SECTION TWO INTERACTION

Maritime Institute
University Gent
Frank Maes & Jan Schrijvers

CHAPTER ONE: EXPERT WORKSHOP

1 PROGRAMME OF THE WORKSHOP

Day 1 (16 January 2004)

Morning session:

8.30 Registration of workshop participants (upon invitation)

9.00 Opening of the workshop

Dr. Frank MONTENY, Belgian Federal Science Policy Office

Ms. Cathy PLASMAN, cabinet of Ministry of the North Sea

9.10 Welcome to participants and introduction to the workshop

Prof. Dr. Frank MAES, co-ordinator GAUFRE project

9.30 Short presentation by participants: their experience, background and contribution

Chair: Prof. Dr. F. Maes

Prof. Dr. Hans BUCHHOLZ

Dr. Paul GILLILAND

Dr. Charles EHLER

Dr. Anamarija FRANKIC

Prof. Dr. Richard KENCHINGTON

Dr. Grant MURRAY

10.45 Coffee/tea break

11.15 Short presentation by participants: their experience, background and contribution

Chair: Prof. Dr. F. Maes

Drs. Bart KORF

Dr. Jon LIEN

Prof. Dr. Hance SMITH

Drs. Hans LEINFELDER

Dr. Kevin St. MARTIN

Dr. Eike RACHOR

12.30 Lunch

Afternoon session:

13.30 Session I: Non-living resources

Moderator: Dr. Jan SCHRIJVERS

15.30 Coffee/tea break

16.00 Session II: Living resources

Moderator: Dr. An CLIQUET

18.00 End of day 1

Day 2 (17 January 2004)

Morning session:

9.00 Session III: Data, zonation and interaction (1)

Moderator: Dr. Bart DE WACHTER

10.30 Coffee/tea break

11.00 Session III: Data, zonation and interaction (2)

Moderator: Dr. Bart DE WACHTER

12.30 Lunch

Afternoon session:

14.00 Session IV: Strategic vision

Moderators: Prof. Dr. Frank MAES, Dr. Jan Schrijvers, Dr. Bart De Wachter

15.30 Coffee/tea break

16.00 Session IV: Evaluation and conclusions

Moderators: Prof. Dr. Frank MAES, Dr. Jan Schrijvers, Dr. Bart De Wachter

17.30 Conclusions and closure of workshop

18.00 Closing reception

2 LIST OF EXPERTS INVITED TO THE WORKSHOP

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3 ABSTRACTS OF PRESENTATIONS

Proposal for a Spatial Offshore Plan -
the German North Sea Coastal Zone as an Example

Hans BUCHHOLZ

Traditionally the oceans - the marginal seas in particular - are mainly used by navigation and fisheries and sometimes by tourism in short distance from the high water mark. For these purposes there is not much demand for spatial offshore planning.

The new planning challenge appears from the introduction of fixed offshore installations. There are already many such installations including: platforms for the exploration and exploitation of oil and gas, and cables and pipelines. However, they have traditionally been perceived as individual measures, and they have been planned for accordingly. At present we have to understand that we are at the beginning of a comprehensive and manifold use of the ocean. We need comprehensive spatial planning with a holistic approach following the principles of ICZM, because each limited resource needs pro-active planning.

A simple transfer of a well organized spatial planning system from the land to the marine area is not possible due to the different character of the sea: it is highly mobile, it cannot be shut off by boundaries, it is more or less uninhabited, and it is widely unknown etc. However, some land oriented spatial planning principles may be transferred to the marine area in order to meet the usual national administrative procedures. Consequently respective states will have several different spatial planning systems, at least for the time being.

The following steps to a spatial offshore plan should be considered:

- to define the planning region which should contain land and sea.
- to map the relevant data of living and non-living nature as well as of human uses.
- to elaborate a vision (Leitbild) for the coastal zone, for the marine area in particular, and to get a political decision on this vision.
- to arrange spatial plans on two levels of generalization: (i) a General Plan for the Coastal Zone of smaller scale, with appropriate area categories; (ii) Regional Plans for the Coastal Zone of larger scale with respective area categories. These plans should be the basis for decisions by authorities.
- In order to achieve sustainable development planning procedure should follow the three main elements of Integrated Coastal Zone Management: (i) management instead of hierarchic administration; (ii) participation of the stakeholders from the beginning; (iii) iterative planning process instead of final decisions.
- Coordination with neighbouring constituencies and states is essential.

The paper will discuss the application of these considerations to the German North Sea coastal zone.

Toward Integrated Management of Ocean Uses Through Zoning

Charles EHLER

Designating areas of the ocean for specific oceanic uses, as a method for setting priorities for the use of marine areas or their resources, is not a new idea. Specific areas of estuaries and coastal waters have been set aside for fisheries management for hundreds of years, both in the developed and developing world. However, planning and managing ocean space in any comprehensive or integrated way through the use of zoning is relatively new. Since the early 1970s Australia's Great Barrier Reef Marine Park Authority has used a zoning approach to manage multiple uses of the world's largest marine protected area. Other countries, including the United States and the Philippines, have adopted similar zoning approaches in the management of their marine protected areas. Even more ambitiously, China has recently passed national legislation that requires development of multiple use zoning plans for its entire territorial sea.

Coastal and ocean managers throughout the world now recognize the importance of setting aside areas of marine waters for specific uses. For example, over 4,000 marine protected areas have been designated—an exponential increase over the past 10 years. Numerous other examples of areas designated for particular activities exist, in which other uses are excluded or restricted to eliminate conflicts. Historically these include, among many others, navigational channels, pipeline/cable corridors, dredged material disposal areas, fisheries closure areas, military firing ranges, and oil and gas drilling leases. Almost always, these "zones" are established through a variety of mechanisms under different authorities, and typically lack any inter-sectoral considerations or integrated planning and coordination.

The management or "governance" of human activities within specified coastal and marine space can have many objectives:

- Allocation with society and among government organizations of rights of use, ownership, and stewardship of marine resources within the space;
- Regulation of these rights of use, ownership, and stewardship;
- Separation of conflicting human activities;
- Protection of natural and/or cultural qualities of the space while allowing a range of other reasonable human uses;
- Designation of suitable areas for specified human uses, e.g., fishing, waste disposal, and transportation, while minimizing the effects of those uses on the quality of the entire space;
- Protection of critical or representative habitats, ecosystems and ecological processes;
- Monitoring and enforcement of these regulations by the appropriate authorities; and
- Provision of effective means to prevent and adjudicate disputes.

Ocean zoning is more complex in that it needs to address and manage activities on the ocean's surface, throughout the water column, and on and beneath the seabed. It is conceivable that one area of the ocean could support multiple uses (by different sectors) or several management objectives simultaneously, and it is also possible that one use or management objective would preclude all others. Ocean zoning may also have a temporal dimension, prohibiting uses of a period of time or on a seasonal basis.

This paper and presentation will examine existing examples of the application of zoning as one tool and a number of "incentives" that can be used to manage marine space in an integrated, multiple-use framework. Differences between zoning on the land and in the marine environment will be identified, e.g., mobile resources v. static boundaries, as well as problems of "open access," but the benefits of marine zoning will be highlighted.

The Environment Sets the Limits for Sustainable Management of the Sea

Anamarija FRANKIC

The health and sustainable use of coastal and sea resources are of critical importance given their role in food production, economic activity, genetic biodiversity and recreation. In addressing integrated costal management it is essential to strike a balance between the need for economic development and the need for natural resource conservation within the same management plan. Therefore, integrated coastal management and sustainable development should include careful consideration of multiple parameters and their interactions. Planning for sustainable uses is a process that comprehensibly and holistically analyses natural resource conditions, human uses and socio-economic aspects. Through effective research, monitoring and incentive programs that maintain ecosystem integrity and balance human values, economic development can be attained in an environmentally and socially sustainable manner. The proposed approach for sustainable use of coastal, marine and land resources is that '*the environment sets the limits for sustainable management and development*'.

One of the most critical challenges is to find suitable sites for different sea -based activities and maintain healthy ecosystem functioning. The first step in this process is to identify the environmental conditions necessary for each activity to succeed. In the case of the Belgian part of the North Sea, the activities/uses include: shipping, fisheries, aquaculture, coastal defense, tourism and recreation, sand and gravel extraction, dredging, energy production, nature protection, cables and pipelines, wrecks, off-shore bunkering, and military use. Determination of suitability involves an evaluation of natural and anthropogenic limitations of a certain area in order to decide if the locality can support the activity (finding "an optimal allocation for user functions"). Developed protocols for each coastal/sea activity can be used as environmental quality standards that will help guide and control activities within certain environmental limits. Ultimately, through guidance of monitoring programs (environmental and socio-economic), better information can be incorporated into the analytical protocols. This will improve evaluations, and complete the feedback loop for the sustainable management planning of the sea and the coast.

Adequate policy addresses the resolution of potential use conflicts, which is often hindered by lack of information or appropriate methodologies. Management choices will be required when certain activities can appear in the same locations based on suitability analysis of the area (e.g. aquaculture vs. tourism/beach area vs. sand/gravel extraction). In these instances, choice has to be based on environmental requirements for the activity and the activity's interaction with the environmental resources (environmental impact assessment, EIA). First priority should be given to the activity with the highest environmental suitability level and the lowest adverse impact on the respective land/water ecosystem. In addition, implementation and decision-making must incorporate socio-economic suitability and cultural factors. Involving the community in the planning and decision-making process is an important step toward acceptability and success of the sustainable management. The use suitability and use conflict analyses (Geographic Information System, GIS models) support the interdisciplinary aspects of sustainable coastal management planning, and decision-making processes addressing where, how and why different uses will mostly succeed in sustainable manner.

Paul GILLILAND

The author has worked for English Nature for over 10 years on marine protected areas, monitoring, advice on a range of marine developments and use, and most recently as Marine Policy Adviser.

English Nature's focus and interest in marine spatial planning has increased over the last 18 months. This has been mainly under the auspices of a developing Maritime Strategy and in response to our report "*Maritime State of Nature: getting onto an even keel"*, which was launched on 6 November 2002. The strategy has two key objectives:

- To set English Nature's objectives for our coasts and seas
- To act as a catalyst for implementation of government initiatives, in particular the Marine Stewardship Process and the maritime elements of the England Biodiversity Strategy.

Our Strategy considers three key areas - Better planning and integration, Recovery of our coasts and seas, and Working with the sea. The former is particularly focussed on Integrated Coastal Zone Management, Marine Spatial Planning and Regional issues.

At a national and international level the UK is committed to investigating some form of marine spatial planning and the need for such planning at sea appears to be widely accepted, including across parts of government. There are, however, relatively few examples of effective spatial planning in the marine environment around the UK to draw on. The principles such planning needs to be based on, the scope of such planning, options for achieving it, what a spatial plan might look like, and what should be aimed for in the short, medium and long-term have been and continue to be the subject of discussion and development.

Over the last few months, English Nature has explored these issues with a wide range of stakeholders, initially through one on one discussions followed by a national conference on 1st October 2003. Important messages from the conference include:

- General and widespread support for some form of marine spatial planning.
- A range of data needs to inform various aspects such as broad scale spatial information, boundaries and cumulative effects.
- The challenge of integrating sectors, not least those with an international dimension to their management such as fisheries and shipping.
- Integrating policy and management across marine and terrestrial components of particular sectors, such as aggregates and energy.
- The need to clarify what legislation is required to underpin any system.

English Nature has been working to identify and develop practical solutions to some of these issues, co-hosting a small workshop on "The practical implementation of marine spatial planning – understanding and addressing cumulative effects", undertaking a short analysis of the relevance and lessons of the land use planning system to marine spatial planning and implications for what the latter might look like, and developing a proposal to provide a simple, interpreted geophysical map of marine seabed and water column features ('countryside map for the sea') as one fundamental information layer to underpin marine spatial planning.

The debate about marine spatial planning includes a regional dimension. 'Regional' can refer to both naturally defined regions and political-administrative boundaries, such as government regions. During 2003 we consulted on and progressed the concept of Marine Natural Areas as a potentially ecologically relevant framework at a regional scale around England within which to consider planning and management. Much of our effort to develop a regional approach has been directed through a pilot project in the Irish Sea. Whilst that project is not producing a marine spatial plan it has made practical progress on a number of topics that would be essential elements of a spatial plan.

The presentation will provide details of the above projects and initiatives to help practical progress in the development of marine spatial planning in England and the UK.

Sustainable Management of the Sea – the Importance of Clear Objectives – Perspectives from the Great Barrier Reef

Richard KENCHINGTON

The social, economic and environmental importance and the need for sustainable management of marine ecosystems are now widely understood and increasingly reflected in legislation and institutional structures.

Designing management systems to respond to the needs poses difficult challenges. In marine ecosystems the biology of plants and animals, and the consequent issues of scale, variability and linkage in space and time, limit the effectiveness of terrestrially derived concepts of spatial planning. Many uses with different levels of impact may occur in the same area. It is important to understand the issues of cumulative and interactive impacts on the natural system and on each other. Unless planning can be conceived to reflect the issues of uses and sustainability at an ecosystem scale, territorial boundaries or fences to delimit different uses are of limited value. Recruits, nutrients and food for plant and animal populations may come from distant spawning areas and impacts such as pollution may come from distant areas and different jurisdictions.

