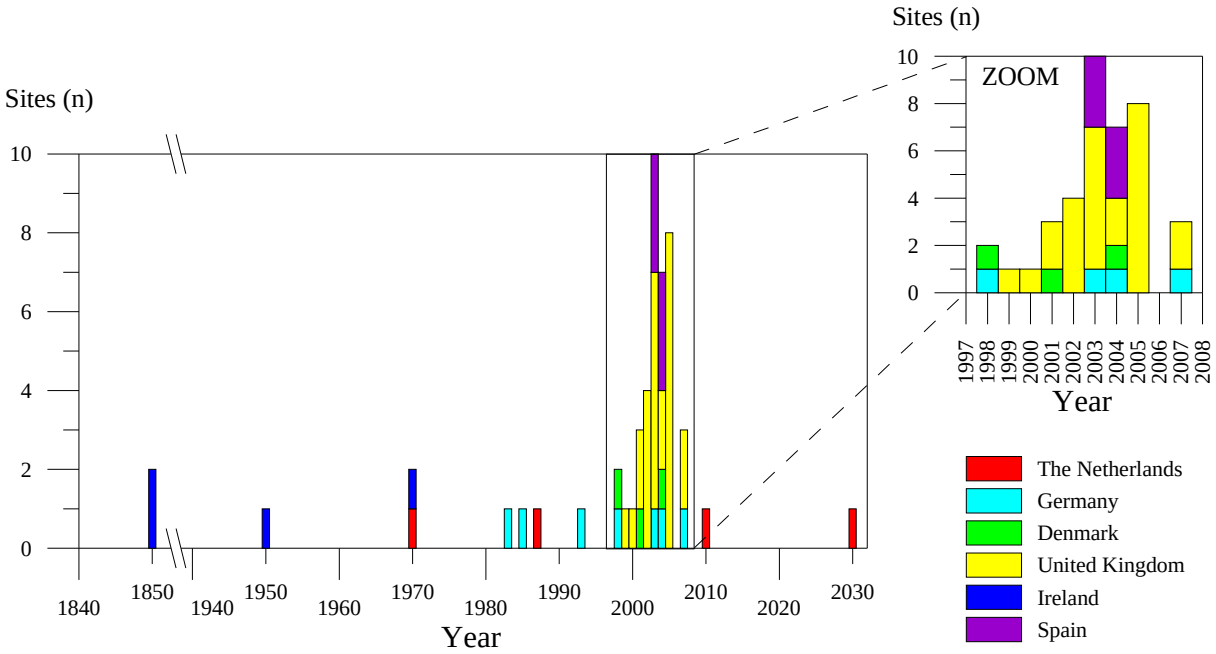

Figure 2.2 Number of land reclamation sites per Contracting Party by year of finalisation of the construction work

The extent of the land reclamation activities reported by Ireland and the Netherlands completely overshadows the extent of land reclamation activities of the other OSPAR Contracting Parties (Figure 2.3). In the case of Ireland, all reported reclamation activities took place prior to the 1980s and included land reclaimed or improved that had previously been below the high water mark**.** There is no indication that the extent of land reclamation activities per Contracting Party is increasing with time. The extent is largely determined by separate and independent land reclamation projects. The number of land reclamation activities was the highest in 2002 – 2005 (Figure 2.2), however, the total extent of the land reclamation projects in this period was relatively small (Figure 2.3).

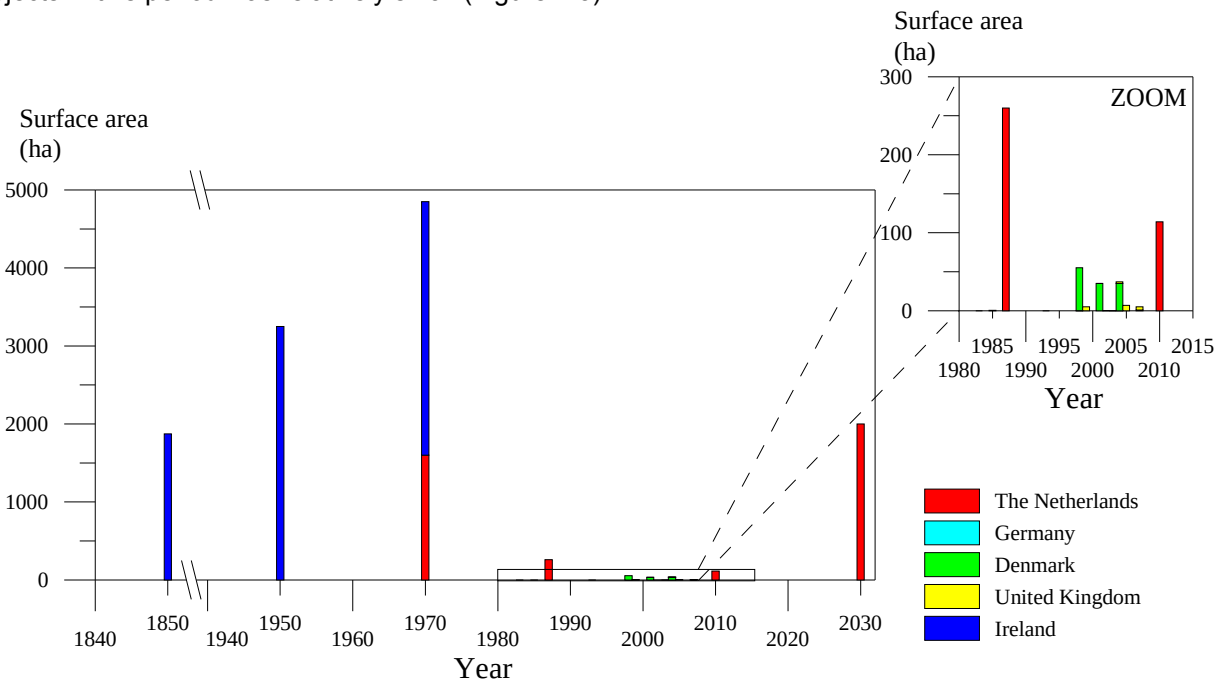

Figure 2.3 Size of the surface area of the land reclamation sites per Contracting Party by year of finalisation of the construction work.

There are also no clear trends in the number (Figure 2.4) and the extent of the land reclamation projects per OSPAR region (Figure 2.5). The number of land reclamation sites is the largest in Region II (Greater North Sea). In this OSPAR Region the number of land reclamation sites increased from 0 to 2 sites per year in the period 1850 – 2000, to three to eight sites per year in the period 2002 – 2005 (Figure 2.4). The number

decreased again after 2005. The number of land reclamation sites per year in the other OSPAR Regions varied from 0 to 3 (Figure 2.4). There are no indications for a trend of increasing land reclamation activities with time.

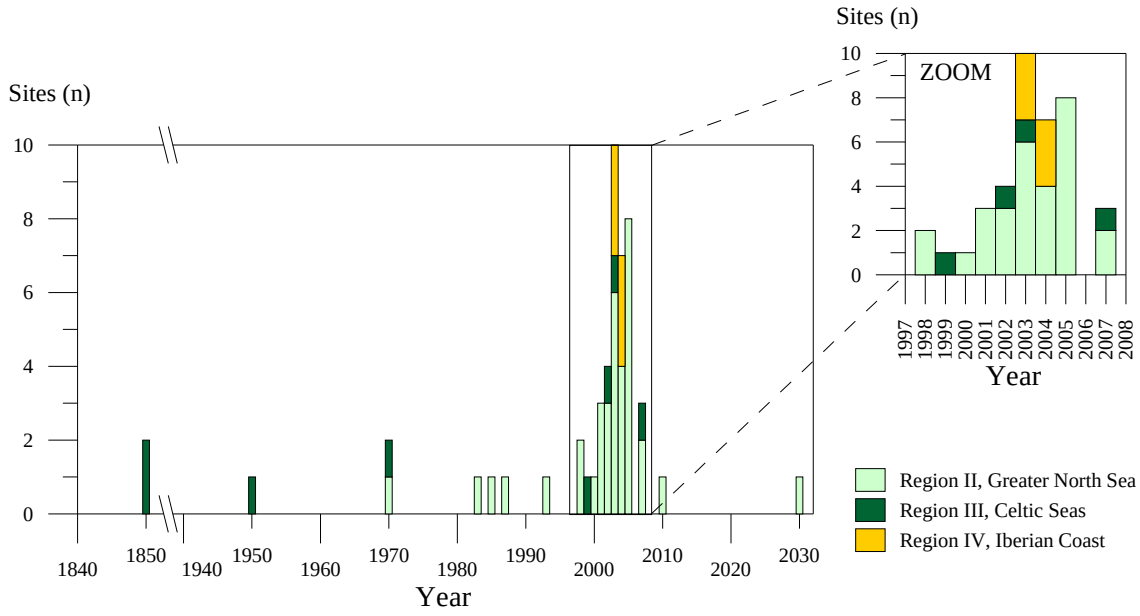

Figure 2.4 Number of land reclamation sites per OSPAR region by year of finalization of the construction work.

The extent of the land reclamation activities strongly depends on the designated use of the reclaimed land. Information on the extent of land reclamation activities is only available for Region II (Greater North Sea) and Region III (Celtic Seas). Land reclamation activities with the largest surface area took place in Region III (Celtic Seas) and in Region II (Greater North Sea) in the period until 1970 (Figure 2.5). The extent of the land reclamation activities in the period 1970 – 2007 is relatively small (Figure 2.5). In this period the largest land reclamation activities were conducted in Region II (Greater North Sea). A large future land reclamation project (Maasvlakte 2) is planned in Region II (Greater North Sea. However, there is no indication for a trend that the extent of land reclamation activities will increase with time.

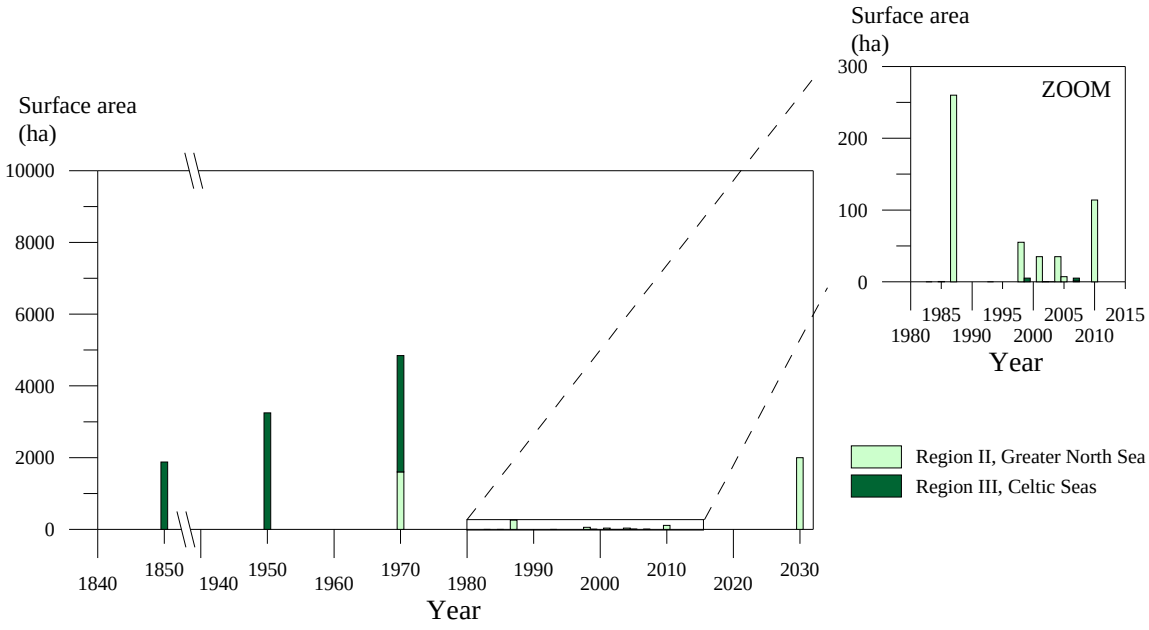

Figure 2.5 Size of the surface area (ha) of the land reclamation sites per OSPAR Region by year of finalization of the construction work.

2.2 Pressures and impacts of land reclamation activities

Land reclamation can have adverse effects on the marine environment. As this activity normally takes place along the coast it mainly influences coastal and near shore marine habitats, *e.g.* sandbanks, estuaries, mudflats, salt marshes and halophytic habitats, as well as species occurring in these habitats, *e.g.* grey seals, terns and black sea ducks. Marine habitats are permanently lost where land is reclaimed from the sea. Land reclamation may also influence habitat types of coastal and terrestrial origin such as sand dunes or freshwater bodies. Since marine sand is usually used as construction material large scale land reclamation, the impacts of sand extraction also have to be considered with regard to the overall impacts (OSPAR 2008/2009c).[2]

Knowledge on the overall pressures and impacts of land reclamation activities on marine ecosystems in the OSPAR Maritime Area is still very limited and no comprehensive reports are available on the environmental effects of land reclamations projects. Today most land reclamation projects are carried out for port expansions and associated industrial developments.

A review of literature, including grey literature, provided some specific information on pressures and impacts of land reclamation activities in some Contracting Parties:

In the United Kingdom land reclamation on estuaries and coasts has been carried out at least since Roman times (Davidson *et al*., 1991). Initial phases of reclamation sought to enclose salt marshes and mudflats with earthen banks for agricultural purposes (King, 1951). These works have been extensive and progressive in the United Kingdom throughout the centuries accounting for much of the estuarine habitat loss (Healy and Hickey, 2002). Of the 155 estuaries in the United Kingdom, 136 (88%) have lost habitats due to land reclamation for agricultural purposes (Flemming and Nyandwi, 1994);

In Ireland, since the 10th and 11th century, approximately 6500 ha of the Shannon estuary lowlands were reclaimed or enclosed for agriculture and other purposes (Flemming and Nyandwi, 1994). Reclamation has significantly altered the morphometrics of the inner estuary by constricting the estuarine water body within its current artificial embankments. The use of embankments and revetments as flood protection devices has significantly reduced the dissipative and water storage capacity of the adjoining low-lying areas which were once tidal wetlands. This has led to the modification of the physical environment and its hydrodynamics, as well as to an alteration in the character of the wetland habitat in the estuary environments. There is a high certainty that sedimentary and morphodynamic processes in the estuary changed as a result, including changes in water and sediment circulation, transport patterns and changes in the tidal prism, with associated alterations in ecology, hydrology and relative sea-level. The precise nature and the impact of these environmental changes are as yet unknown and substantial additional research is still required in these areas (Flemming and Nyandwi, 1994);

Flemming and Nyandwi, 1994 evaluated grain-size distribution patterns along the East Frisian Coast, Germany (in the Wadden Sea), with the aim of identifying potential effects of man-made structures. Land reclamation and dyke construction along the mainland coast resulted in a steeper than normal energy gradient along the shoreward margin of the Wadden Sea. This resulted in a decrease in fine sediment deposition and consequently in a dramatic reduction of mud flats. Since many faunal assemblages are grain-size specific, it can be assumed that the backbarrier ecosystems must have undergone significant modifications as a result of the substantial reduction in mudflats since the onset of land reclamation and dyke construction (Guo and Jiao, 2007);

Land reclamation in coastal areas may have a significant effect on local ground water systems as well (Guo and Jiao, 2007). Following reclamations water tables rise and the salt water – fresh water interface moves seaward. An unintended advantage is an increase in fresh ground water resources because the reclaimed land can be an additional aquifer and rain recharge takes place over a larger area.

It can be assumed that the impacts of land reclamation activities might have parallels to the impacts of disposal of dredged sediment. In both cases materials are deposited on the seabed. The environmental impacts due to the disposal of dredged sediment are assessed in OSPAR, 2008a and OSPAR, 2008/2009a. The environmental impacts of the dredging activity are assessed in OSPAR, 2008b.

Impacts of disposal of dredged sediments that are relevant to land reclamation activities include:

- possible chemical disturbances. However, sediment may only be disposed of at sea when the sediment composition meets the sediment quality criteria for disposal. The chemical impact of this sediment is considered to be zero or acceptably low, therefore in most studies the chemical

[2] The environmental impacts of sand and gravel extraction are assessed in OSPAR, 2008/2009c.

impact of disposal of dredged sediment is not determined. In general, land reclamation projects use large amounts of sand extracted at sea and therefore chemical effects are not expected;

- habitat alterations due to a change in sediment structure (*i.e*. grain-size). Complexity and community structures would change due to the deposition of fine grained sediment on coarser grained natural sediment (and possibly *vice versa*);
- burial and smothering of the benthic community caused by enhanced sedimentation due to the disposal of sediment;
- local and temporal resuspension of sediments, causing increased turbidity. High turbidity results in low levels of transmitted light and can negatively affect the functioning of light-dependent organisms such as phytoplankton, eelgrass and visual predators, *e.g*. fish and fish-eating birds (Essink, 1999). Increased turbidity can be both caused by natural processes such as storm events and tides, and human activities, *e.g*. the disposal of dredged sediment at sea;
- possible increase in suspended particulate matter concentrations as large amounts of sediments are brought into suspension. This can cause a regression of sea grass meadows;
- an impact on macrozoobenthos in an area extending about two kilometres from the official disposal site;

The extent of the above mentioned effects are site specific, weather dependent and influenced by the disposal method.

3. What has been done? Did it work?

Knowledge on the environmental effects of land reclamation activities is very limited at present and it is difficult to assess whether national regulations in place are sufficient.