The biophysical foundation of marine management is not the major constraint to planning. With current technologies seabed habitat mapping is relatively easy and, depending on the general applicability of the inherent assumptions, modelling can provide a reasonable understanding of biophysical constraints and opportunities for management. The issue is to devise the most effective contemporary solution to sustainability in the face of multiple uses and impacts, natural variability and resilience of the ecological system in the face of individual and cumulative impacts

A fundamental issue is that we do not manage the sea or marine environments. We have no means for significant management of most of the ecosystem processes. We can hope to manage human behaviours to influence what people do, or do not do, to marine resources and habitats. There is a challenge in this because the concept that human activity can damage the sea is very recent. Most people were brought up with notions of the seas as vast, remote, dangerous - a source of food and resources for the brave, and a limitless sink to absorb the wastes of life on land. The fact that we are holding this workshop demonstrates that we are in transition but the process of achieving the necessary changes in behaviour must go beyond experts telling the rest of the community what to do. It has to involve a process of collective development of reasonable decision rules.

Management plans can address the purposes and conditions of use and entry to areas of a marine ecosystem, but to do so requires an open approach to planning. It requires broad involvement of interested, affected and impacting parties in the development of decision rules or operating principles. These should lead to the identification of reasonable constraints and opportunities for managing impacts and achieving objectives subject to an overarching objective of sustainability. The process should be far reaching because quite frequently impacting parties may be unaware of their impacts or connection to the marine ecosystem. Where they operate in a different jurisdiction these problems are compounded.

The operating principles should identify areas of common agreement for overarching management principles. They will also clarify matters where different sectors have conflicting objectives that may be addressed by limitations to contain impacts within demonstrably sustainable levels, or by spatial or temporal separation. A process based on broadly discussed and understood operating principles can help to achieve the best feasible contemporary solution to manage human behaviours. It should also provide the basis for ongoing adaptation and revision as understanding of management and perceptions of reasonable behaviour evolve in the light of actual experience.

Approaches to support planning and management of the Belgian North Sea
Richard KENCHINGTON

This is an overview of the output of the workshop as compiled by Dr. Richard Kenchington.

Overview of resource and use issues

- The Belgian sector of the North Sea is very heavily used by Belgium, its neighbours and the international community.
- Major longstanding uses are shipping, fishing and sand and gravel extraction.
- The Belgian North Sea has a major section of the northern part of the English Channel designated shipping lanes and dredged access channels for Belgian and southern Dutch ports. Disposal of dredge spoil and demands for deeper channels to service competing ports are substantial issues for the central and northern nearshore areas of the Belgian North Sea.
- The area is fished by Belgian and other fishing nations. Information on the relative importance of areas for particular fisheries is not available. The romance of fishing ports is an element of local cultural and recreational significance. The real economic significance of fisheries in the local inshore seas (within 20 km of the coast) is not known. Neither is the economic and resource demand significance of the same area for recreational fishing.
- The 68km coast is a largely developed area of substantial significance for recreation and tourism. While many of the activities are urban/resort based recreation there is continuing and probably increasing demand for recreational fishing and environment based activities including summer swimming, beach walking and natural environment appreciation.
- A new and potentially major use flowing from national energy policy is the establishment of wind farms. As a new activity, the extent of real demand and the policy framework for wind farm establishment and operation are unclear. An area has already been designated for wind farm development but there are debates about location of windmills in relation to visibility from the shore and in relation to bird migration routes.
- The Belgian North Sea is part of the much larger system of the southern North Sea/Northern English Channel. A coherent understanding of its biodiversity and of any specific ecological significance will involve working with neighbouring countries, probably in the context of the EU environmental policy framework. There is demand for the establishment Marine Protected Areas, but the extent to which these would serve functions of broad ecological system or biodiversity conservation as opposed to nature based cultural or recreational objectives needs to be evaluated.

Possible contributions of planning methods

It is always difficult to evaluate options and priorities for methods without a clear understanding of the policy framework for the planning application.

From my understanding of the papers and discussion at the workshop it appears that the current management framework is predominantly sectoral with generally minimal communication between sectors. Where they are specifically considered, environmental issues are dealt with through prediction and regulation of environmental impacts. Cross-sectoral and broader community benefit matters are dealt with on an issue-by-issue basis within the normal flow of cabinet-based government.

Against this background, it appears that there is a reasonable understanding of the physical/biological context of the Belgian North Sea. The major issues that need to be addressed in order to apply this information in planning and policy are social and economic, and these need to be understood in a cross-sectoral and broader policy context.

Planning and regulation of the public commons of marine areas and resources requires consideration of the best way that public benefit can be derived from those resources. The burden of proof is on the user of those resources to demonstrate that the use is reasonable, sustainable and that it does not bring unreasonable detriment to other current and future uses. Such considerations relate largely to social and economic values. This differs from the general context of terrestrial resource management where the majority of the resources are owned or leased and the owner or lessee is free to do what they will unless constrained by laws and regulations that protect the interests of the public or neighbouring property owners. The burden of proof for introduction of limitations is on the community. This is clearly reflected in the language of land based planning – where a plan is produced by experts and may be advertised for a period to enable the public or interested parties to make objections.

On this basis, planning for allocation and management of access to public marine resources and areas – including the licensing of uses - should be carried out in the context of a systematic and generally open process to determine the purpose and entry of uses in the area being planned. The requirements for such a process include:

- Legislative authority – that sets out as clearly as possible the objectives and scope of planning and management to implement plans
- Operating principles or decision rules that apply to the planning operation in question. These will obviously include the requirements of the legislation but, particularly in a multiple use planning context, they should identify the operational context of all allowable uses so that clashes, conflicts and synergies can be clearly addressed. Because some decision rules will clash – for example having a 5 km exclusion zone around a wind mill and not closing any areas currently used for fishing – it is generally necessary to preface the rules by "as far as practicable". The task of the planning process is to identify possible solutions within those constraints and in doing so to clearly identify the winners and losers so that the overall balance can be reviewed. It is important in an open political process that the decision rules are developed and canvassed publicly very early in the planning process.
- Best practicable understanding of the social and economic context of uses and values of the area. Industries and government agencies often have substantial information on the relevant sectors, but there is typically a lack of information on cross-sectoral issues and community views. In particular, the values of recreational uses and cultural associations are typically very poorly understood. Local ecological and usage knowledge techniques described at the workshop have an important role in collecting such information.
- GIS technologies. Multiple use planning of marine areas involves many types of information, much of it is geographical in order to describe the distribution of uses, values and options. There are many commercially available packages. The key elements are a geographic base that can accommodate specific small site information and can aggregate information at scales from the local to the whole of the area.
- Decision support technologies. Again there are several packages available. An absolutely critical consideration is the openness and relevance of the assumptions in the algorithms and the ability for the package to run with the decision rules or operating principles for your application and to report the extent to which a rule is satisfied by any proposed solution. Ideally it should enable suggested changes to be entered in the field and stored as evaluated options for later decision-making process.

<u>Information needs</u>

The common problem at the start of a planning process is that there is a lot of information but little of it is immediately relevant to the tasks of allocating uses to areas or setting conditions on the conduct of uses. It is important to develop a database or meta-database so that the information is accessible for the planning process but it is particularly important to identify gaps in available information. This is a task for the planner as information client and should generally be done in parallel with the process of clarifying decision rules because that is the point at which specific information requirements are most obvious. It is the nature of most planning processes that by the time there is a decision to make a plan there is a very limited time period for collection of new information. It is important to identify immediate research priorities that can contribute to the planning decisions on purposes and conditions of use entry. The process will also identify longer-term research activities that should be conducted in order to assess the effectiveness of the plan and ensure that information not available in the initial planning can be available for plan revision.

To illustrate the process I attach a list of some possible decision rules noted during the workshop and the information needs they generate. My recommendation to the University of Gent would be conduct a research project to develop a set of suggested decision rules or operating principles in a consultative process with government, sectors and the public and to use this to identify research priorities for the eventual planning process. It is almost certain that the research derived decision rules will be revisited when the planning process starts. But it will probably be the case that the revisions will be relatively minor and any further research done to address information gaps identified by decision rules will be a major contribution to the actual planning process.

A second recommendation would be to develop research partnerships with agencies in neighbouring countries so that the ecosystem and EU usage contexts of the Belgian North Sea are clearly understood by all countries with primary responsibilities for the ecoregion.

Table of some decision rules and information needs noted during the workshop. Some of the information needs may relate to several decision rules.

Table II.1a: Some decision rules and information needs during the expert workshop (Jan 2004)

Decision rule	Information need
Provide for at-sea disposal at levels similar to current.	Social and economic costs and benefits of dredging. Likely future demands, economic justification and costs for deeper dredging.
Reduce impacts of dredge spoil disposal to minimum practicable.	Current flows, spawning areas, and linkages.
Maintain current shipping traffic management corridors.	Map shipping corridors.
Make provision for expanded level of marine gravel/aggregate extraction.	Extent of natural replenishment of gravel/aggregate and comparison to rate of extraction.
Minimise impacts of marine gravel/aggregate extraction.	Comparison of dredged and undredged areas.
Marine gravel/aggregate extraction should never expose seabed clay strata.	Map of thickness and grades of sediments overlying the clay/rock substrate of the Belgian North Sea.
Provide marine wind farm sites sufficient to provide certain % of Belgium's power needs.	Intended role of wind generation in national energy strategy.
The seabed at sites allocated for wind farm development should not consist of mud or fine sands.	Map of suitable areas.
Some areas suitable for wind farms should be set aside as control or reference areas for determining the impacts of wind farms.	Map ecological values of all potential wind farm areas to help identify reference and protection values.
Maintain local fishing communities.	Identify and evaluate social and economic characteristics and viability of local fishing

	communities.
Maintain sustainable commercial and recreational fisheries.	Identify areas of usage, catches trends and economic values of commercial and recreational fisheries.
Allocate a defined percentage of relevant fish stock/fishing areas to recreational fishing.	Cost benefit analyses of commercial and recreational use of fish stocks.
In consultation with the Government of Flanders, make reasonable provision for development of coastal marine recreation and tourism.	Map areas used currently for recreation and tourism activities, and areas with potential for recreational and tourism use. Map of Flanders coastal plan and implications for use of marine areas.
Protect representative areas of the seabed from activities such as trawling and dredging that disturb benthic communities.	Map of areas of seabed use by activities. Map relative usage importance of different parts of the area. Map relative ecological importance of components of the area.

Bart KORF

The North West European society has many demands competing for allocation in the North Sea: not only the more traditional uses of fishing, shipping and maritime defense, but also oil and gas drilling, sand dredging, wind energy and the allocation of marine protected areas are forms of present day use. We are even considering the construction of an artificial island off the Dutch coast to be used as an airport.

These developments are causing the North Sea to become more and more crowded. The appearance of the sea will change drastically over the next decade. Even in the seemingly endless vastness of the sea competition for space for the accommodation of the different human uses is becoming increasingly likely. We cannot foresee when this will exactly happen, but inevitably competition for space at the sea will become apparent.

We need to consider whether our present legislation is able to cope with these developments. The present day legislation for the EEZ of the Netherlands consists of a set of different sectoral laws: Mining Law, Sand and Gravel Extraction Law, and the Law for the Management of Public Works. The Environmental Impact Law and several other environmental laws also apply to activities in the EEZ. These are adequate for the time being.

So there is no general, more integrated law in force. Recently the Dutch government has decided to enforce the Nature Conservation Law and the Flora and Fauna Law in the EEZ. At the same time our government has decided that there is no need for a special North Sea Law.

At the moment some relevant policy documents are in process in my country: a.o. the "Nota Ruimte" (National Policy Document on Spatial Planning) and the Integrated North Sea Management Plan 2015; the latter is a plan of the directorate of the North Sea Public Works Authority. Furthermore in January 2004 a workshop on Spatial Planning of the North Sea was organized by the OSPAR secretariat in order to deal with section 76 – 79 of the Bergen Declaration (containing the conclusions of the Fifth International Conference on the Protection of the North Sea, March 2002, Bergen, Norway). So the national and international North Sea policy is beginning to move slowly towards a more integrated approach. In my opinion international cooperation and tuning is very important in this process.

Methodological Input from Flemish Spatial Structure Planning for Marine Planning

Hans LEINFELDER

Introduction

Since the start of the 1990s Flanders has developed a new spatial planning policy, called structure planning. In 1996 and 1999 it resulted in new legislation that replaced the existing national law, dating from 1962, and in 1997 the first Spatial Structure Plan for Flanders was approved by the Flemish government and parliament.

Although without doubt spatial planning on land differs fundamentally from marine planning, input from the experiences with the Flemish structure planning methodology can be useful for marine planning.

First my presentation will focus on the procedural aspects of spatial structure planning in Flanders that, until now, have shown to be successful in developing public support for the spatial policy plan. Second I shall highlight the content of a structure plan, or better said, the successive steps in building up a coherent plan. Because of the fundamental differences between spatial and marine planning I shall try to give an initial translation of the terms/jargon of spatial planning in – may be – useful terms for marine planning. Finally I shall briefly centre on the necessary steps for implementation.