No specific actions on land reclamation have been developed by OSPAR apart from the evaluation of the activity through this assessment but some OSPAR measures have an influence on this activity:

- 2003 OSPAR Biological Diversity and Ecosystems Strategy, agreement 2003/21
- Revised OSPAR Guidelines for the Management of Dredged Material, agreement 2004/08
- Agreement on Sand and Gravel Extraction, agreement 2003/15

In general, OSPAR Contracting Parties regulate land reclamation through permits from both national and regional authorities. Minimisation and compensation of environmental effects are taken into account through national regulations. National environmental laws and regulations are implemented both during the planning phase and the realisation of land reclamation activities (Port of Rotterdam, 2007a). Relevant legislation includes public works acts, environmental acts, planning acts, nature protection and conservation acts. Relevant EU legislation, such as the EIA, Birds and Habitats Directives, and international conventions also have to be considered in land reclamation projects.

Most Contracting Parties don't have specific national policies on land reclamation (Port of Rotterdam, 2007a). Only the United Kingdom (in Scotland) has a local policy for land reclamation. The main aim of this policy is to minimise the loss of habitats, the impacts on water quality and on natural heritage and interferences with other legitimate uses.

The authorities of OSPAR Contracting Parties that are responsible for land reclamation activities often belong to different national administrations or institutions (Port of Rotterdam, 2007a), *e.g.* ministries and agencies of public works, environment and nature (often united in the same ministry or department), agencies of marine and coastal area or local planning authorities (*e.g*. port authorities and local planning departments).

Environmental Impact Assessments (EIAs) are the most common instruments for Contracting Parties to assess environmental issues with regard to land reclamation projects. The factors that determine whether an EIA is mandatory are different within the Contracting Parties as they include *e.g*. location, scale, size, sensitivity of the area.

EIAs normally consider issues such as impacts on species and habitats, other human uses (*e.g*. fisheries, navigation, recreation, cable and pipeline laying), international and national marine protected areas, water quality and coastal processes (sediment transport, erosion, sedimentation, hydrodynamics). The results of an EIA may affect *inter alia* the design/shape of the land reclamation, the public consultations and the permit

conditions. Within the OSPAR maritime area, before consent is given to a land reclamation project, a public consultation takes place through either a public inquiry, a hearing or informal meetings.

Based on the outcome of the EIA, mitigation and compensation measures can be imposed within the OSPAR maritime area. Examples of mitigation and compensation measures include (Port of Rotterdam, 2007a):

- silt curtains to reduce turbidity;
- creation of new salt marshes (by salt marsh enhancement techniques);
- timing restrictions/phase of construction;
- habitat creation or enhancement;
- restricted corridors of working.

When land reclamation is approved, environmental monitoring is obligatory in most cases. Generally, monitoring requirements stem from the EIA process and include parameters such as (Port of Rotterdam, 2007a):

- water quality;
- biological effects;
- biological diversity;
- sediments, *e.g*. composition, particle size;
- hydrodynamics, *e.g*. waves, tides;
- sedimentary environment, sediment transport pathways, sediment resuspension/turbidity and sediment deposition;
- bathymetry;
- benthic ecology;
- fish ecology;
- commercial fisheries & shellfisheries;
- marine mammals;
- birds and habitats.

In Spain it is common to monitor turbidity and also, in some cases, unexpectedly high dispersion of fine sediments. This information is normally part of monitoring reports.

Generally, enforcement authorities or agencies inspect the construction activities related to land reclamation to ensure the implementation of the permit or licence conditions. Enforcement usually entails confirmation that the work is progressing according to the stated working method and that the materials used are as listed in the licence.

4. How does this field affect the overall quality status?

There is only very limited information available on the effects of land reclamation activities on ecosystems in the OSPAR Maritime Area. It is, therefore, difficult to determine how land reclamation affects the overall quality status of the marine environment. However, some valuable information is available from the Environmental Impact Assessments (EIA) of individual land reclamation projects.

Most Contracting Parties performed EIAs and monitoring studies to assess the impact of land reclamation projects on the environment (Hoogduyn, 2006). However, the results of these studies are mostly not published in peer-reviewed journals or the internet. For this assessment only the EIA for the Maasvlakte 2 project in the Netherlands (see Textbox 1 and Annexes 3 and 4) was available (Port of Rotterdam, 2007a and b). The Maasvlakte 2 EIA comprises EIA summary reports on the construction phase and the operational phase.

The summary of the EIA on the construction phase concluded the following (Port of Rotterdam, 2007a):

- Sand extraction and construction work for land reclamation will cause disturbance because of noise, both below and above water, and the use of equipment, which may frighten off shy species. This disturbance may temporarily cause them to avoid the area in the immediate

vicinity of the source of disturbance. However, many protected species have a large action radius, and there are ample alternative locations in the surrounding area. Therefore, the temporary effect on the living and foraging area of protected species, including birds, mammals and fish, will be slight. Permanent effects will not occur;

- A local and temporary effect of sand extraction will be the impairment of seabed life. With an extraction depth up to 20 m below the seabed, the area effect is limited and there will be no constraints for re-colonization. Recovery is likely to take place in two to four years;
- At an extraction speed not exceeding 150 million m^3 per year, the fine silt concentration (suspended matter concentration) in the land reclamation area will for a few years be higher than the normal annual average concentration. The fine silt will spread with the tidal current both to the south and north and will join the fine silt that is naturally present. In the Voordelta area the concentration of fine silt will increase. The natural variation in fine silt concentration is exceptionally large anyway: after severe storms in the winter, the water is far cloudier than during a slightly longer period with very calm weather in summer, because of the fine silt swirled up from the seabed. Typical values for the annual average fine silt concentration in the Voordelta area are 20 – 30 mg/l near the coast and 5 – 10 mg/l farther out to sea. The increase in the annual average fine silt concentration in the Voordelta area caused by sand extraction will reach approximately 6 mg/l at the most in 2010. During stormy periods the fine silt concentration will rise to 100 mg/l. This increase will not have an adverse impact on the protected habitat types such as seabed, flats and salt marshes;
- Fuel consumption by equipment used for the construction of Maasvlakte 2 will affect air quality. Model calculation shows that annual average concentrations of NO_2, SO_2 and PM10[3] will increase by 8.0%, 20.5% and 0.45% respectively. However, the air quality standards will not be exceeded;
- The reclaimed land will take up a small area where fishing currently takes place. This concerns mainly fishing by means of smaller vessels, such as cutters. During the extraction of sand there will be fishing at the location of the sand extraction pits.

After the completion of the EIA concerning the construction of Maasvlakte 2, new geological data from field studies became available on the amounts of fine silt in the area of sand extraction pits. New calculations on the effects of sand extraction showed a lower impact on bird species than assumed earlier.

The summary of the EIA on the operational phase of Maasvlakte 2 concluded the following (Port of Rotterdam, 2007b):

- Loss of acreage of protected habitat type[4]: “Sandbanks slightly covered by sea water all the time”, with the seabed at a depth of NAP[5] 0 to -20 m. The reclaimed land will take up approximately 2000 ha; the size of the part of the erosion pit below NAP[5] -20 m will have increased after 10 years to approximately 470 ha. In total, almost 2500 ha of this habitat type[4] acreage will be lost. This represents a reduction of 2.8% of the total acreage of this habitat type in the Voordelta;
- Loss of potential forage area of the Black Sea duck (in winter). The maximum potential effect for the Black Sea duck is that 3.1% of the potential foraging area will be lost (in winter). This is due mainly to the presence of the reclaimed land. This is a significant effect: although sea ducks are certainly not present in large numbers in the Voordelta every year, if it does occur it will be because they really need the Voordelta in the winter concerned as a foraging area. In such a situation there will be no fallback alternatives;
- Reduction of the living and foraging area of the common tern and sandwich tern. The size of the population in the Voordelta will decrease by at most 5.9% (common tern) and 3.7% (sandwich tern) in relation to the average population size in recent years. This is a permanent effect, so it is considered “significant”;
- The presence of reclaimed land will change the current near and farther away from Maasvlakte 2. This will have minor consequences for the carrying of fine silt along the coast. Along the Dutch coast the fine silt concentrations will decrease, while slightly farther out to sea

[3] PM10: Particules with an aerodynamic diameter of less than or equal to 10 micrometers.

[4] Habitat type 1110 – Sandbanks slightly covered by sea water all the time (Habitats Directive)

[5] Amsterdam Levelling Reference, Normal Amsterdam Level (NAP)

they will increase. A change in sediment structure can result in a change in the community structure of the benthos.

The use of Maasvlakte 2 will also have negative effects on the surface water quality (Port of Rotterdam, 2007a, b). This is mainly attributed to an increase in shipping activities and to a possible increase in water temperature. Many ship hulls are treated with antifoulings that contain organotin. Although the use of organotin has been banned in the European Union since 2003, there is not yet a worldwide ban. The increase in the number of ships that will visit the area will also have an impact on safety measures to be taken to prevent accidents as they can result in leakage of fuels and stored chemicals. The water temperature may increase slightly, less than 3°C, due to discharges of cooling water by power stations and chemical companies at Maasvlakte 2. Nevertheless, no ecological problems are expected. The use of Maasvlakte 2 will have a minor contribution to the air quality in the Rijnmond region, where Maasvlakte 2 is situated.

The comparison of land reclamation with the dumping of dredged material might give an indication of the relative importance and the overall impact of land reclamation. The total amount of material that is deposited in land reclamation seems to be relatively low compared to the amount deposited through the dumping of dredged material (see Table 4.1). This might indicate that the overall impact of land reclamation is lower than that of dumping of dredged material. However, in contrast to the dumping of dredged material, land reclamation leads to a permanent loss of habitats. In addition, land reclamation activities last longer than dumping activities, *e.g.* the construction of Maasvlakte 2 will last over twenty years. Also the disturbance by noise as well as increased turbidity and the suspended particulate matters are likely to be more severe and for longer periods.

Table 4.1 Comparison of dumping of wastes (tonnes dry weight) and land reclamation (tonnes) in 2003 and 2004 by the Contracting Parties in the OSPAR maritime area. Source: (OSPAR, 2005) (OSPAR, 2006)

Contracting Party	**2003**		**2004**	
	Dumping of Waste (tonnes dry weight)	**Land Reclamation (tonnes)[1]**	**Dumping of Waste (tonnes dry weight)**	**Land Reclamation (tonnes)[1]**
Belgium	24 805 920	*NI*	22 029 402	*NI*
Denmark	2 687 568	0	4 656 310	0
France	*NI*	*NI*	37 383 837	*NI*
Germany	7 790 000	0	9 724 000	0
Iceland	0	*NI*	566 617	*NI*
Ireland	694 292	0	763 282	0
The Netherlands	7 719 286	0	11 336 603	0
Norway	1 140 127	0	1 933 688	0
Portugal	707 850	*NI*	907 232	*NI*
Sweden	375 605	0	2 752 400	0
Spain	1 290 608	4 761 634	4 902 990	139 485
United Kingdom	17 522 159	421 800	15 770 462	36 000
Total	**64 733 415**	**5 183 434**	**112 726 823**	**175 485**

NI = No information

Textbox: 1

Maasvlakte 2

Maasvlakte 2, is a new Dutch port and industrial zone that will be built right on the North Sea (Port of Rotterdam, 2007a, and b). For the construction of Maasvlakte 2 about 2000 ha of land will be reclaimed from the sea. Maasvlakte 2 will provide harbour areas for companies requiring much space and access to deep water sea lanes such as companies involved in large scale container storage and transhipment, logistics and chemical industry. The objective is to start reclaiming land in 2008, to open the first port sites in 2013 and to be fully operational in 2033.

In The Netherlands, large scale projects like Maasvlakte 2, must have an Environmental Impact Assessment (EIA) conducted in advance. This sets out the implications of a plan for the environment and the vicinity and possible alternatives, and forms the basis for the permission of an application. For the Maasvlakte 2 project, two EIAs were carried out: Construction of Maasvlakte 2 (Port of Rotterdam, 2007a) and Use of Maasvlakte 2 (Port of Rotterdam, 2007b). The EIAs contain the information that decision-making authorities need to be able to consider environmental interests that need to be addressed in the decision making process.

Summaries of the EIAs (in English) are available at www.maasvlakte2.com. The most important conclusions of the EIAs are:

- The plan and lay-out of Maasvlakte 2 have gradually been optimised and additional measures have been chosen in a way that is designed to minimise the environmental impact as far as possible.
- The water quality in the docks will still fail to meet the standard for the substance organotin.
- The target value for the maximum increase in water temperature in the docks will be slightly exceeded, because existing companies on the present Maasvlakte will no longer be able to discharge their water directly into the North Sea.
- The creation of a marine reserve will provide compensation for lost habitats.
- There are considerable uncertainties in the longer term. An extensive monitoring programme must show to what extent additional measures will be necessary in due course.
- Maasvlakte 2 will be a leading sustainable industrial site capable of responding flexibly to market demand.

The best available methods and techniques were used to identify possible effects. In particular for the effects on the coast and sea and on nature, various workshops were held to check the results of the EIA study. When model calculations identified uncertainties in the predicted effects, either the maximum effect (worst case) or the expected value defined with explicit statement of the uncertainties was taken as baseline.

The actual effects of the construction and the operation of Maasvlakte 2 will be studied in an extensive monitoring and evaluation programme during and after the construction phase. This monitoring will be conducted mainly in the framework of already existing programmes and partly in sub-studies specifically focused on Maasvlakte 2. The monitoring and evaluation programme will be aimed at revealing causal relations between the construction of Maasvlakte 2 and changes in the ecosystem. To reveal these causal relations, the monitoring and evaluation programme started in 2004 with baseline studies. The aim of the baseline studies is to determine the current quality status of the Maasvlakte 2 area.

Figure4.1: Artist's impression of Maasvlakte 2 and Maasvlakte 1 in the background (Source: Port of Rotterdam, 2007a)

5. What do we do next?

Land reclamation can have adverse effects on the marine environment but the available information and the nature of the activity indicate that the existing national and EU environmental regulations and legislation applicable to land reclamation are sufficient. OSPAR Contracting Parties have implemented appropriate mechanisms to control land reclamation projects providing mechanisms for the protection of the marine environment as well as for mitigation and compensation. However, the actual adverse effects of land reclamation activities on marine ecosystems in the OSPAR Maritime Area are not yet sufficiently studied and data from most EIA are not accessible. It is therefore very difficult to assess whether the measures taken by OSPAR Contracting Parties are sufficient to protect species, habitats and ecosystem processes from adverse effects.

More information is needed on the actual impacts on species, habitats and ecosystem services and the effectiveness of existing actions and measures. The results of EIA and of monitoring studies provide a valuable source of information on the effects of land reclamation projects and the results from all Contracting Parties should be analysed. The EIA reports on the construction and zoning phases of Maasvlakte 2 in the Netherlands provide a test case to acquire knowledge on the environmental impacts of large scale land reclamation projects.

In conclusion, the following priority actions for OSPAR are recommended:

- to assess and analyse expected and observed effects of land reclamation activities on the marine environment, based on EIAs from Contracting Parties and on monitoring and research reports;
- to exchange and assess information on a case-by-case basis of EIAs, monitoring programmes, and measured environmental impacts;
- to use the Maasvlakte 2 project as an international test case to acquire knowledge on the environmental impacts of large scale land reclamation projects.

References [6]

Davidson, N.C., Laffoley, D.d'A., Doody, J.P., Way, L.S., Gordon, J., Key, R., Drake, C.M., Pienkowski, M.W., Mitchell, R. and Duff, K.L., 1991. Nature Conservation and estuaries in Great Britain. Peterborough, UK: Nature Conservation Council, 422pp.

EIA Directive. Council Directive 97/11/EC of 3 March 1997 amending Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment (OJ L 73, 14.3.1997, p. 5–15)

Essink, K., 1999. Ecological effects of dumping of dredged sediments: options for management. Journal of Coastal Conservation, Volume 5, No.1, 69-80pp.

Flemming, B.W. and Nyandwi, N., 1994. Land reclamation as a cause of fine-grained sediment depletion in backbarrier tidal flats (southern North Sea). Netherlands Journal of Aquatic Ecology Vol. 28, No.3 and 4, 299-307.

Guo, H. and Jiao, J.J., 2007. Impact of Coastal Land Reclamation on Ground Water Level and the Sea Water Interface. Ground Water 45, 362-367.

Habitats Directive. COUNCIL DIRECTIVE 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (OJ L 206, 22.7.1992, p. 7)

Healy, M.G. and Hickey, K.R., 2002. Historic land reclamation in the intertidal wetlands of the Shannon estuary, western Ireland. Journal of Coastal Research, Special Issue 36, 365-373.

Hoogduyn, R.J.M., 2006. Draft assessment on land reclamation. Background document on land reclamation in the OSPAR area. Ministerie van Verkeer en Waterstaat, Rijswijk, The Netherlands, 218pp.

King, C.A.M., 1951. Beaches and coasts. Edward Arnold, London 1951, 403pp.

OSPAR 1992. Convention for the Protection of the Marine Environment of the North-East Atlantic, Oslo and Paris Commissions, Paris, 21-22 September 1992.

OSPAR 2003. OSPAR Agreement (2003-15) on Sand and Gravel Extraction. OSPAR Commission, Bremen, 2003.

OSPAR 2005. Dumping of wastes at sea in 2003. OSPAR Commission, 2005. Publication number 220/2005.

OSPAR 2006. Dumping of wastes at sea in 2004. OSPAR Commission, 2006. Publication number 277/2006.