Procedural aspects of spatial structure planning

Spatial structure planning is considered to be a form of strategic planning. Fundamentally, this means that spatial structure planning is not comprehensive. It is no longer possible to cope with all the problems and qualities in our complex society. The sectoralisation in vertical, quasi isolated departments in government structure on the one hand, and the increasing ambitions at the different policy levels (European, national, regional, local, transborder … etc) on the other hand, do not improve the conditions for the former technical planning approach, typical during the 1960s and 1970s (fordism).

As a result of the changing planscape, starting a spatial structure planning process now involves defining the scope (problems, qualities, opportunities … etc) of the planning process to focus the research, the analyses and the debate. The scope is defined through discussion between relevant stakeholders who become more deeply involved, and convinced of the necessity of the planning process, through a common sense approach.

The planning process itself is being developed on three simultaneous and coinciding tracks.

The first track is the development of a long-term vision of the spatial structure of a region and consists of an abstract, but strategic vision crystallised in spatial concepts. Where do we want to be within 10, 15, 20, 30, 50 … years.

As the development of a long-term vision takes time, because of negotiations and the slowness of political decision-making, short-term actions are made possible on the second track. Nevertheless, these actions need to fit in the long-term vision under construction so a permanent feed back between the two tracks is necessary. The experiences with the public through the short-term actions will support the development of the long-term vision, and vice versa.

The third track is communication. Communication between different policy levels, negotiation with stakeholders, information and participation of civil society, are absolute necessities to a long-term vision and the realisation of short-term actions.

Successive steps in the development of a spatial structure plan

Of course the development of a spatial structure plan starts with an analysis of the existing situation. As mentioned before, however, it is impossible to undertake a comprehensive analysis, so the scope of the strategic plan influences the topics that are analysed. The aim of the analysis is an integrated image of the main spatial elements in a certain region, also called the existing spatial structure. In practice this analysis is often executed through: first, the morphological and functional analysis of different spatial substructures – the physical system, the settlement structure, the structure of open area functions (nature, agriculture … etc), the structure of economic activities and the traffic infrastructure; and second, the integration (which is more than an addition) of these substructures, which highlights the spatial relationships between the different substructures. In marine planning the emphasis will probably be more on functional rather than on morphological features. Intuitively potential substructures for marine planning could be the physical system (currents, relief, geology), nature (bird routes and stopping places … etc), fisheries, harbours, energy production, recreational activities, courses of navigation for the transport of people or freight, undersea cables … etc. The territorial combination of several substructures (functions and activities) can result in the definition and characterisation of sub-regions in the analysed region.

The next step in the development of the spatial structure plan is the formulation of a "desired" spatial structure. Taking into account the existing spatial structure, an overall vision for the region is defined. Although I hesitate at formulating a vision for the sea, the overall vision of the Spatial Structure Plan for Flanders, "Flanders, open and urban", illustrates that a vision is in fact a stepping-stone that gives direction to the spatial concepts, the policy perspectives and the actions that are formulated later on in the plan. A spatial concept gives a condensed expression, in words and in images, to the way in which the government thinks about future spatial development. As a spatial concept can be expressed in an image, it means that the content of a spatial concept has to be locatable. The integration of different spatial concepts results in a schematic image of the desired spatial structure. This desired spatial structure can consequently be operationalised in development perspectives and actions for the different sub-structures, which have already been analysed. The step of formulating concepts and their integration into a desired spatial structure plan has to guarantee the coherence of development perspectives and actions.

Necessary steps for implementation

Spatial structure planning in Flanders ends with the formulation of perspectives and actions. This implies that a spatial structure plan is quite abstract and vague and as a consequence is not powerful enough to limit individual property rights. It is no more than a political vision on spatial development and thus only binds different government levels to the extent they are involved.

When the necessity occurs to implement certain aspects of the structure plan in order to make decisions, the relevant parts of the structure plan must then be translated into an implementation plan. Because of the judicial nature of implementation plans they require precision very specific in zoning.

Blending Information: The Use of Local Ecological Knowledge for Spatial Planning at Sea

Grant MURRAY

Spatial planning at sea often involves attempting to integrate economic, social and environmental dimensions into management plans for specific geographic areas. To be effective, spatial planning requires accurate and relevant information about the marine environment as well as the dynamics of historical and contemporary marine resource usage patterns. Knowledge about past marine ecosystems is particularly important when management is concerned with restoring degraded ecosystems or areas. Resource status and usage patterns in marine areas are often difficult to gauge and scientists and managers rarely have enough, or the right kind of, information to ensure effective spatial planning. Fisheries science, for example, often only has access to quantitative, large-scale, offshore data that can be limited to species of commercial importance.

We begin with the argument that the environmental knowledge of local resource users can be an effective complement to scientific knowledge for spatial planning at sea. It may also be essential for interpreting more traditional types of data. Local ecological knowledge (LEK) is based on the experience of local resource users, and is quite different from normal 'science' in that it is usually transmitted orally, is location based, and can have significant time depth. Although the information gathered from any one fisher is usually limited to the particular geographic area with which they have direct experience, their knowledge is often highly detailed and specific to areas not always covered by fisheries science. Furthermore, this knowledge can, at least in theory, be collected and aggregated to construct a larger scale, highly detailed picture of local fisheries extending back several decades (Neis and Felt 2000). The qualitative, long-term, local, and coastal character of fishers' observations, in other words, can be seen as spatially and temporally complementary to more 'scientific' information (Neis et al. 1999).

The presentation will give a few examples of 'useful' information that LEK can provide (see Hutchings 1996 and Neis et al. 1999). In managing scarce stocks or sub-populations, for example, LEK can illuminate aspects of local stock structure including movement patterns, spawning grounds, juvenile habitat and spatial patterns in fish morphology. Dates when fish are caught in fixed gear in different locations can indicate seasonal and directional movements of fish populations, while negative trends in CPUE can be quantified on a decadal scale that provides a clearer picture than landings information alone. Furthermore, harvesters may also have information on commercially insignificant but ecologically important species that may appear as bycatch. LEK researchers have developed specific methods to reconstruct historical changes in the fisheries of the northwest Newfoundland and Labrador coasts of eastern Canada. This research involves combining different types of information, including Local Ecological Knowledge (LEK), archival information contained in the historical record, and 'scientific' information from a variety of sources. In the case of LEK, sampling strategies to arrive at a sample of fishers from different areas and fisheries should attempt to reflect the social, spatial and technological complexities of current and past fisheries in our study area. In our LEK research, we actually include two different types of semi-structured interviews, including taxonomic interviews with older, retired fish harvesters and career history interviews with recently retired fish harvester experts. Both types of interviews involve verbal and chart data, where ecological (and other) information is either drawn directly on maps or remains verbal, but where the maps are used to generate and focus discussion.

Some additional challenges and advantages related to doing this kind of research include sampling issues, concerns about data interpretation and 'filtering', and finding 'linkages' between different types of data. Overall, neither system (LEK or 'normal' science) alone provides a comprehensive portrayal of environmental phenomenon and human interactions with the environment. Combining these knowledge sources with archival data has the potential to create a new knowledge system with significant potential to increase the effectiveness of spatial planning in marine environments.

Conflicts in German Offshore Waters (mainly the EEZ) and First Approaches for a Solution by Spatial Plannings

Eike RACHOR

For several years, new developments have occurred in offshore waters of the North Sea and the Baltic Sea, mainly including planning for wind farms[1], sand and gravel exploitation and nature conservation (according to the European Habitats and Birds Directives). Until now, no legal instrument existed to direct such planning and to restrict them to suited, non-conflict areas. Germany uses the instrument of spatial planning on land ("Raumordnung") to reduce conflicts and allow for very early decisions about suitable sites and different uses, especially in the case of specific developments.

No such instrument has been applicable until now within coastal waters (up to 12 nautical miles), or the increasingly important exclusive economic zone (EEZ). This was recognised by the Conference of the German Ministers for Raumordnung in December 2001, when a proposal was made to the Federal government to develop a strategy for spatial development and to investigate whether the German laws of Raumordnung can be applied to the EEZ.

The Land Niedersachsen (Lower Saxonia) has already initiated spatial planning within its coastal waters, where large areas belong to the Wadden Sea National Parc.

Permissions for wind farms and sand and gravel extraction within the EEZ are granted pursuant to specific laws, which consider each application on its individual merits and must not regard parallel proposals at a greater distance from the site in question.

Over the last few weeks, the Federal Ministry for Environment has allowed an open discussion of potential proposals for the European NATURA 2000 network, during which areas to be possibly developed for marine nature reserves were put forward[2]. In addition, areas outside such potential reserves and suited for large wind farm constructions ("Eignungsgebiete" for wind energy converters) have been proposed and are now in discussion. Such new developments are considered to be helpful for investors and may be regarded as the first step towards spatial planning in offshore waters.

Naturally, such planning should consider developments in the neighbouring countries' EEZs, which requires international cooperation and coordination.

[1] www.bsh.de/de/Meeresnutzung/Wirtschaft/Windparks/index.jsp
[2] www.HabitatMareNatura2000.de/

The Belgian Sea
Hance SMITH

The purpose of this presentation is to consider the practical implementation of a sea use planning system for Belgium. It first considers salient points regarding the geography of the 'Belgian Sea'. This is followed by a brief discussion of the vision and purpose underlying the establishment of such a system; stages of plan development; the format of the plan(s); and a brief conclusion.

From a sea use planning perspective, the key coastal and marine environmental regions involved are respectively the Schelde, the inshore coastal area, and the open sea. Key aspects of sea use patterns include the global shipping route connecting the English Channel and the North Sea; the cross-Channel ferry routes; and major Belgian port approaches. Also of high priority are aggregate dredging, demersal fisheries, coastal leisure activities, waste disposal, and conservation uses. The overall spatial plan or plans will be built on the interactions among the uses, and the relationships between the uses and the environment.

The presentation briefly considers the vision and purpose of the spatial planning approach in this case. Fundamental ideas relate to development, sustainability, connectivity and governance. There follows the specific objectives – particularly the national objectives, but also taking account of the federal structure of the Belgian government and local authorities; and EU and international dimensions, which are of particular significance in the present case. The technical underpinnings of the spatial planning approach are also outlined (Matrix).

The stages of plan development are grouped into three themes. First are the information bases involved, including research, scoping of the plan(s) and formation of stakeholder networks. This is followed by development based on conferences and workshops and pilot study areas, taking due account of the influence of cultural factors such as language. Management of plan development is considered in terms of stakeholders, political aspects, implementation and monitoring.

Factors to be taken into account in formatting spatial plans include external influences: environmental, technological, economic, social, political and risk all of which have regional implications. The objectives are also considered; followed by the roles of the organisations involved and the nature and degree of integration required at various geographical scales.

Finally, concluding comments are made regarding the Belgian Sea, vision and purpose, stages and format

Sea Use Matrix
Hance SMITH

Table II.1b: Sea use matrix

			Sea and Land									**Land only**	
			Transport	Strategic	Minerals & Energy	Living resources	Waste disposal	Leisure & recreation	Education & research	Conservation	Coastal engineering	Settlement	Manufacturing & Services
TECHNICAL MANAGEMENT	**Information Management**	Environmental Monitoring											
		Surveillance of uses											
		Information technology											
	Information Assessment	Environment											
		Technology											
		Economic											
		Social											
		Risk											
	Professional Practice	Natural/social sciences											
		Surveying											
		Engineering											
		Accountancy											
		Planning											
		Law											
GENERAL MANAGEMENT	**Technical management co-ordination**												
	Organisation management												
	Policy												
	Strategic planning												

Using GIS to Facilitate Public Participation in the Spatial Management of a Marine Commons

Kevin St. MARTIN

The marine commons is increasingly managed using spatial approaches and methodologies. For example, fisheries have been typically addressed in terms of quantities by species for numeric allocation, but management bodies are now turning toward more localized and inherently spatial forms of management (e.g. rotating closures, Marine Protected Areas, areas of concern relative to endangered species or habitats, ecosystems approaches, and community-based management zones). The implementation of spatial approaches is made possible by new technologies and methods such as GIS. At the same time, these technologies are producing new ontological understandings of the marine environment as a spatially diverse "landscape" inhabited by a variety of users and interests. New categorizations of the marine environment are produced and reified via these technologies. While the marine commons has always been a heterogeneous environment, it has been difficult to represent it as such without the advent of GIS technologies and the ever-expanding collection of spatial data in digital form. Both the natural environment (e.g. benthic habitats, bottom morphology) and the social environment (e.g. fishing zones, energy production areas) are produced via maps that detail their characteristics and locations.

These newly emerging geographies of the marine environment do not typically include local and community-based understandings of space. Indeed, they often "over-write" the geography of the marine environment as understood, for example, by fishermen or recreational users. How the common marine environment is being defined via new spatial technologies employed by official agencies, etc. directly contributes to an effective dissonance between new images of the environment and those maintained by coastal communities and the public. Integrating the spatial understandings of community members/public groups as central to the formation of spatial management plans will produce a process where the public is engaged at the fundamental level of producing/defining the space of the common marine environment.

Research on the use of GIS as part of a public participatory methodology has lead to the emerging field of PPGIS (public-participatory GIS), which focuses on the integration of local understandings of the environment as vital to the management of natural resources and commons spaces generally. For example, my own work maps locations of primary and secondary importance to fishing communities (defined by home port locations and gear types). These communities (in the U.S. Northeast) rely upon particular resource areas of the marine environment and have come to inhabit and intimately understand such areas. Integrating data layers depicting areas utilized by particular communities as well as the local environmental knowledge produced by such communities will contribute greatly to the spatial management of the fisheries commons. In addition, the visualization of "community spaces" on the commons provides communities with a sense of inhabitation and stewardship that is often eroded by images of the commons depicting only resources or government produced zones of management. Connecting on-shore communities to the specific offshore locations upon which they depend provides a concrete basis for participation at a number of levels.

The PPGIS approach is clearly valid beyond the case of fisheries and might be used as a way to integrate a variety of commons "inhabitants" (e.g. recreational or other user groups) into the spatial management of common marine environments. Integrating these groups and their geographic understandings and uses of the marine environment is an important step toward avoiding the dissonance that often results from official mappings of the environment that ignore the perceptions and experiences of local communities.

4 SESSIONS

Session 1: Non living resources

An introduction was given in terms of the Belgian state of:

- transport with shipping, dredging and dredge disposal;
- sand and gravel extraction; and
- energy with cables, pipelines and wind turbines.

A short summary emphasised the crucial issues for some of these users. The users were also geographically pointed out using a brief map introduction. The central question was "How do we allocate marine space to each user?" The discussion proceeded to build on relevant issues and questions concerning certain uses:

Issues on dredge disposal sites:

- Small pockets with high intensity disposal based on economic issues such as distance from dredging sites and recirculation
- Long distance and long term impacts as a consequence of turbidity plumes and toxic pollution
- Opportunistic use of dredge disposal as recycling for extraction
- The establishment of ecosystem links and ecosystem indicators to reflect dredge disposal impact
- The creation of larger "waste disposal" zones

Issues on sand extraction sites:

- Small pockets with high intensity extraction based on economic issues such as distance to the coast and sand suitability
- Local depressions and change in currents because of high intensity extraction pockets
- Missing data concerning sand transport and recovery of affected banks
- Long distance and long term impacts as a consequence of turbidity plumes and resuspension
- The spread of extraction intensity based on temporal closure of zones
- The establishment of ecosystem links and ecosystem indicators to reflect extraction impact?
- The creation of larger "extraction" zones in the open sea?

Issues on wind energy:

- Economic issues such as distance from coast
- Environmental suitability such as geology
- Environmental limits such as impact on alongshore sand transport, benthos, seabirds and habitats
- Seascape and distance to coast
- Cabling for electricity
- Interaction with other users such as shipping, fisheries and military use
- The establishment of ecosystem links and ecosystem indicators to reflect wind turbine impacts?
- The creation of "energy" zones?

Session 2: Living resources

An introduction was given in terms of the Belgian state of:

- fisheries and aquaculture;
- tourism; and

- marine protected areas.

A short summary emphasised the crucial issues for some of these uses. The users were also geographically pointed out using a brief map introduction. The central question was "How do we allocate marine space to each user?" The discussion proceeded to build on relevant issues and questions concerning certain uses:

Issues on fisheries:

- Required data
- Oral mapping
- Optimal scale for zonation
- Allocation of fishing zones
- Environmental limits of fishing zones
- Socio-economic effects
- Interaction with other functions

Issues on aquaculture:

- Allocation of aquaculture zones
- Environmental limits and suitability for aquaculture
- Interaction with tourism, MPAs and energy

Issues on tourism:

- Required data and level of detail
- Data on effective location and intensity
- Allocation of tourism activities
- Differences in beach-related activities and sea activities
- Environmental limits for tourism zones
- Socio-economic effects
- Interaction between tourism and MPAs

Issues on marine protected areas:

- Ecological data for designating MPAs
- Required level of data
- Data on management measures in designated MPAs
- Allocation of MPAs
- Offshore MPAs (beyond 12 miles zone)
- Optimal scale for MPAs
- Elements to be taken into account for delimitation
- Integral coastal protected areas (combination of land and sea protected areas)
- Effects of MPAs on environment: chances for restoration
- Effects of multiple-use zones
- Socio-economic effects

Session 3

The second day of the workshop (session 3 and 4) tried to address the issues as generated by the two previous sessions in more detail. The challenge is to bring the different use functions together and to actually make a plan taking into account the different data, zonation and interaction issues. Session therefore concentrated on the following issues:

Data:

- How to deal with missing, insufficient or incomplete data?
- How to deal with availability of data?
- How to choose the level of data? What about sampling point clustering?
- How to detect the necessity of data?

Zonation:

- How to deal with spatial scale?
- How to deal with the degree of resolution and the size of the zones?
- How to deal with suitability of zones for certain user functions?
- How to define homogenous zones? On a legal basis or on a physical/environmental basis?
- What criteria should be used for environmental zonation?

Interaction:

- How to deal with effects if not described in literature?
- The use of a qualitative vs. a quantitative index for effects?
- How to deal with spatial and temporal scale?
- How to deal with effects on the environment? Ecosystem level? What indicators?
- How to deal with effects on the socio-economic system? What indicators?
- How to deal with cumulative impacts?
- How to deal with hypothesised and/or delayed impacts?
- How to deal with contrasting effects of one use on several components
- How to compare or combine impacts from different uses? Can we use impact classes?

<u>Session 4</u>

The last session aimed at summarising the previous discussions. It was meant to lead to answers on the above questions and to potentially create recommendations. This session wanted, however, to go beyond the mere scientific and analytic approach of the previous sessions. Accordingly, two additional aspects were dealt with:

- Balancing environmental and socio-economic objectives
- Decision support and public participation

5 CONCLUSIONS OF THE WORKSHOP

Introduction

- As discussed above, sessions 1 and 2 described the different historical, current and future uses of the Belgian part of the North Sea (BPNS), and their issues regarding spatial planning. The following two sessions then introduced the GAUFRE project, as a project that is searching for a strategic planning tool and a decision support instrument for spatial planning within the BNS. Emphasis was placed on the different analytical steps to be followed.
- The workshop revealed different elements, proposals and recommendations towards the further development of the GAUFRE project. These are stated below. However, the issue of spatial planning at sea was tackled on two levels. It is therefore important to emphasise that the focus of the workshop was on:
    - The development of an analytical decision support system rather than on the management of political decision making; and
    - The development of a tool rather than the actual preparation of a spatial plan, which is regarded as the outcome of such a tool.

Strategic vision

- The development of a strategic vision concerning a spatial plan at sea – before initiating a planning process – is very valuable and often underestimated.
- The strategic vision and its link with a spatial plan could learn from the procedure under which a "desired" spatial structure plan for land is produced. This "desired" plan is fed by an underlying strategic vision.
- The strategic vision should go beyond short-term issues and small-scale conflicts. It should optimally take into account:
    - Revision of a rigid system being ruled by political and economic sensitivities;
    - Integration of planning at sea with planning on land;
    - Integration of national planning with regional and international planning; and
    - Public participation from the very beginning.

International framework

- Most uses and their space allocation on the BPNS should be seen in a strategic way within an international and European network. It is obvious that marine spatial planning should go beyond national boundaries.
- The Belgian part of the North Sea is – on different levels – part of a much larger system belonging to the North West Atlantic, the EU waters and the North Sea. It links the English Channel with the southern part of the North Sea.
- The levels that contribute to the international integrative network are varied. The most important however are:
    - Shipping: The BPNS covers one of the busiest shipping routes in the world linking the English Channel with the southern part of the North Sea. The Belgian coast and the Westerscheldt estuary reveal harbours that are part of a larger harbour network along the North Sea nations (Hamburg-Le Havre Range).
    - Fisheries: Both the economic control of the fish catches (EU Common Fisheries Policy) as well as the ecological control of the fishery stocks (spawning and nursery areas) are to be seen on an international rather than national level.

  - Environment: The EU Environmental Policy Framework stresses the need for coherent knowledge of ecological significance and biodiversity on an international scale. It is also obvious that environmental impacts are transboundary.
- The strategic vision (see 2) will have to be rethought within this international framework and will need to break through a solid system of historical and fixed rules.
- General recommendations that were given regarding the international framework are:
  - Cooperate with neighbouring countries within research partnerships;
  - Cooperate with neighbouring countries making use of agencies within these countries.

Decision rules

- In order to identify the operational context of all allowable uses, decision rules for sector need to be described. These decision rules therefore are operating principles and should be a reflection of the best option and the most ideal situation for the sector. They should be based on a general strategic vision (see 2.) and should take political issues into account.
- The decision rules cannot be isolated from intersectoral clashes, conflicts and synergies. They are therefore to be identified as "as far as practicable" taking these interactions into account. These intersectoral interactions should go beyond the marine realm and also concentrate on links with land use.
- The types of decision rules that are generated within the different sectors are varied and encompass:
  - Legislative requirements: These requirements are on a single use level such as EIA or on a multiple use level. Examples are "as of right" rules and permit and licensing systems;
  - Political and policy requirements on a single and multiple use level;
  - Scientific requirements leading to quantitative decision rules either based on the socio-economic state of the activity or on the state of the environment.
- The method to generate decision rules should start from existing rules. It should then make use of public participation, expert knowledge and literature. The consultative process with government, sectors and public is very important.
- The aim of decision rules in the planning process is to identify possible solutions within constraints. This process therefore follows 3 steps:
  - Define clear goals and objectives per sector i.e. outline the decision rules per sector in interaction with other sectors (see above);
  - Define the type and the resolution of data needed: Decision rules as generated under step 1 should lead to the identification of required information. These data gaps then make way to future focused research. Immediate research priorities should directly contribute to the planning process. Long term research priorities could eventually fine-tune plan revisions in a later stage;
  - Make a management plan with different scenarios using a multiple objective analysis in order to balance the objectives of the decision rules for each sector with one another. By the time the actual planning process has started, decision rules for each sector will only show minor differences.

Information

- Information is needed at all levels of the planning process as stated under 4.5. The management of data however faces problems. Most of these problems are to be found on two levels:
  - The quantity of data: missing data or a problem with accessibility to data leads to data gaps. On the other hand, too much data can lead to a lack of overview and focus;
  - The quality of data: not all data is fit for use and metadatabases are needed to control quality.

- Data management should go beyond the mere scientific generation of data as being published in literature and grey literature. It should also make use of thorough public participation. This can contribute to the filling of data gaps, but can also narrow data if too much is available.
- The use of public participation as a data tool can reveal historical data, local ecological knowledge and socio-economic knowledge. It should concentrate on the community as a whole, on representatives of the different stakeholders and on experts. It should be made clear that the delivery of information by the community and by stakeholders is in their own advantage.
- Especially the fisheries sector is a valuable source of public and oral information. Specific methodologies exist to reach the fisheries community and to generate information from these interviews. This leads to the collection of historical data, to oral mapping, to fisheries hot spots, etc.
- Information and data gathered using public participation should not be seen as unscientific. Public information is seen as an additional – scientific – source of information. Social science should be seen as an integral part of the whole process. It should eventually be combined with, rather than replaced by, "real" scientific data. "Social" data has the strength to bridge analytical gaps created by a continuous flow of "real" scientific data.
- Besides the search for new data gathering tools – such as public participation – attention should also be given to certain data pools:
  - Information on cross sectoral issues and conflicts is of the utmost importance to generate decision rules and to balance them in a planning process;
  - Monitoring and the use of carefully selected reference sites will reveal reference data to be used within a dynamic planning process.
- In conclusion, it was stated that there is need for a general way of coping with data problems and learning how to deal with uncertainty and missing data:
  - It is not necessary to collect all data in order to make a decision; and
  - It is important to be open and honest about data problems.

<u>Public participation</u>

- Public participation aims to actively involve the public in the planning process. It can either be institutionalised or at random. The use of public participation within the planning process should start from the very beginning. There is need for a continuous exchange of information between the public and planners.
- Public participation is used on three different levels:
  - The collection of data from the public by making use of local knowledge (see 5);
  - Involving the public in the planning process; and
  - Involving the public in the decision making process.
- Involving the public in the planning process can be done on different levels:
  - The public should be involved from the beginning with the creation of a strategic vision (see 2);
  - The public should be involved from the beginning with the creation of decision rules (see 4). The exchange of goals and objectives among stakeholders from different sectors can lead to an acceptance of "as far as practicable" decision rules within each separate sector;
  - The public should be involved from the beginning with the generation of scenarios and scenario impact analysis. The risk exists that these scenarios are not politically acceptable. The actual generation of scenarios, however, should be done independently from politics.

- The extent to which the public can actively get involved in the planning process is dependent on several factors. Some sectors such as fisheries will be more open for involvement. The political and cultural background of the country or community involved can also play a role.
- Involving the public in the decision-making process can also be done. Though the actual decision-making is done by the decision makers, the public can also play a role. The active involvement of the public in the scenario generation during the planning process will avoid conflicts at the end of the planning process, and when decisions start needing to be made. Though the public may not be actively involved in the making of a final decision, this process will enhance the acceptance of a final plan or a decision.