OSPAR 2008a. Literature review on the impacts of dredged sediment disposal at sea. OSPAR Commission, 2008. Publication number 362/2008.

OSPAR 2008b. Assessment of the environmental impact of dredging for navigational purposes. OSPAR Commission, 2008. Publication number 366/2008.

OSPAR, 2008/2009a. Assessment of the impacts of dumping of wastes at sea OSPAR Commission, 2009. Publication number 433/2009.

OSPAR, 2008/2009b. Assessment of the impacts of coastal defence structures. OSPAR Commission, 2009. Publication number 435/2009.

OSPAR, 2008/2009c. Assessment of the Impacts of sand and gravel extraction. OSPAR Commission, 2009. Publication number 434/2009.

Port of Rotterdam, 2007a. Environmental Impact Assessment for Construction of Maasvlakte 2. Summary, 34 pp. Available from: http://www.maasvlakte2.com/en/Environmental_Impact_Assessment/index.jsp

Port of Rotterdam, 2007b. Environmental Impact Assessment for Zoning of Maasvlakte 2. Summary, 26pp

[6] All OSPAR publications and measures can be downloaded from the 'publication' and 'programmes and measures' sections, respectively, of the OSPAR website http://www.ospar.org. All European Community legislation, documents can be downloaded from the Eurlex website of the European Community http://eur-lex.europa.eu/en/index.htm; EC publications can be searched at http://circa.europa.eu

Available from: http://www.maasvlakte2.com/en/Environmental_Impact_Assessment/index.jsp

Port of Rotterdam, 2007c. MER B Aanleg Maasvlakte II (in Dutch). Available from: http://www.maasvlakte2.com/nl/merprocedure/index.jsp

Annex 1. Overview of the extent of historic and present OSPAR land reclamation. The scale of the reclamation reflects the relative importance of different types of land reclamation.

Land	OSPAR region	Applicant	Area/ region	Quantity of materials	Surface area	Type of material [I]	Specific use [II]	Achieved in
1. The Netherlands	II	Maasvlakte	Rotterdam/ North Sea	170 000 000 m^3	1600 ha	Sand, rocks	IN	1970
2. The Netherlands	II	Port of Rotterdam (Slufter)	Rotterdam/ North Sea		260 ha	Sand, clay	Store of polluted dredging	1987
3. Germany - Bremen	II	Bremen (FHB)	Bremerhaven		0.076 ha		HA	1983
4. Germany - Bremen	II	Bremen (FHB)	Bremerhaven		0.454 ha		HA	1985
5. Germany - Bremen	II	Bremen (FHB)	Bremerhaven		0.285 ha		HA	1998
6. Germany - Bremen	II	Bremen (FHB)	Bremerhaven		0.041 ha		HA	2004
7. Germany - Bremen	II	Bremen (FHB)	Bremerhaven		0.007 ha		HA	1993
8. Germany - Bremen	II	Bremen (FHB)	Bremerhaven		0.008 ha		RE	2003
9. Germany - Bremen	II	Bremen (FHB)	Bremerhaven		1.070 ha		HA	2006 – 2007
10. UK - Scotland	II	Port Authority	East Coast/Firth of Forth	158 000 tonnes	6.0 ha	Crushed demolition and stone	Residential and commercial (RA/IN)	2005
11. UK - Scotland	II	Port Authority	East Coast/ Fraserburgh	24 000 tonnes	2.0 ha	Dredged rock	Commercial (HA)	2004
12. UK - Scotland	III	Private	West Coast /Glasgow	11 300 tonnes	4.0 ha	Crushed demolition, hardcore and stone	Residential and commercial (RA/IN)	On going
13. UK - Scotland	III	Port Authority /Council	West Coast /Clyde	100 000 tonnes	5.0 ha	Dredged material and stone	Commercial (IN)	1999

Land	OSPAR region	Applicant	Area/ region	Quantity of materials	Surface area	Type of material [I]	Specific use [II]	Achieved in
14. UK – England / Wales	II	Skipaway Ltd	River Medway	5000 m^3 to 6000 m^3	Small scale	Granular fill, large stone rip rap and hardcore	Reclamation of inter-tidal mud and stone revetment for industrial use	2000 – 2003
15. UK – England / Wales	II	Hanson Quarry Products Europe Ltd	River Medway	5500 m^3 of chalk, 500 m^3 of granular concrete and rock	Small scale	Chalk, rock and concrete	Reclamation of mud flat for industrial use	2000 – 2005
16. UK – England / Wales	II	Cliffe Contractors Ltd	River Medway	7500 m^3	0.28 ha	Coarse granular fill (crushed concrete or similar)	Reclamation of mud flat for industrial use	2000 – 2002
17. UK – England / Wales	II	Gatehead Metropolitan borough council	River Tyne	Not known	Small scale	Rock	Reclaimed for industrial use	2000 – 2001
18. UK – England / Wales	II	E Thomas Construction	River Truro	1000 m^3	Small scale	Boulders, pebbles, gravel, sand (50%) and 50% silt and clay	Small capital (4500m^3) dredge with a portion of the material used to reclaim a small area of foreshore	2000
19. UK – England / Wales	III	Stena Line Ports Ltd	Holyhead	440 000 m^3	Medium scale	Sand, gravel and stone	Reclamation of a ferry berth for vehicles	2000 – 2002
20. UK – England / Wales	II	PASCO'S BOATYARD	River Truro	500 m^3	Small scale	Hardcore	Reclamation of mudflat for a boatyard	2001 – 2003
21. UK – England / Wales	II	ABP	Plymouth	10 000 m^3	Medium scale	limestone bedrock	Reclamation of dock area	2003
22. UK – England / Wales	II	Port of Felixstowe	River Orwell (Shotley)	60 000 m^3 of silt and 100 000 m^3 of clay	Small scale (0.016 ha)	Silt and clay	Compensation scheme under the Habitats directive	2002 – 2003

Land	OSPAR region	Applicant	Area/ region	Quantity of materials	Surface area	Type of material [I]	Specific use [II]	Achieved in
23. UK – England / Wales	II	Port of Felixstowe	River Orwell (Trimley)	60 000 m^3 of silt, 140 000 m^3 of clay and 30 000 m^3 of gravel.	Small scale (0.01ha)	Silt, clay and gravel	Compensation scheme under the Habitats directive	2001
24. UK – England / Wales	II	Exchem organics	Bramble Island, Essex	25 000 m^3	Small scale	Silt	Use of capital dredge material for saltmarsh replenishment	2002 – 2003
25. UK – England / Wales	II	Shotley Marina Ltd	Shotley Flats, Essex	3500 m^3	Small scale	Sandy silt	Use of maintenance dredge material on the foreshore	2002
26. UK – England / Wales	III	Aggregate Industries UK Ltd	Par, Cornwall	60 000 tonnes	Small scale	Sand, gravel and rock.	Backfilling of area behind sheet piled in order to create small cargo ship berth	2003
27. UK – England / Wales	II	Environment Agency	Horsey Island, Essex	200 000 m^3	Medium scale	Silt	Replenishment of salt marsh and mud flat	2003 – 2005
28. UK – England / Wales	II	Port of Tyne Authority	River Tyne	8000 m^3	Small scale	Silt	Placement of contaminated sediment in dock	2002
29. UK – England / Wales	II	Premier Marinas (Falmouth) Ltd	River Fal	82 650 tonnes	Small Scale	Silt	Placement and capping of contaminated material	2002 – present
30. UK – England / Wales	II	Manor of Bosham Ltd.	Bosham Quay, West Sussex	170 000 000 m^3	Small scale	Silt	Replenishment of foreshore	2003 – 2005

Land	OSPAR region	Applicant	Area/ region	Quantity of materials	Surface area	Type of material [I]	Specific use [II]	Achieved in
31. UK – England / Wales	II	Plymouth Yacht Haven Ltd.	Plymouth, Devon	4000 m^3	Small scale (0.15 ha)	Crushed rock from land based sources	Reclamation of land between a boat hoist area and a slipway for a recreational boatyard extension	2004 – 2005
32. UK – England / Wales	II	Premier Marinas Ltd (Chichester)	Chichester, West Sussex	12 000 tonnes	Small scale	Silt	Salt marsh feeding / habitat creation using material from maintenance dredging	2004
33. UK – England / Wales	II	Equity Estates Projects Ltd	River Medway, Kent	Not known	Small scale (approx 0.001 ha)	Land based fill	Reclamation for industrial purposes	2004 – 2005
34. UK – England / Wales	II	Sea containers Property Services Ltd	Newhaven, East Sussex	Not Known	Small scale (0.327 ha)	Stone/rock and gravel from land based sources	Reclamation for a marina extension	2004 – 2005
35. UK – England / Wales	II	Teignmouth Quay Company Ltd	Teignmouth, Devon	30 000 m^3 from capital dredging and 10 000 m^3 to 20 000 m^3 of imported fill materials	Small scale (0.45 ha)	Combination of dredgings and granular fill materials from a land based source	Extension of commercial dock	2004 – 2005
36. Denmark	II		The Harbour of Aarhus		55 ha		Harbour use (HA)	Permission 1998
37. Denmark	II		The Copenhagen marina called Prøvestenen		35 ha		Harbour use (HA)	Permission 2001
38. Denmark	II		Amager Beach		35 ha		Recreational use (RE)	Permission 2004
39. Spain	IV		Gijón	4 250 547 tonnes			Harbour expansion (HA)	2003