Technology

- Information management, impact analysis and decision support can all be assisted by using a variety of techniques and methods.
- Two issues were touched upon during the workshop concerning information management techniques:
  - Several techniques exist to generate information from local knowledge and usage knowledge. Most of them can be found in the social fisheries sciences;
  - Geological, biological and ecological information should be expressed in a geographical way by means of validation mapping. However, these validation maps should go beyond mere data and should therefore address issues of functionality within the system (i.e. its link with hydrodynamics or its link with higher trophic levels). It is also important to put "validation" within a human value system.
- Impact analysis can be tackled in different ways. The use of matrices is a simple way to combine different aspects of different sectors and carry out a physical conflict analysis based on best knowledge. This can only be done after a definition of objectives and priority actions of current and future uses. The environment should also be defined.
- Decision support systems are extremely important tools during the planning process. Possible techniques are multiple objective analysis, cost benefit analysis and comparison methods in which decision rules of sectors and among sectors are evaluated and balanced. During the development of these decision support systems, two issues need to be taken into account:
  - Decision support systems should not be too sterile and analytical. Such tools will lead to outcomes that will not be accepted by the public. The public might show up with proposals that are completely different from the analytical outcomes of the tool; and
  - Decision support systems should not try to take every single detailed impact into account. A detailed impact analysis will lead to even more analytical gaps and confusion about reliability of outcomes.
- There is also an increasing need for academic and educational tools in order to make the public familiar with issues concerning marine management.

Management instruments

- The allocation of marine space to different uses and concurrent marine spatial planning is a major instrument in managing the marine environment in a sustainable and productive way. Other instruments are also available.
- Planning and regulation of the public commons of marine areas and resources carries a requirement to consider the best public benefit from those resources. The burden of proof is conceptually on the user of those resources to demonstrate that the use is reasonable, sustainable and that it does not bring unreasonable detriment to other current and future uses. An example of this burden of proof would be to demand performance data in order to maintain a permit or license.

Financial management instruments were also addressed such as the polluter pays principle and the creation of funds by users themselves in order to finance management issues and monitoring in a later phase.

- The limitation of accessibility to resources was briefly mentioned during discussions on fisheries. The temporal or permanent closure of areas in order to safeguard fish stocks can be done in different ways. It was stated that the protection of spawning and/or nursery areas – even if situated outside the BPNS - will be more effective than the actual closure of fishing grounds themselves.

Planning process

- The above-mentioned aspects are all part of the actual planning process, be it on different levels and in different stages of the process.
- The planning process however should be characterised by certain general principles:
  - The planning process should be a systematic and iterative process following a well developed protocol;
  - The planning process should be open. This transparency should be reflected on different levels such as legislation, information gathering, impact analysis, technology as well as on generation of scenarios and the actual decision support;
  - The planning process should be dynamic and continuous with a large degree of flexibility towards modification in time. Continuous monitoring within carefully selected reference sites is a way to guide this process; and
  - The planning process should be positive and avoid the process of exclusion. Especially on a small area such as the BPNS, it is of the utmost importance to stress opportunistic and mutual use of space (such as tourism, MPAs and fisheries; and wind farms and aquaculture).
- It can be valuable to apply certain aspects of the land planning process to the process of planning at sea. This is already reflected in Decision Rules. Land use planning also starts from an existing spatial structure with baseline information on socio-economic and ecological data. The generation of decision rules within and among sectors will then lead to the creation of a desired spatial structure with different scenarios.

Conclusion

- The elements, proposals and recommendations, as stated above, reveal two issues that reshape the continuation of the GAUFRE project:
  - It is important that the tool for decision making in spatial planning at sea is not too rational and analytical. It is important to merge pragmatism and public participation with the development of the tool;
  - The current methodology is valuable, but should be applied using decision rules that are created for each sector taking into account sectoral interactions. The actual tool should focus on calculating the impacts on these decision rules.

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CHAPTER TWO SUITABILITY ANALYSIS

1 METHODOLOGY

Suitability analysis is an important tool within marine spatial planning as it indicates which zones of the BPNS are suitable for different types of activities. The suitability analysis is initially based on jurisdictional and technical constraints the different users should take into account. For some users, specific economical and social aspects can play an important role in the suitability evaluation of the BPNS.

The result is a suitability table of which:

- The rows represent the different types of uses within the North Sea; and
- The columns represent possible constraints.

2 RESULTS

In allocating specific zones for different types of uses within the BPNS it is important to consider both the applicable marine legislation, as well as the technical constraints of undertaking different activities in certain areas (Table II.2a). The technical constraints are subdivided in geophysical, hydrological, bathymetrical and chemical constraints. Technical constraints can also include the requirement for a safety zone where a particular use poses a safety risk in relation to other types of activities within the BPNS.

Besides jurisdictional and technical constraints (Table II.2a), socio-economic and ecological considerations can also play an important role in the allocation of zones. It is considered that an optimal allocation of uses should take into account:

- What are the economically most profitable places?
- Where are the social negative effects (visual disturbance, health) minimal?
- Is the ecological damage minimal?

This viewpoint has been taken into account when assigning, for example, zones for aggregate extraction, anchoring, etc. In this respect additional information about socio-economic and ecological information is given in Table II.2b.

Table II.2a: Suitability analysis of the users of the BPNS

	Juridical restrictions		Technical constraints				
	Zones	*Exclusion zones*	*Geophysical*	*Hydrological*	*Bathymetrical*	*Chemical*	*Safety*
Fisheries	0-3 NM: < 70GT 0-12 NM: < 221kW 0-12 NM: Dutch vessels 3-12 Nm: French vessels (herring, sprat)	Paardenmarkt, shipping routes EEZ: non-EU vessels to fish	generally none; beam trawling not on mud & sludge grounds	none	Min. 4-5 m (related to keel of ship + undulation water)	unpolluted	none
Aquaculture	Currently not applicable	Paardenmarkt	?	Low currents	Preferably < 10m	unpolluted	?
Aggregate extraction	Concession areas (15 million m³/ 5 years) EIA	Paardenmarkt	Between 125-500 µm & max. 0.8 –1.6 mm for fine sand; between 300-500 µm & max. 2.5 - 3 mm for coarse sand	none	Between 8 - 32 m, with ideal depth around 15 m	For application in concrete Ca < 30%	communication cable : > 250m pipeline : > 1000 m
Dredging		Paardenmarkt	none	none	Min. 4 m	none	none
Dredge disposal	EIA	Marine areas with exceptions	none	none	Min. 4 m	none	none
Dumping	Historically assigned zones; no dumping activities foreseen in future						
Wrecks	EIA (to abandon or destroy ship)		none	none	none	none	none
Anchoring	Westhinder anchorage legally determined	Paardenmarkt	none	none	none	none	
Shipping	Traffic separation scheme (TSS) internationally	Paardenmarkt	none	none	Min. 13 m (43 ft) for piloted	none	none

	Juridical restrictions		Technical constraints				
	Zones	*Exclusion zones*	*Geophysical*	*Hydrological*	*Bathymetrical*	*Chemical*	*Safety zones*
Research			none	none	none	none	none
Military	Assigned		none	none	none	none	
Cables & pipelines	Burying depth of electricity cables min. 1 m Crossing shipping lane: depth described in permit EIA	Dumping & anchoring zones	none	none		none	electricity cable & 500 m both sides gas pipes For cable/pipeline laying: 50 m on both sides electricity cable
Wind farms	Assigned to concession zones EIA	shipping routes, military zones, dredging zones, cables & pipelines, industrial waste and dumping sites	Preferably no hard stone layers (tertiairy), scour hollows (quaternary), deformations, seabed areas < 2.5 m and dune areas	none	none	none	Electricity cable: 250 m Communication cable: 250 m Pipelines: 500 m Shipping route: 5 km
Coastal defense	EIA	none	none	none	none	none	
Recreation	in assingned launch zones; Non-motorised: < 1 km if < 7Bft; Swimming	Harbours/marina's	none	none	none	none	Safe distance to hard coastal structures
MPA	Assigned		none	none	none	none	none

Table II.2b: Socio-economical & ecological recommendations

	Economical			***Social***		***Ecological***
	Distance	***Technical***	***Other***	***Safety***	***Other***	
Fisheries	Close to coast	Preferably sand or stone grounds	Preferably rich fish grounds Unpolluted areas		Fishing has cultural value	Alternative fishing techniques
Aquacultur e	Close to coast		Preferably in combination with wind farms Unpolluted areas			No intensive fish farms Shell fish (mussels, oysters, etc.)
Aggregate extraction	Close to coast					
Dredge disposal	Close to coast					
Cables & pipelines[1]		Optimal depth to bury cable in medium to hard clay or rocks 2m; in sand, mud or soft clay 2-5 m				
Wind energy Van Hulle et al. 2004	Max. 40 - 60 km	Max. 20 - 30 m depth, depending on depending on site characteristics and turbine type Distance between 2 turbines 5 -10 rotor diameters in the prevailing downwind direction and 5 rotor diameter in crosswind direction		sufficient distance from shipping lanes	Min. distance 25 km due to visual disturbance	Excluded in MPA & important bird migration routes

	Economical			***Social***		***Ecological***
	Distance	***Technical***	***Other***	***Safety***	***Other***	
Wrecks				Not in shipping lanes	Protection status for wrecks with cultural and historical value should be considered	The installation of specific marine reserves as circles with a radius of 500 meters around the following wrecks is proposed: the Westhinder, the Waverley, the Lies, the Kilmore, the Garden City and the Birkenfels
Coastal defense				Maximal		Preference soft coastal defense to minimise ecological impact
Recreation				Safety zones towards hard coastal defense structures, Guarded bathing zones		
MPA						One large flexible area

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CHAPTER THREE INTERACTION BETWEEN USERS AND THE ENVIRONMENT

1 INTRODUCTION

It is important to understand and manage human activities and actions and their effects on the marine environment if an ecosystem-based marine structure plan is to be developed. One of the tasks in the description of current uses of the North Sea is to describe the impact of human activities on the environment by performing an environmental impact analysis.

The environmental impact analysis has a number of different stages, including:

- Identifying the impact:
  - Classification of environmental impact into 3 main categories (physical, chemical, ecological), further divided into 21 subcategories;
  - Defining the cause of any disturbances, divided in 16 uses, and further divided into 36 subcategories based on type of activities or construction/exploitation phase.
- Identifying the relative importance (qualitatively) of those impacts based on available literature and on expert judgment of the joint Gaufre-partners (Environmental impact table).
- Identifying the intensity of the uses and their subcategories on the BPNS (Intensity classification maps).
- Identifying the impacts of the uses and their subcategories on the BPNS (Environmental impact maps).

The final result of the environmental impact analysis is a physical, chemical and ecological impact map per use /activity. The following steps may be taken to reach this goal:

- Identification of the different environmental impacts on the BPNS and their sources;
- Qualitative evaluation by means of an environmental impact table;
- Drawing of intensity maps as a base for the environmental impact maps;
- Drawing of physical, chemical and ecological environmental impact maps.

The impact analysis does not make any judgments about the consequences of the identified impacts, nor does it explain the mitigation mechanisms that might be in place. It also does not analyse cumulative impacts.

2 METHODOLOGY

The need to qualitatively analyse the impacts of different users on the environment arose from:

- A lack of specific quantitatively scientific data of different users:
  - Lack of data on the intensity of certain uses;
  - Lack of quantitative impact-effect-intensity relations;
  - Quasi lack of quantitative comparison of impacts of different users;
- Contradictions in quantitative data literature by different authors;
- Uncertainty about specific quantitative data.

To be able to evaluate quantitatively the environmental impact of all the identified current and future users of the North Sea substantially more scientific research is needed.

The qualitative evaluation of the impacts of the users on the environment is based on available literature and on expert judgment of the joint Gaufre-partners. We are aware of the incompleteness and potential bias of this method, but it is the best option for performing an impact analysis that delivers results relevant for the end-users of the project.

2.1 IDENTIFICATION OF THE DIFFERENT ENVIRONMENTAL IMPACTS AND THEIR SOURCES

2.1.1 Environmental impacts

There are 3 main categories of environmental impact (physical impact; chemical impact; ecological) that have been identified. Each category has been further subdivided into relevant subcategories.

2.1.2 Sources of impacts

These impacts are the result of different activities taking place at the BPNS. The first step was the identification of the main users of the BPNS. Some of these uses were then further separated according to their different impacts on the environment. . The main users were identified as follows:

- Type of activity:
  - Shipping: commercial shipping
  - Fisheries: beam trawl, otter trawl, line fishing, standing nets
  - Aggregate extraction: sand and gravel extraction
  - Dredging: dredging, dredge disposal
  - Historical dumping: war ammunition, industrial waste
  - Military exercises: shooting, sweeping of mines, other
  - Water recreation: soft (non-motorised), hard (motorised), recreational fishing
  - Beach recreation
  - Aquaculture: algae, shellfish, fishing
- Construction/ exploitation phase:
  - Cables and pipelines
  - Wind farms
  - Coastal defense: hard and soft
  - Pylons
- Others:
  - MPA
  - Wrecks
  - Research

2.2 ENVIRONMENTAL IMPACT TABLE

Structure

All the possible environmental impacts of the identified users have been summarized in an impact table where:

- Rows represent different uses of the North Sea; and
- Columns represent classes of possible environmental impacts.

Scoring

The size of the environmental impact of each user/activity has been qualitatively scored based on available literature and expert judgment of the joint Gaufre-partners.

The following qualitative scale has been set up:

Score	Description
3	A known, major impact.
2	A known, medium impact.
1	A known, small impact.
0	Known as having no impact or a negligible impact.
0*	Known as having a negligible impact at low intensity, but having an impact beyond a certain (high) intensity threshold.
X	Known as having an impact, but the magnitude of the impact is not known/ qualified.
NK	Uncertainty if there is an impact or not.

Each score refers to the impact that a use/activity has on the environment.

Some important constraints should be mentioned at this point in the description of the approach.

- At this stage of the study, the impact of the uses is evaluated without taking into account interactions with other users. This is very important, as the nature of the interactions on other users is often poorly known, if known at all. This should increase the objectivity and reliability of the analyses of the impact.

- Only direct impacts have been scored. This means that secondary effects are not taken into account. This is important for a correct interpretation of the ecological impact (as this is in reality often a combination of direct and indirect effects). For example, the effect of fish aquaculture on benthos via the release of nutrients and via the release of micro-pollutants (e.g. antibiotics) is not reflected in the impact score.

- No direction is given on the severity of the impact. This means that the impact is evaluated only on its size (how big is the impact), but not on whether this is a positive or negative change to the environment. This approach has advantages as well as disadvantages.
    - The disadvantage is that this procedure is somewhat counterintuitive. The impact of MPAs becomes 0 on all accounts. MPAs do not influence the environment in a direct way (without taking into account the interactions – with the exclusion of other disturbing activities or uses). Of course the absence of other activities will result in a beneficial effect of MPAs on ecology (and perhaps chemistry or physical aspects), but as stated in the point above, different uses are separately evaluated.

- The main advantage of this approach is that no answer is needed (which is often policy biased) to the very difficult question of whether the impact is actually 'bad' or 'good' for the environment. The connotations 'bad' and 'good' include a moral/anthropocentric evaluation. For some impacts the answer to this question may seem quite straightforward, as in the case of release of persistent micro-pollutants in the environment that will result in deterioration of marine biodiversity. In other cases the answer is much less obvious. For example, is the change in morphology caused by dredging a 'good' or 'bad' change?

- The score on its own is density/intensity independent. This means that an impact is evaluated without taking into account how often or how intense an activity is taking place on the BPNS. An example will clarify this. The impact of beam trawl fisheries in the sediment morphology takes into account the effect of one fishing activity by one ship on the sediment morphology and does not take into account how often the activity takes place.

  The influence of the density/intensity of the use will be taken into account in a following step where impact is combined with intensity.

- The score does not take into account the duration of the effect (short term or long term) nor the recovery period needed after the impact. This means that a "1 second" explosion due to sweeping for mines is not necessarily evaluated a higher or lower impact than the month's long noise impact of construction works.

- The score does not take into account the spatial scale of the effect. For instances, the area impacted by soft coastal defense construction will not influence its impact score.

Despite all the constraints described above, it is recognized that even in those conditions the exercise of constructing a balanced impact matrix is not evident. One big problem is the lack of data and studies that would facilitate the balancing between different uses as well as between different disciplines. Nevertheless, we feel that the result can contribute to the objective study of the impacts over several disciplines and between uses.

A score was attributed following these steps:

- 1. Scoring per user/activity (row):
  - A first score (S1) was distilled from different literature sources (national, international)
  - Adjustment of the score (S1) has been done in relation to the relevance to the BPNS, resulting in score (S2)
  - Weighing of the different impact scores (S2) within an user/activity resulted in some cases in new adjustment of the scores (S3)
- 2. Scoring per impact category (column):
  - The final scores of step 1 (S3) were weighed per impact category/subcategory across users/activities and adjusted where certain users/activities impacts were deemed too large or too small in comparison with other users/activities for the same environmental impact category/subcategory. This resulted in the final scores (S4) found in the impact table.
- 3. The matrix resulting from the previous steps was subjected to an internal evaluation by different partners with different expert-knowledge. This was discussed in round table sessions to motivate and fine-tune the balancing between users/activities and between different disciplines.

Some additional remarks:

- Some users/activities cause an environmental impact of which the magnitude is not known (X).
- For some users/activities it is not known or certain if they cause a certain environmental impact (NK).

The following integrated scores were then calculated:

Score	*Calculation*	*Example*
S5 – score	Environmental impact score per environmental category per user/activity = Σ[S4-scores] $_{\text{per environmental category per user/activity}}$	Physical / Chemical/ Ecological impact of dredging

2.3 INTENSITY CLASSIFICATION MAPS

Besides qualitative impact evaluation, the different users/activities were scored on the intensity of their occurrence on the BPNS. Intensity scoring was based on the best available real intensity data. These were reclassified into four categories.

- 0 : no presence /activity
- 1 : presence / low intensity
- 2 : presence / medium intensity
- 3 : presence / high intensity

Based on these categories, intensity classification maps (Arc Gis, grid 1 km^2) have been drawn for each user/activity.

2.4 ENVIRONMENTAL IMPACT MAPS

The impact table together with intensity maps form the basis of the environmental impact maps.

The impact maps are ArcGis maps (grid size 1 km^2) and have been constructed in the following way:

- Basis:
  - ArcGIS Intensity Classification map (grid size 1 km^2) of each user/activity divided in 4 qualitative categories (3= high intensity; 2 = medium intensity; 1 = low intensity; 0 = no presence);
  - Environmental impact table of different users/activities.
- Environmental Impact Maps (Arc GIS, grid size 1 km^2):
  - Multiplication of Intensity map * Environmental Impact Score.
  - 3 types of environmental impact scores can be distinguished: a physical, a chemical and an ecological impact score. They give a relative scoring of the uses/activities regarding their physical, chemical and ecological impact on the environment.
  - For two activities (shipping, water recreation) an additional condition was integrated. If intensity surpassed an intensity threshold the '0' value of the impact matrix was changed into a value of '1' for the impact maps. This was done based on the following grounds:
    - ~ If an activity has no or only negligible impact, in an intensity independent way, then this would mean that whatever the intensity, no impact could be the result. This is of course not the reality. Therefore a critical analysis of the impact matrix where the scores were '0' was performed for the different uses to identify those impacts that could be expected to have an impact in high intensity situations, but no impact in low intensity situations. As mentioned before, these scores were noted as 0*.
  - The final layout is a map with a 9-gradation score (9= highest impact). In this way the physical, the chemical and the ecological impact maps can be compared <u>within one use</u>.

Following impact maps can be distinguished:

Environmental impact map	Calculation
Environmental impact map per category per user/activity	(ArcGIS intensity map per user/activity) * (S5-score per environmental category per user/activity) (f.ex. for dredging: a physical impact map, a chemical impact map and an ecological impact map)

3 RESULTS

3.1 CLASSIFYING ENVIRONMENTAL IMPACTS INTO CATEGORIES

There are 3 main categories of environmental impact, including: physical, chemical and ecological disturbance. These are further sub-divided in respectively 9, 6 and 6 disturbance subcategories.

Table II.3a: Overview environmental disturbance categories/ sub-categories

Category	*Subcategory*	*Specification*
Physical disturbance	Landscape	Visual disturbance.
	Sediment morphology	Small-scale spatial disturbance.
	Sediment composition	Mostly changes in particle size distribution.
	Waves & currents	Changes in hydrodynamics, direction and magnitude of waves and / or currents.
	Topography	Large-scale spatial disturbance.
	Noise	Increase of the level or amount of sound in the marine environment beyond its natural range.
	Light pollution	Introduction of a source of light that would not naturally occur in the marine environment.
	Temperature	Changes in the environment's natural temperature range.
	Turbidity/ light penetration	Change in the extent to which light penetrates the water column.
Chemical disturbance	Oxygen	Changes in the environment's natural oxygen range.
	Oil	This is restricted to the oil itself excluding micropollutants (PAHs, metals).
	Micropollutants	Introduction of substances that are normally not found in the marine environment. Includes heavy metals, organic pollutants, POP's, pesticides … etc
	Air pollution	Includes NO_x, VOC, SO_x, CO_2 … etc.
	Solid waste	Introduction of all types of garbage and solid waste.
	Eutrophication	Due to nutrients outflow, nutrient release or due to waste (e.g. fish offal, sewage).
Ecological disturbance	Habitat change	Change in the physical, chemical and ecological characteristics.
	Benthos	Change in biodiversity, biomass or interactions of benthic organisms.

Category	*Subcategory*	*Specification*
	Birds	Change in biodiversity, biomass or interactions of birds.
	Exotic species/ introductions (incl. pathogens)	Introduction of species to the marine environment that do not occur naturally or historically (exotic species) or of disease-producing organisms, either from terrestrial or marine sources (pathogens).
	Fish stocks	Change in biodiversity, biomass or interactions of fish.
	Trophic relations	Change in trophic interactions of benthos, birds and fish.

3.2 DEFINING THE SOURCES OF DISTURBANCE (USES)

In total 16 uses were defined for the BPNS. These were further divided into specific activities or construction/exploitation phases (Table II.3b).

Table II.3b: Different sources of disturbance: uses of BPNS

Use	*Description*	*Activity/ phase*
Fisheries		beam trawl
		otter trawl
		line fishing on ships
		standing nets (coast)
Aquaculture	Activities associated with cultivating food resources of the sea or inland waters. Possible causes of impacts include feeding, disposal of waste, maintenance, physical location … etc	algae
		shellfish
		fishing
Aggregate extraction	The exploitation of sand and gravel on well-defined concession areas at the BPNS.	
Dredging	Activities associated with the maintenance of port access and navigation channels.	dredging
		dredge disposal
Dumping	Historic activities associated with disposal of waste and other products (such as ammunition) at sea.	war ammunition
		industrial waste
Wrecks	Mostly historic shipwrecks	presence
		removal
Shipping	All shipping-related activities, including tourist activities. Possible causes of pollution include leaching of anti-fouling paints, ballast water discharge, maintenance and accidents.	
Anchoring places	Activities related to the anchoring of ships.	
Military exercises	Activities related to defense activities and training in the marine environment.	navigation
		shooting
		sweeping for mines
Cables	Activities associated with submarine cables (communication cables	construction

Use	Description	Activity/ phase
	& electricity cables).	exploitation
Pipelines	Activities associated with pipelines.	construction
		exploitation
Wind farms	Activities related to the production of wind energy at sea.	construction
		exploitation
Coastal defense	Activities related to the protection of the hinterland	construction hard
		presence hard
		construction soft
		presence soft
Pylons	Constructions at sea for e.g. monitoring systems, radar installations, etc.	construction
		exploitation
Water recreation	Recreational activities associated with water.	soft
		hard
		fishing
Beach recreation	Recreational activities associated with the beach.	

3.3 IDENTIFYING THE RELATIVE IMPORTANCE OF THE ENVIRONMENTAL IMPACTS (ENVIRONMENTAL IMPACT TABLE)

The relative importance of impacts caused by the use is given in an environmental impact table.

The impact matrix is the outcome and summarises the analysis described in the methodology section. The matrix plots the different uses (rows) against the identified disturbances (columns). For each disturbance category an outline is given of activities that cause the disturbance and their relative importance. It is not the intention of this study to discuss each use – per disturbance category, but rather to give an overview of the most important findings.

3.3.1 Physical disturbance

Under physical disturbance 9 subcategories have been identified. For the purpose of this project some subcategories have been combined.

3.3.1.1 Landscape

The physical disturbance of landscape is mainly a social judgment. The coastline is the symbol of infinity, and an infringement of this symbolic value can have large social consequences.

Considering previous resistance by citizens against the construction of offshore wind energy projects, this is definitely a physical disturbance that should be taken into account. Another source of visual disturbance is the coastal defense infrastructure. However, because of the lower heights of such structures the impact is considered less important than those of wind turbines or pylons. Due to the technical support of cranes, machinery, etc. the impact will be higher during the construction phase.

Finally, shipping and water recreation can become minor impact sources in case of high densities (score 0*). This can be the case during the summer season when more ferries, sailing boats and motorboats are at sea, and there are a large number of tourists on the shore.

3.3.1.2 Sedimentology (sediment morphology & composition, topography)

As becomes clear of the matrix, the majority of uses have an impact on the sedimentology (Laffoley 2000; Cooke & McMath 2001; Plunkett 2001; NOO 2002; Ecolas 2003). During the construction phase impact is higher (score 3) than during the exploitation phase (score 1).

In comparison to all uses /activities, dredging generally causes the most severe impact on the sedimentology (score 3) (Bergman et al. 1991; De Groot 1996; Harvey et al. 1998). Considering the sediment morphology on local scale, also beam and otter trawling (Lindeboom 1998; Bergman et al. 1991) and sand and gravel extraction (Bergman et al. 1991; De Groot 1996) have a major impact on the marine ecosystem.

3.3.1.3 Waves & currents

Consistent with the analyses of the impact on sedimentology, the biggest impact is expected from dredging activities, as these activities alter the seabed drastically.

Other sources of disturbance of waves and currents are fixed infrastructures such as wind turbines, pylons, and coastal defense infrastructure.

3.3.1.4 Noise

Almost all users of the BPNS can be considered minor sources of noise disturbance. The biggest impact comes from military activities (sweeping for mines and shooting). These exercises do not occur very often. A higher noise impact is expected during the construction phase of marine structures.