Land	OSPAR region	Applicant	Area/ region	Quantity of materials	Surface area	Type of material [I]	Specific use [II]	Achieved in
40. Spain	IV		Avilés	427 500 tonnes			Harbour expansion (HA)	2003
41. Spain	IV		Ferrol	83 587 tones			Harbour expansion (HA)	2003
42. Spain	IV		Santander	101 500 tonnes			Harbour expansion (HA)	2004
43. Spain	IV		Ferrol	12 565 tonnes			Harbour expansion (HA)	2004
44. Spain	IV		Marín-Pontevedra	25 420 tonnes			Harbour expansion (HA)	2004
45. Ireland	III		Shannon Estuary		6500 ha		Airport (AI)	1950s
46. Ireland	III		Shannon Estuary				Moneypoint Power Station	1970s
47. Ireland	III		North slobs in Wexford Harbour		950 ha			1845 – 1855
48. Ireland	III		South slobs in Wexford Harbour		925 ha			1845 – 1855

I = *e.g.*: Sand, clay, rocks.
II = Agriculture (AG), Airport (AI), Harbour (HA), Industry (IN), Recreation (RE), Residential Area (RA), Shopping malls (SM)

Annex 2. Overview of the extent of planned OSPAR land reclamation. The scale of the reclamation reflects the relative importance of different types of land reclamation.

Land	OSPAR region	Applicant	Area/ region	Quantity of materials	Surface area	Type of material [I]	Specific use [II]	Achieved in [year]
1. The Netherlands	II	Port of Rotterdam (Maasvlakte 2)	Rotterdam / North Sea	300 000 000 m^3	2000 ha	Sand	IN	2030
2. The Netherlands	II	Zeeland Seaports (Westerschelde Container Terminal)	Vlissingen Oost		141 ha		IN	Earliest delivery date expected in 2010
3. UK-Scotland	III	Port Authority (Private)	West Coast / Clyde	Not known	Approx. 12.0 ha	Dredged plus stone	RA and IN	N/A
4. UK-Scotland	III	Port Authority	West Coast/ Loch Ryan	Not known	Approx. 5.0 ha	Imported fill	IN	N/A
5. UK-Scotland	II	Port Authority	Shetland	Not known	Approx. 4.0 ha	Dredged plus imported	IN	N/A
6. Denmark	II		The Harbour of Aalborg				Harbour use (HA)	
7. Denmark	II		The Harbour of Esbjerg				Harbour use (HA)	
8. Denmark	II		The Harbour of Køge				Harbour use (HA)	
9. Denmark	II		The Baltic Gate				Harbour use (HA)	
10. Ireland	III		Dublin Port		25 ha		Harbour use (HA)	
11. Ireland	III		Cork Harbour		25 ha		Harbour use (HA)	

I = *e.g.*: Sand, clay, rocks.
II = Agriculture (AG), Airport (AI), Harbour (HA), Industry (IN), Recreation (RE), Residential Area (RA), Shopping malls (SM)

Annex 3. Case Study: Maasvlakte 2

1. Introduction

Maasvlakte 2 is a new port and industrial site that will be built alongside the existing Maasvlakte, situated in the Netherlands (Port of Rotterdam, 2007a and b) (see Figure 4.1 in Textbox 1, in main text). Maasvlakte 2 is of an unprecedented size and scale by Dutch standards because of its large surface area (2000 ha), location and magnitude. Although the surface area of reclaimed land of Maasvlakte 2 is the same as that of Maasvlakte 1 (finalised in 1970), the process is much more complex due to extensive public consultations and stringent environmental legislation.

Maasvlakte 2 will provide harbour areas for companies requiring much space and access to deep water sea lanes such as companies involved in large scale container storage and transhipment, logistics and chemical industry. Maasvlakte 2 will be land reclaimed from the North Sea and will be surrounded by a sea defence, partly designed as a concrete sea wall and partly as sandy dyke. As is the case in the present Maasvlakte, there will be space on Maasvlakte 2 for recreation. Maasvlakte 2 will cover approximately 2000 ha. Up to 1000 ha will be used by port and industry companies. The other 1000 ha will be needed for docks, canals, turning basins, roads, railways, pipelines and sea defences with dunes and beaches. The planning calls for construction to start in 2008 so that the first port sites can go into operation in 2013. The remaining sites will be developed gradually. There will be synchronisation with market developments and the demand for space on Maasvlakte 2. Maasvlakte 2 is expected to be fully operational in 2033.

2. Decision-making – process

Maasvlakte 2 is a large, significant and far-reaching project. The construction of this new harbour and industrial area is part of the Rotterdam Mainport Development Project (PMR). Preceding such a major project as the PMR is a lengthy period of planning, research and decision-making. During this planning process a straightforward dialogue is continued with environmental organisations and other representatives. The result is a plan, that all involved parties can agree to. The decision-making process regarding the PMR consists of the following consecutive links:

- The Key Planning Decision (PKB): reservation of space and determination of the conditions regarding the layout;
- Environmental Impact Assessment (EIA);
- Granting of permits for construction and use: permission and conditions for construction, and environmental and building permits for the use of the sites in question.

Key Planning Decision

In the PKB the Dutch government has set out its decision to build Maasvlakte 2. The PKB validates the usefulness and necessity of building Maasvlakte 2, and contains various constraints for the development of Maasvlakte 2. Some of the constraints are the maximum size of the land reclamation area and the confines of the area within which sand may be extracted. The PKB also states that, in line with nature conservation laws, damage to protected nature must be avoided or mitigated to fullest possible extent. Wherever a significant nature impact is found to be unavoidable, compensatory measures must be taken. The PKB makes ‘spatial reservations’ for this compensation for nature.

PKB distinguished two major steps in the Maasvlakte 2 project: construction and zoning (Figure 5.1). Before starting the construction, detailed plans for land reclamation and sand extraction were made. Zoning plans are made to serve as a spatial guideline for activities that will take place on Maasvlakte 2 when it is operational.

Environmental impact assessment

In The Netherlands, for large scale projects like Maasvlakte 2, an EIA must be carried out in advance. This sets out the possible environmental effects of the planned project for the area and its vicinity and possible alternatives, and forms the basis for permit applications. For the Maasvlakte 2 project, two Environmental Impact Assessments were carried out:

1. Construction of Maasvlakte 2 (Port of Rotterdam, 2007a); and
2. Use of Maasvlakte 2 (Port of Rotterdam, 2007b).

The EIAs contain the information that decision-making authorities need to properly weigh up the environmental interests that need to be addressed in the decisions to go ahead with the construction of Maasvlakte 2. A schematic representation of the land reclamation project Maasvlakte 2 and the EIA in relation to decision-making is shown in Figure 5.1.

Permissions

The important question, when it comes to preparing for the construction and use of Maasvlakte 2, is 'Which permits and/or exemptions are needed?'. Since there is no example to follow – Maasvlakte 2 is a unique project – a procedure plan has been drawn up which maps out everything that needs to be done in the coming years. All in all, over a hundred permits are involved.

Some permits that are needed are:

- A concession falling under the Land Reclamation and Dykes Act 1904;
- A permit for extraction of sand from the sea, falling under the Earth Removal Act;
- Permits in connection with nature conservation, falling under the Flora and Fauna Act and Nature Conservation Act.

In addition, testing against the European Birds and Habitats Directives is required. The objective of the European Birds and Habitats Directives is to establish a European network of nature areas called Natura 2000. EU member states must contribute to its establishment by designating Natura 2000 areas and by protecting habitat types and species that occur within these areas. The land reclamation area lies almost entirely within a Natura 2000 area, the Voordelta. The sand extraction area lies outside a Natura 2000 area. However, the extraction of sand may have consequences for the Voordelta if suspended matter concentrations (fine silt) increase due to extraction activities. The tidal current will carry fine silt to the Voordelta which will increase the turbidity temporarily. This may have consequences for protected species in the area.

For a brief chronological survey of the steps in the entire decision-making process concerning the Rotterdam Mainport Development Project (PMR) to date, see www.maasvlakte2.com.