3.3.1.5 Light pollution & temperature

These disturbances have a relatively low impact and are caused by a limited number of users.

3.3.1.6 Turbidity/ light penetration

The change in light penetration in the water column is closely related to disturbance in sedimentology. Therefore it is not surprising that the main disturbers are dredging, sand and gravel and trawling activities (Bergman et al. 1991; De Groot 1996; TVNK 2001; Pieters et al. 2002). Other minor disturbers are the construction of cables and pipelines (Bergman et al. 1991; Ecolas 2003) and of hard infrastructure elements (NOO 2002).

Turbidity will affect on its turn the flora and fauna by reducing light production or by smothering the marine flora (NOO 2002).

3.3.1.7 Summary

Considering physical disturbance on the BPNS the most important disturbance sources based on the top 5 relative impact scores, are:

Table II.3c: Most important physical impact sources

Use	*Activity*	*Relative impact*
Dredging	dredge disposal	3
	dredging	2.8
Wind farms	construction	
Pilons	construction	
Coastal defense (hard)	construction	2.4
Coastal defense (soft)	construction	2.2
Aggregate extraction		1.8

3.3.2 Chemical disturbance

As will be made clear out of the brief descriptions of the chemical disturbances, most chemical pollution is strongly linked to ship traffic. Nevertheless, other activities like aggregate extraction can disturb biogeochemical cycles and influence photosynthetic activity (Rzonzef 1993).

3.3.2.1 Oxygen

The uses that directly have a significant effect on the bottom (trawling, dumping, dredging) are given a minimal impact score. We want to note however that most shipping activities will have an indirect effect on oxygen levels by the bacterial destruction of wastes. Excess nutrients deplete oxygen in coastal waters and reduce biodiversity in sea life communities (Gesamp 1991; NOO 2002). Turbidity can also reduce oxygen available to the seabed and lower levels of the water column.

3.3.2.2 Oil

All shipping-related activities with respect to oil pollution are evaluated in a similar way. This means that all activities involving a boat (fishery, aggregate extraction, shipping, anchoring, military navigation, wreck removal) are possible sources of oil pollution (score 1). Shipping is given a score 2 because larger ships use heavy fuels that have higher environmental consequences. Motorised recreation is given a 0* as these boats are rather small by comparison. It is only in very high densities that small boats can become a problem. Dredging is also a shipping-related activity, however, this use is considered relatively "clean".

Oil spills have an impact on marine organisms. Some marine invertebrates exposed to oil show changes in burrowing depth and reduced growth, recruitment and reproductive capacity (Fukuyama et al. 1998). It is likely that some species of sediment-dwelling organisms will suffer adverse effects for several years after being exposed (Payne 1992). Oil can also be toxic to crustaceans, limpets, bivalves, sea stars and fish (Michel et al. 1992; Fukuyama et al. 1998; Jewett et al. 1999). The effects of oil and hydrocarbons on seabirds are also well documented. Oil affects the waterproofing and insulating properties of a bird's plumage, which can cause hypothermia and an inability to remain afloat or fly (Walraven 1992; Brown 1992). Other effects on seabirds include irritation of eyes (Walraven 1992), and internal organ damage or pneumonia.

3.3.2.3 Air pollution

The same argument used for the release of oil into the sea also applies in the case of air pollution. . All shipping–related activities are given a minor impact (score 1), while larger ships (shipping and military navigation) are given a medium impact score.

3.3.2.4 Micro pollutants

The outflow of micro pollutants into the marine environment is strongly linked to shipping-activity (Bergman et al. 2001; Cooke & McMath 2001; NOO 2002). Possible sources are hull fouling, shipping maintenance and ballast water discharge (NOO 2002).

Potentially, the most important source of micro pollutants is aquaculture. The different degrees of impact are reflected through different scores between fish (score 3), algae (score 2) and shellfish (score 1) (Buschmann et al. 1996; Gesamp 1991; Henderson et al. 2001; Kaiser 2001). The high impact score of dredge disposal (score 2) is due to the fraction of contaminated soil disposed at a defined zone.

3.3.2.5 Solid waste

The most frequent sources of marine debris (pollution from human activities) are plastics and other synthetic materials such as glass and metal. Marine debris has been identified by the International Oceanographic Commission as one of the five biggest marine pollutants (Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection 2001). Indirectly these pollutants can have a different impact on various species: illness by ingestion of litter, accumulation of heavy metals in tissue or even death.

For the purposes of this project, solid waste is restricted to waste originating from shipping-related activities (score 1). The reason for an impact score of 2 for fishing vessels is due to fishing gear garbage; while for the score of 2 for shipping reflects the size of the ships. In NOO (2002) reference is made to aquaculture as a source of solid waste, but without quantifying the impact (referenced as "X"). For the Belgian coast no information was found on the possible impact of solid waste generated from beaches or tourism .

3.3.2.6 Eutrophication/ nutrients

The organic enrichment of the marine environment causing an overflow of nutrients can lead to toxic algal blooms, reduction in sediment oxygen levels or the release of methane and toxic hydrogen sulphide (Gesamp 1991; NOO 2002). Sources are aquaculture and fishery. River and land-based eutrophication was not considered in this study.

The effects of aquaculture vary according to the type of farm and its surrounding environment. Fish farms in particular are known to release high number of wastes (uneaten faeces and fish food) into the environment (score 3). Shellfish farming does not involve additional feeding but may result in the build-up of excretions (score 1). Another important source of disturbance are fishing vessels because of the dumping of dead by-catch into the surrounding environment (score 2).

All other shipping-related activities are given an impact score 1 because of their galley wastes and wastewaters (from toilets, sinks and showers) (NOO 2002).

3.3.2.7 Summary

Considering chemical disturbance on the BPNS the most important disturbance sources based on the top 5 relative impact scores, are:

Table II.3d: Most important chemical impact sources

Use	*Activity*	*Relative impact*
Shipping		3.00
Fisheries	Beam/ otter trawl	2.67

Military exercises	navigation	
Aquaculture	fishing	2.33
Dredging	dredge disposal	1.67
Fisheries	line fishing on ships	
Aggregate extraction		
Wrecks	removal	1.33

3.3.3 Ecological disturbance

Ecological disturbance is the result of indirect (physical, chemical changes) and direct interactions with the ecosystem. In calculating the relative ecological impact only the direct interactions were taken into account.

3.3.3.1 Habitat change

Habitat change should be interpreted as structural changes of the habitat on a large scale. The most important identified changes are:

- Turning over the sediment by trawling or dredging (score 2);
- The destruction of existing habitat by coastal defense infrastructure (score 2 - 3);
- The construction of new habitats (fixed infrastructures) on the existing habitat (score 3).

3.3.3.2 Benthos

Benthos are organisms living in or on the sea bottom. A disturbance of the bottom will often have negative consequences on benthic organisms. Beam and otter trawling, aggregate extraction and dredging are therefore considered as major impact uses (score 3) (Bergman and Hup 1992; Rijnsdorp et al. 1994; De Groot 1996; Kaiser and Spencer 1996; Lindeboom 1998; Phillipart 1998; Hall 1999; Bergman and Van Santbrink 2000; Bergman et al. 1991; Johnson 2002; Schratzberger et al. 2002; Newell et al. 1998, 2004; Bonne 2003). Biota are obliterated during dredging and may take months or years to recover (Coleman et al. 1999). The immediate effects of most fishing processes in sedimentary environments include reductions in the abundance of many benthic species and in the total benthic biomass in areas where sediment was disturbed (Hall 1999). Even species that are not directly exploited by fishery can be affected by the removal of a substantial proportion of their prey, predator or competitor biomass (Hall 1999).

Besides, the construction of cables, pipelines and hard infrastructure elements (wind turbines, coastal defense, pylons) are also attributed a high impact score (2 or 3) (Bergman et al. 1991; De Groot 1996; Ecolas 2003). The disturbance during construction is only temporarily, but can cause serious effects over a longer time-frame. Once the hard elements are built, they can form an artificial base for the settlement of new benthic species. Nevertheless, some existing species will be destroyed. These two factors have led to a minor impact score for hard infrastructure in the exploitation phase, while in the case of soft coastal defense there is no "positive" compensation of creation of new habitats (impact score 2). The same positive argumentation as for hard coastal defense structures has led to a score of minor impact for wrecks.

3.3.3.3 Birds

The impact of certain uses on birds can be either positive or negative. The presence of fishing vessels or aquaculture systems can attract birds to an area due to the availability of an extra food source. On the other hand, birds can get entangled in fishing nets or aquaculture systems. All other shipping-related activities have been given a minor impact score.

Most construction phases received a minor impact score. The medium impact score for wind energy is associated with the negative effect of wind turbines on bird populations (casualties, changing behavior) (Everaert et al. 2001). In this respect pylons have also been given a minor negative impact, while the impact score 1 given to hard coastal defense structures is due to the fact that such structures may offer new feeding habitat for birds. This can, however, also be negatively interpreted as the loss of part of the natural (beach) feeding habitat. The negative or positive approach of this topic is a matter of personal opinion and is one of the reasons why in the impact table the scores are not given a positive or negative sign.

Water recreation will not normally affect birds. In case of high tourist peaks beach tourism can however have a minor negative impact, therefore a score of 0*.

3.3.3.4 Fish stocks

It is evident that the impact of fishery on the fish stocks is the highest of all uses. A major impact score has been given to trawling activities due to its environmentally-unfriendly fishing technique and its commercial importance (high catch). Besides fishing mortality of target populations (over fishing), non-target populations (by-catch) are also affected (Kaiser and Spencer 1996; Phillipart 1998; NOO 2002).

Other ocean floor-disturbing activities such as aggregate extraction, dredging and the construction of infrastructures are also classified as having a minor negative impact on fisheries (score 1). The minor impact score for wrecks, hard coastal defenses, wind turbines and pylons again involve the positive/negative issue of creating a new habitat and so offering new niches to certain fish species.

3.3.3.5 Introduction of marine (exotic) species and/or pathogens

There is no doubt that the introduction of pathogens will have a negative impact on the ecosystem because of their intrinsic negative nature (disease-producing organisms). The introduction of marine (exotic) species can have a positive effect, by adding to the biodiversity of the system, or a negative one, by affecting (reduction, disappearance) native species by the dominant nature of some exotic species. Unfortunately the latter is often the case.

Important input sources are shipping and directly related activities (anchoring, wrecks) and sail boats (Bergman et al. 1991; Cooke and McMath 2001; Lafolley 2000; Reise et al. 1999; NOO 2002). Therefore they have been given a 1 as impact score. Hard infrastructure (wind turbines, pylons, coastal defense) has also been given a minor impact score because infrastructure forms a potential substrate on which various organisms can survive. A well-known example is the introduction of the Japanese oyster (*Crassostrea gigas*) that settles on the groyne and successfully competes with the native oyster (*Ostrea edulis*) and mussel (*Mytilus edulis*).

3.3.3.6 Trophic relations

The change in trophic relations will mostly be a consequence of changes in biodiversity, abundance and / or biomass of the other animal groups considered (benthos, fish, birds) or changes in their habitats. As the impact on trophic relations is also dependent on interactions with other organisms (e.g. algae) that were not included otherwise, this topic has been incorporated as a separate ecological disturbance.

High impact scores will be strongly linked to impacts already discussed in the groups of organisms. Several literature sources mention the impact on trophic relations due to dredging (Maertens 1984; Cooke and McMath 2001; Laffoley 2000; Bergman et al. 1991), aggregate extraction (Cooke and McMath 2001; Bergman et al. 1991; Newell et al. 2004), aquaculture (Cooke and McMath 2001; Laffoley 2000; Bushmann et al. 1996; Kaiser 2001; GESAMP 2001; Henderson et al. 2001; NOO 2002); fishery (Lindeboom 1998; Cooke and McMath 2001; Laffoley 2000; Bergman et al. 1991), anchoring (de Groot 1982; Laffoley 2000) and hard structures (Laffoley 2000).

3.3.3.7 Summary

As far as ecological disturbance on the BPNS is concerned, the most important disturbance sources are based on the top 5 relative impact scores, including:

Table II.3e: Most important ecological impact sources

<table>
<tr><td>Use</td><td>Activity</td><td>Relative impact</td></tr>
<tr><td>Wind turbine parks</td><td>construction</td><td rowspan="2">3</td></tr>
<tr><td>Fisheries</td><td>beam and otter trawl</td></tr>
<tr><td>Coastal defense (hard)</td><td>construction</td><td rowspan="2">2.75</td></tr>
<tr><td>Pilons</td><td>construction</td></tr>
<tr><td>Wind farms</td><td>exploitation</td><td rowspan="2">2.25</td></tr>
<tr><td>Dredging</td><td>dredging</td></tr>
<tr><td>Coastal defense (hard)</td><td>presence</td><td rowspan="4">2</td></tr>
<tr><td>Sand and gravel extraction</td><td></td></tr>
<tr><td>Aquaculture</td><td>fishing</td></tr>
<tr><td>Pilons</td><td>exploitation</td></tr>
<tr><td>Coastal defense (soft)</td><td>construction</td><td rowspan="2">1.75</td></tr>
<tr><td>Aquaculture</td><td>Shellfish</td></tr>
</table>

Here, we want to emphasize once more that only the qualitative "size" of the impact was taken into account and not whether the impact was "positive" or "negative" to the ecosystem.