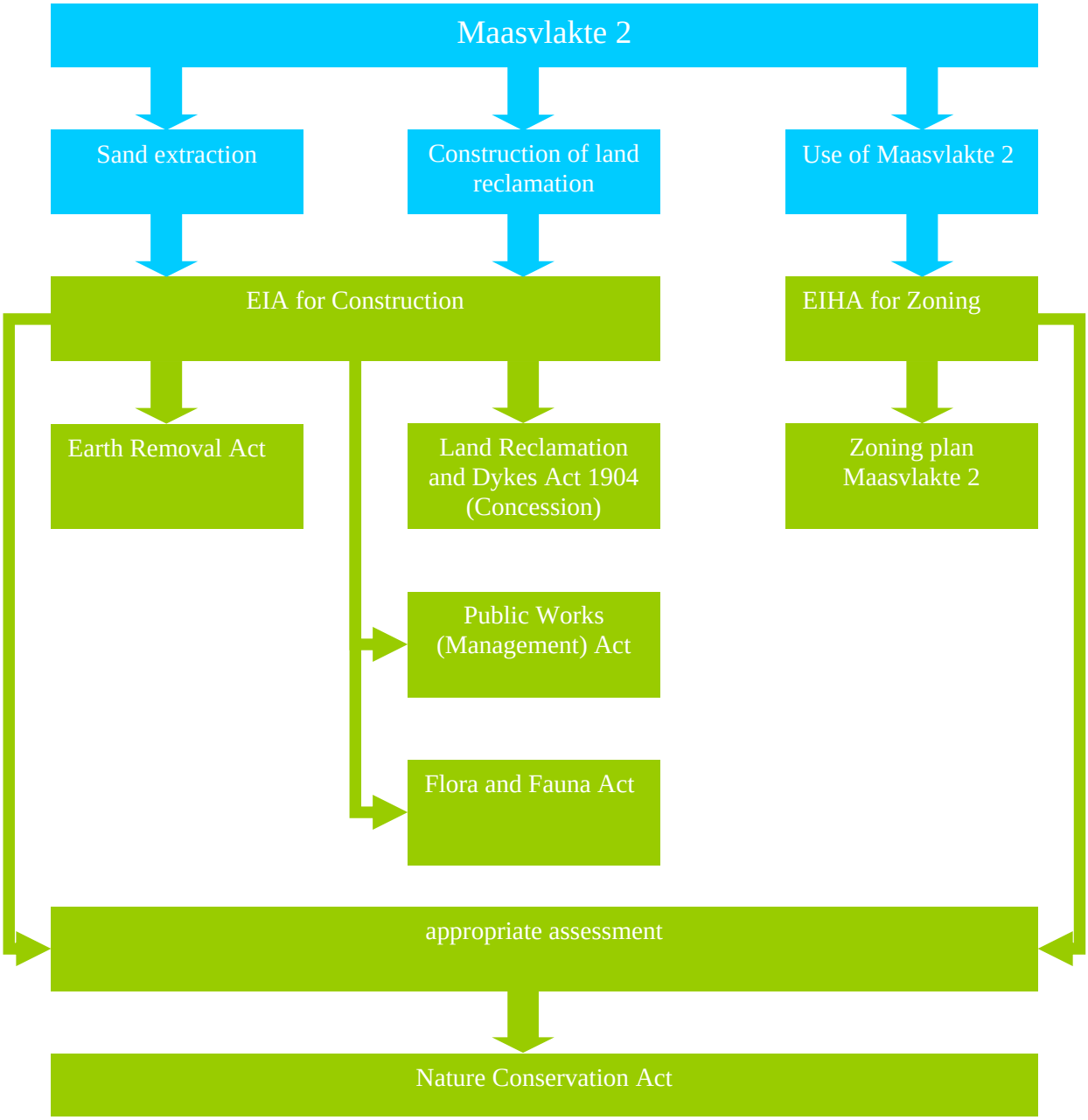

Figure 5.1 Schematic representation of the land reclamation project Maasvlakte 2 and the Environmental Impact Assessments in relation to decision-making (Source: Port of Rotterdam, 2007a).

3. Environmental impacts

EIA studies were carried out to determine the environmental impacts for the marine ecosystem during the construction of Maasvlakte 2 and when Maasvlakte 2 is fully operational (zoning phase). All environmental aspects that were considered in the EIAs of Maasvlakte 2 are listed in Annex 4. Only the significant impacts that will, or are predicted to occur according to the EIAs, are briefly described below.

3.1 Construction phase

1. Sand extraction and construction work for land reclamation will cause disturbance because of noise below and above water and the use of equipment, which may frighten off shy species. This disturbance may temporarily cause them to avoid the area in the immediate vicinity of the source of disturbance. However, many protected species have a large action radius, and within the large Voordelta there are ample alternative locations. Therefore, the temporary effect on the living and foraging area of protected species such as birds, mammals and fish will be slight. Permanent effects are not expected to occur.

2. A local and temporary effect of sand extraction will be the impairment of seabed life. With an extraction depth up to 20 m below the seabed, the aerial effect is limited and there will be no constraints for recolonisation. Recovery is likely to take place in two to four years.

3. At an extraction speed not exceeding 150 million m^3 per year, the fine silt (suspended matter concentrations) concentration in the Voordelta will be higher than the normal annual average concentration for a few years. The fine silt will spread with the tidal current both to the south and north and will join the fine silt that is naturally present. In the Voordelta the concentration of fine silt will increase. At a higher fine silt concentration, the water will become cloudier. The natural variation in fine silt concentration is exceptionally large anyway: after severe storms in the winter, the water is far cloudier than during a slightly longer period with very calm weather in summer, because of the fine silt swirled up from the seabed. Typical values for the annual average fine silt concentration in the Voordelta are 20–30 mg/l near the coast and 5–10 mg/l farther out at sea. The increase in the annual average fine silt concentration in the Voordelta caused by sand extraction will reach approximately 6 mg/l at the most in 2010. During stormy periods the fine silt concentration will rise to 100 mg/l. This increase will not have an adverse impact on the protected habitat types (seabed, flats and salt marshes). However, there is a chance that adverse effects may occur for some protected species: three species of shellfish-eating ducks (eider, black sea duck and scaup) and two species of fish-eating birds (common tern and sandwich tern). A higher fine silt concentration makes the water cloudier and reduces incidence of light. This can slow the growth of algae, food for shellfish and shellfish larvae, the food source of shellfish-eating ducks. If the water becomes too cloudy, fish-eating birds will have difficulties to see their prey fish. They may have to fly farther to get their food. In the breeding season this may be at the expense of the success of breeding and thus the size of the population. The adverse effects of land reclamation to some shellfish-eating ducks and fish-eating birds are given in Table 3.1.

Table 3.1 Potential effects on population of 5 species due to land reclamation activities (Source: Port of Rotterdam, 2007b).

Species	**Situation in 2009 – 2011 without sand extraction for Maasvlakte 2**	**Situation in 2009 – 2011 with sand extraction for Maasvlakte 2**
Eider	No effect	Reduction: 0% to at most 6.4%
Scaup		Reduction: 0% to at most 5.0%
Black Sea duck		Reduction: 0% to at most 7.1%
Common tern		Reduction: 0% to at most 0.9%
Sandwich tern		Reduction: 0% to at most 0.9%

4. Along a large section of the Dutch coast it is necessary to replenish sand periodically to stop the coastline from receding. This is called shoreline retention. Maasvlakte 2 will have consequences for shoreline retention only at the location of the land reclamation and not for coastal sections in the vicinity (Delfland, Voorne, Goeree) or farther away. At the existing Maasvlakte and Slufter, an average of 800 000 m^3 of sand per year is currently being provided. As a result of Maasvlakte 2, this will increase to approximately 1.2 million m^3 per year. Compared with present maintenance dredging, the maintenance dredging in the construction phase will increase. As a result of the construction of the soft sea walls and the sand extraction, more fine sediment will temporarily enter coast and sea system. Some will sink in the Maasgeul and farther on in the Maas entrance and in the existing docks. In the present situation the maintenance dredging here amounts to 16 million m^3 per year. This will increase by approximately 45% in the 2008 – 2013 period and then decrease again.

5. Fuel consumption by equipment used for the construction of Maasvlakte 2 will affect air quality. Model calculations show that annual average concentrations of NO_2, SO_2 and $PM10^3$ will increase with 8.0%, 20.5% and 0.45% respectively. However, the air quality standards will not be exceeded.

6. The reclaimed land will take up a small area where fishing currently takes place. This concerns mainly fishing by means of smaller vessels, such as cutters. During the extraction of sand there will be fishing restrictions at the location of the sand extraction pits.

After the completion of the EIA concerning the construction of Maasvlakte 2, new geological data from field studies became available on the amounts of fine silt in the area of sand extraction pits. New calculations on the effects of sand extraction show a lower impact on bird species than assumed earlier.

3.2 Operational phase

In the operational phase, the phase when the reclaimed land is present, the reclaimed land will have several significant effects on the protected nature values in the Voordelta for which compensatory measures are mandatory according to the nature conservation laws. These effects are:

1. Maasvlakte 2 will cause a loss of acreage of the protected habitat type[4] ,"Sandbanks slightly covered by sea water all the time", with the seabed at a depth of NAP[5] 0 to -20m. Direct space utilisation on acreage of this habitat type[4] will be approximately 2000 ha, the gross size of the reclaimed land. Due to the presence of reclaimed land, the speed of the current seawards from the reclaimed land will increase at some locations. The current will carry sand from the seabed with it. To the west of the sea wall this will create an erosion pit. The number of hectares over which the pit will be deeper than NAP[5] -20 m at a particular time will also be considered as a loss of acreage of the protected habitat type[4]. After ten years the part of the erosion pit below NAP[5] -20 m will have a maximum size of approximately 470 ha. Almost 2500 ha of this protected habitat type[4] will be lost permanently in total, which represents 2.8% of the total acreage of this habitat type in the Voordelta;
2. A total loss of 3.1% of the potential forage area of the Black Sea duck (in winter). There are no fallback alternatives for this loss;
3. Reduction of the living and foraging area of the common tern. The size of the population in the Voordelta will decrease by 5.9% at the most in relation to the average population size in the last years. This is a permanent effect;
4. Reduction of the population size of the sandwich tern in the Voordelta by 3.7% due to a reduction of the living and foraging area and to intensified recreation in the area. The sandwich tern forages at sea in summer. Recreation in summer will increase the disturbance to sandwich terns. The calculated effect is largely of a permanent nature;
5. The presence of reclaimed land will change the current near and farther away from Maasvlakte 2. This will have minor consequences for the carrying of fine silt along the coast. Along the Dutch coast the fine silt concentrations will decrease, while slightly farther out to sea they will increase. A change in sediment structure can result in a change in the community structure of the benthos;
6. Since the closing off of Haringvliet in the Netherlands in 1970, Haringvlietmond (the Haringvliet entrance) has gradually become shallower. This process will continue for many years. Consequently, the salt spray at Voorne and Goeree will decrease. Land reclamation will slow down the ongoing shallowing of Haringvlietmond. As a result, the salt spray at Voorne and Goeree will decrease less rapidly than in the situation that Maasvlakte 2 will not be built.

The use of Maasvlakte 2 will also have an effect on the surface water quality. The effects on surface water are summarized as negative. This is mainly attributed to an increase in the number of ships that will visit the area and to a possible increase in water temperature.

Many ship hulls are treated with antifoulings that contain organotin. Although the use of organotin has been banned in the European Union since 2003, there is not a worldwide ban yet. Therefore, the presence of organotin will only reduce slowly.

The increase in the amount of ships that will visit the area will also have an impact on safety measures that should be taken to prevent accidents that can result in leakage of fuels and stored chemicals. The Port of Rotterdam Authority is already working on a set of measures to keep future accessibility and safety up to standard.

The water temperature may increase slightly, less than 3°C, due to discharges of cooling water by power stations and chemical companies at Maasvlakte 2 with no ecological problems expected.

The use of Maasvlakte 2 will have a minor contribution to the air quality in the Rijnmond region where Maasvlakte 2 is situated. This negative contribution will be avoided to the fullest extent possible and no problems are foreseen.

3.3 Compensation

The four significant effects described above require compensatory measures. Compensation will be provided by creating a marine reserve in the Voordelta where nature values will be increased by 10%, together with a management plan. The point of departure for sizing the marine reserve is that it must be at least 10 times as large as the protected habitat type Ten times the maximum loss of 2500 ha of this habitat type[4] is 25 000 ha. The PKB has made a spatial reservation for a marine reserve of 31 250 ha.

4. Knowledge gaps and monitoring

The best available methods and techniques were used to forecast effects. Various workshops were held with experts to check the study results especially for the effects on the coast and sea and on nature. When model calculations identified uncertainties in the predicted effects, either the maximum effect (worst case) or the expected value, defined with explicit statement of the uncertainties, was taken as a baseline.

Applying an upper limit for the uncertainties means that knowledge gaps do exist and that they are taken into account. In this way knowledge gaps do not stand in the way of further decision-making. Knowledge gaps were mainly identified in predicting the effects of the construction work on the coastal and marine environment.

The actual effects of the construction and the operation of Maasvlakte 2 will be studied in an extensive Monitoring and Evaluation Programme during and after the construction phase. This monitoring will be conducted mainly in the framework of already existing programmes and partly in sub-studies specifically focused on Maasvlakte 2.

The main questions of the Monitoring and Evaluation Programme concerning Maasvlakte 2 are (Port of Rotterdam, 2007c):

- Is there a discrepancy between the measured adverse effects of the construction of Maasvlakte 2 and the measured positive effects of the compensation measures;
- Has the construction of Maasvlakte 2 any adverse effect on the transport of fine sediment and does this affect the ecosystem of the Wadden Sea;
- Does the construction of Maasvlakte 2 affect the transport of fish larvae resulting in a decrease of commercial fish quantities?

In more general terms, the Monitoring and Evaluation Programme is aimed at revealing causal relations between the construction of Maasvlakte 2 and changes in the ecosystem. To reveal these causal relations, the Monitoring and Evaluation Programme started in 2004 with baseline studies. The aim of the baseline studies is to determine the current quality status of the Maasvlakte 2 area. The following topics are addressed in the baseline studies (Port of Rotterdam, 2007c):

- Morphology of the sea bed;
- Benthos;
- Fish and fish larvae;
- Coastal birds and sea birds;
- Functionalities of the sea area of concern;
- Transport of fine sediment;
- Physical and ecological parameters in dune areas.

The baseline studies will be finalized before the actual construction of Maasvlakte 2 starts. The effects of the construction of Maasvlakte 2 will, amongst others, be studied by monitoring the following aspects in space and time (Port of Rotterdam, 2007c):

- Salinity, and concentration of suspended particulate matter and chlorophyll in the water column;
- Characteristics of the benthos, *i.e*. biomass, density, species composition, community structure, and sediment composition of the habitat of the benthos;
- The sedimentological composition of the sea bed, *i.e*. silt/clay percentage;
- The structure of the fish and fish larvae population such as type, amount, length, weight, *etc*.;
- Morphology of the sea bed.

It is noted that at the time of writing the Monitoring and Evaluation Programme was not yet fully worked out.

5. Current status of the Maasvlakte 2 project

It is the objective to finalise all decision-making procedures towards the end of 2007. During 2007 the tendering procedure will also be completed resulting in a contract with the contractor who will carry out the work. The start of construction is planned for 2008. The first phase of construction will be dominated by the construction of the sea walls and the first sites of the inner area. From 2013, the first companies can be operational on Maasvlakte 2. In the second phase, after 2013, the remaining sites will be built and gradually put into service.

Annex 4. Environmental topics that are considered in the EIA study Maasvlakte (Source: Port of Rotterdam, 2007a)

Environmental topic	Had to be considered in EIA* (Y / N)	Criteria / limits / critical values	Have baseline studies / field surveys been carried out? (Y / N)
Commercial fisheries	Y	Surface of fishery, Influences surface of forage area and spawning grounds, Temporary effects; decrease of shellfish fishery in the coastal area	Y
Recreational fisheries	Y	Influences surface of recreational fishery area	
Aquaculture sites	Y	Influences on mussel culture	
Shellfish beds	Y	Influences surface of forage area and spawning grounds	Y
Spawning grounds and nursery areas	Y	Influences surface of forage area and spawning grounds	Y
Over wintering grounds for shellfish	N	-	
Migration routes of finfish and shellfish	Y	Influences surface of migration routes	Y
Migration, roosting and feeding areas for birds	Y	Influences surface of migration routes	Y
Haul-out sites *etc*. for marine mammals	Y	Study area is not important area of distribution	Y
International conservation area (*e.g*. habitats, Ramsar)	Y	Significant effects have to be compensated	
National Conservation areas	Y	Bird and Habitat Directives, salt and sand spray reduction, changes in water tables, dune compensation	Y
Coastal processes (sediment transport, erosion, sedimentation, hydrodynamics)	Y	Flow situation, sedimentation's changes, erosion patterns, effects on silt transport	Y
Water quality	Y	Suspension	
Navigation	Y	Safety studies, collision risks	
Areas of significant aesthetic, cultural or historical importance	Y	Harmful effects on concerning categories	Y
Marine archaeological sites	Y	Harmful effects on concerning categories	Y
Recreational beaches	Y	Beach surface, Beach conditions, changes beach nourishment rates.	Y
Engineering uses of the sea floor (cables, pipelines)	Y	Cable routes of e.g. BritNed	Y
Sea water extraction sites	Y	-	Y
Decommissioning	N	-	
Other: Sand winning	Y	Extraction site of at least 100 ha or several extraction sites that cover at least 100 ha in total and are close together: An EIA is required. Direct and indirect loss of habitat due to the land reclamation. Effects on the compensatory marine protected area.	Y

* Dependent on the region, more topics can be considered

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