Table II.3f: Environmental impact table

		Physical env.									chemical env.						ecology					
		landscape	sediment morphology	sediment composition	waves & Currents	morphology, topography	noise	light pollution	temperature	turbidity / light penetration	oxygen	oils	micro pollutants	air pollution	solid waste	eutrophication / nutrients	habitat change	benthos	birds	introductions (incl. pathogens & micro-	fish stocks	trophic relations
fisheries	beam trawl	0	3	1	0	0	1	0	0	2	1	1	1	1	2	2	2	3	1	0	3	3
fisheries	otter trawl	0	3	1	0	0	1	0	0	2	1	1	1	1	2	2	2	3	1	0	3	3
fisheries	line fishing on ships	0	0	0	0	0	1	0	0	0	0	1	0	1	1	1	0	0	1	0	2	1
fisheries	standing nets (coast)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	2	1
aquaculture	algae	0	2	0	x	0	NK	0	0	x	0	0	2	0	x	0	1	0	0	2	0	2
aquaculture	shellfish	0	1	0	1	0	NK	0	0	x	1	0	1	0	x	1	1	0	1	2	0	3
aquaculture	fishing	0	1	1	0	0	NK	0	0	x	1	0	3	0	x	3	0	0	1	2	2	3
aggregate extraction		0	3	1	1	1	1	0	0	2	1	0	1	1	0	1	2	3	0	0	1	2
dredging	dredging	0	3	2	2	3	1	0	0	3	0	0	1	1	0	1	2	3	1	0	1	2
dredging	dredge disposal	0	3	3	2	3	1	0	0	3	1	0	2	1	0	1	1	3	0	0	0	2
dumping	war ammunition	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dumping	industrial waste	0	0	0	0	0	0	0	0	0	0	0	NK	0	0	0	0	NK	0	0	0	0
wrecks	presence	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	1
wrecks	removal	0	0	0	0	1	1	0	0	0	0	1	1	1	1	0	1	1	0	1	1	1
shipping		0*	0	0	0	0	1	0	0	0	0	2	2	2	2	1	0	0	1	1	0	0
anchoring places		0	1	0	0	0	1	0	0	0	0	1	1	1	0	0	0	1	0	1	0	0
miltary exercises	navigation	0	0	0	0	0	0	0	0	0	0	1	2	2	1	1	0	0	1	1	0	0

		Physical env.									chemical env.						ecology					
		landscape	sediment morphology	sediment composition	waves & Currents	morphology, topography	noise	light pollution	temperature	turbidity / light penetration	oxygen	oils	micro pollutants	air pollution	solid waste	eutrophication / nutrients	habitat change	benthos	birds	introductions (incl. pathogens & micro-	fish stocks	trophic relations
miltary exercises	shooting	0	0	0	0	0	2	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0
miltary exercises	demining	0	0	0	0	0	3	0	0	0	0	0	1	0	1	0	2	0	1	0	0	0
cables	construction	0	3	1	0	0	0	0	0	1	0	0	1	0	0	1	1	2	0	0	0	0
cables	exploitation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pipelines	construction	0	3	2	0	1	0	0	0	1	0	0	1	0	0	1	1	3	0	0	0	0
Pipelines	exploitation	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
wind farms	construction	2	3	3	1	1	2	1	0	1	0	0	0	0	0	0	3	3	2	0	1	3
wind farms	exploitation	1	1	1	1	1	2	1	NK	0	0	0	1	0	0	0	2	1	2	1	1	2
coastal defense	construction hard	1	3	3	1	2	1	0	0	1	0	0	1	0	0	0	3	3	1	0	1	3
coastal defense	presence hard	1	1	1	1	1	0	0	0	0	0	0	1	0	0	0	2	1	1	1	1	2
coastal defense	construction soft	1	3	2	1	2	1	0	0	1	1	0	0	0	0	0	2	2	1	0	0	2
coastal defense	presence soft	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	1	2	0	0	0	2
Pylons	construction	2	3	3	1	1	2	1	0	1	0	0	0	0	0	0	3	3	1	0	1	3
Pilons Pylons	exploitation	1	1	1	1	1	2	1	0	0	0	0	1	0	0	0	2	1	1	1	1	2
water recreation	soft	0*	0	0	0	0	0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
water recreation	hard	0*	0	0	0	0	1	0	0	0	0	0*	0*	0	0	0	0	0	0*	1	0	0
water recreation	fishing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
beach recreation		1	1	0	0	0	1	0	0	0	0	0	0	0	1	0	1	1	1	0	0	0

		Physical env.									chemical env.						ecology					
		landscape	sediment morphology	sediment composition	waves & Currents	morphology, topography	noise	light pollution	temperature	turbidity / light penetration	oxygen	oils	micro pollutants	air pollution	solid waste	eutrophication / nutrients	habitat change	benthos	birds	introductions (incl. pathogens & micro-	fish stocks	trophic relations
MPAs		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

(0) no impact; (1) small impact; (2) moderate impact; (3) major impact; (NK) not known or uncertain if there is an impact; (X) impact but magnitude of impact unknown

3.4 INTENSITY CLASSIFICATION MAPS

3.4.1 Intensity classification

An intensity classification has been carried out based on the intensity maps of each use in which the intensity of occurring on the BPNS per grid-cell (1 km²) was determined. An intensity classification map was created for each use. This will be used as basis for the drawing of environmental impact maps.

The intensity classification maps give a relative representation of the intensity of each activity. Based on the available real intensity data and on intrinsic characteristics of each use, a subdivision has been made in (Table II.3g):

- Intensity-independent uses: activities that are evaluated on a present/absent base. It concerns the "fixed" uses s like pylons. Also for historically assigned zones and anchoring a present/absent evaluation is considered sufficient. They will be scored as 0 (absent) or 1 (present) in the intensity classification map.
- Intensity-dependent uses s per km² (BPNS): activities that are evaluated on their intensity per grid-cell (1 km²). The intensity evaluation is uses -dependent and will be measured as the intensity per km² during the period of one year. Four classes are distinguished: high, medium, low intensity and no activity. The intensity classification scores are given in Table II.3h.
- Intensity-dependent uses per meter of coastal municipality: activities that are evaluated on their intensity per meter of each coastal city. More specifically the coastal infrastructure is discussed here. Four classes are distinguished: high, medium, low intensity and no activity. The intensity classification scores are given in Table II.3h.
- No specific intensity information on the BPNS was available for the use water recreation.

Table II.3g: Overview intensity-independent and intensity-dependent uses

Intensity-independent use	Intensity-dependent use
Dumping (industrial, war ammunition) (historically)	Fishery
Anchoring	Aggregate extraction
Pylons	Dredging
	Shipping
	Wrecks
	Cables
	Pipelines
	Wind energy
	Water recreation
	Aquaculture (no current use)
	Military exercises (navigation, shooting, sweeping for mines)
	Coastal defense (hard)
	Coastal defense (soft)

Table II.3h: Intensity evaluation intensity-dependent uses

Use	Intensity evaluation	Intensity classification
Fishery - commercial	Relative intensity of fishing vessels per year per grid-cell based on the number of observations of commercial fishing vessels per km², including observation uncertainty.	0: absent 1: ≤ 0.003 2: ≤ 0.013 3: ≤ 0.33
Fishery - sport	Relative intensity of fishing vessels per year per grid-cell based on the number of observations of sport fishing vessels per km², including observation uncertainty.	0: absent 1: ≤ 0.004 2: ≤ 0.016 3: ≤ 1.29
Aggregate extraction	Extracted volumes (m³)/year/km²	0: absent 1: ≤ 6.40 2: ≤ 26.82 3: ≤ 17639.05
Dredging	Ton dry material (m³)/year/km²	0: absent 1: ≤ 197647.17 2: ≤ 776064.75 3: ≤ 5508590
Disposal	Ton dry material (m³)/year/km²	0: absent 1: ≤ 59138.58 2: ≤ 985643.63 3: ≤ 9611052
Shipping	Number of shipping vessels/ year/ km²	0: absent 1: ≤ 745 2: ≤ 3109 3: ≤ 40488
Military	Number of exercise days/year/km²	0: absent 1: ≤ 9 2: ≤ 10 3: ≤ 78
Wrecks	Number of wrecks/km²	0: absent 1: ≤ 1 2: ≤ 2 3: ≤ 3
Cables	Length of cable/km²	0: absent 1: ≤ 748.64 2: ≤ 1072.21 3: ≤ 4378.97
Pipelines	Length of pipeline/km²	0: absent

Use	Intensity evaluation	Intensity classification
		1: ≤ 551.21 2: ≤ 1016.26 3: ≤ 176508
Wind energy	Megawatt/km²	0: absent 1: ≤ 7.2 2: ≤ 10.8 3: ≤ 14.4
Buoys	Number/km²	0: absent 1: ≤ 1 2: ≤ 2 3: ≤ 6
Coastal defense (hard)	Total length of hard coastal defense infrastructure / length of coastline For each municipality	0: absent 1: ≤ 0.75 2: ≤ 1.86 3: ≤ 2.73
Coastal defense (soft)	Total amount of sand deposition (m^3) / m coastal municipality	0: absent 1: ≤ 13.27 2: ≤ 58.27 3: ≤ 893.58

3.4.2 Intensity classification maps

In this section we shall not go into detail in respect of the intensity of occurrence of the users of the BPNS. Reference is made to the template fiches and to the intensity maps. Nevertheless, some general conclusions will be repeated:

- A large number of uses – only take place within the 24 nautical mile zone. The exceptions are cables, pipelines, military exercises (shooting), shipping, fishery and wrecks.
- The most intensively used zones are closer to the coast and within the territorial waters (12 Nm). A large proportion comes from shipping and fishery.
- Some uses are scattered over the BPNS, like cables, wrecks, shipping and fishing, while others are concentrated in specific zones like wind farms, dredge disposal, aggregate extraction, military exercises, pylons.

3.5 ENVIRONMENTAL IMPACT MAPS

Based on the environmental impact table and the intensity classification maps, a physical, a chemical and an ecological impact map was produced for the majority of uses and their respective activities. Due to the different intensity evaluation method per user, **the impact maps are only comparable within one use /activity**.

No environmental impact maps have been made for the uses taking place on the interface between land and sea – coastal defense and tourism and recreation – since:

- These activities are rather small players with respect to environmental impact in comparison with the other uses;
- The available GIS-information data was too limited or time-consuming to work out an impact analyses.

These uses are discussed by means of tables and figures.

Physical, chemical and ecological impact maps for all other uses can be found on the following pages. As mentioned before the maps are the result of the multiplication of the intensity classification (highest class: 3) and the relative Impact Score (IS) (highest IS: 3). This results in an impact scale of 0 (blue) to 9 (red).

3.5.1 Aggregate extraction (Map II.3a)

The highest impacts of aggregate extraction are of physical (IS: 1.8) and ecological (IS: 2.0) nature. The chemical impact is however not negligible (IS: 1.3). The most disturbed areas are highly correlated with the tops of the sandbanks: Thorntonbank (zone 1A), the Kwintebank (zone 2A and 2B) and the Oostdyck (zone 2C). Finally a fourth impact zone can be distinguished due to dredging activities (see 3.5.2).

3.5.2 Dredging (Map II.3b)

Similar to the aggregate extraction, the physical (IS: 2.8) and ecological (IS: 2.25) impact is much higher than the chemical impact (IS: 1.0). The highest impact is seen in the vicinity of the harbour of Zeebrugge and towards the mouth of the Scheldt estuary (the "Scheur"), the gateway to the port of Antwerp.

3.5.3 Dredge disposal (Map II.3c)

The picture for dredge disposal is slightly different than that of dredging. Here the physical impact (IS 3.0) scores much higher than the chemical (IS: 1.67) and ecological (IS: 1.5) impact. Two areas have even been given the highest physical impact (total score of 9) observed on the BPNS, namely the Sierra Ventana (Br and W S1) and the area near Zeebrugge (Br and W ZB Oost).

3.5.4 Fishery (Map II.3d)

A distinction has been made between commercial fishery (beam and otter trawl) and sport fishery. In general, the impact of commercial fishing is higher than the impact of sport fishing and for both types of fishery the impact increases closer to the coast.

For commercial fishing, the ecological impact is considered as the highest on the BPNS (IS: 3.0), followed by the chemical (IS: 2.67) and physical (IS: 1.4) impact. Sport fishery vessels cause more chemical (IS:

1.33) than ecological (IS: 1.0) damage. The physical impact of sport fishery is considered to be very low (IS: 0.2).

3.5.5 Military use (Map II.3e)

The combination of intensity of military exercises and their relative impact scores result in the highest impact in the nearest shooting area (due to a higher intensity) and in the sweeping for mines (due to a higher relative impact score) zone. All impacts are relatively low in comparison to other users.

3.5.6 Shipping (Map II.3f)

It is obvious that the chemical impact will play a major role in shipping. The chemical relative impact score for shipping is estimated on 3, which corresponds to the highest impact score on the BPNS. In comparison with the chemical impact, the ecological and especially the physical impact can be considered negligible.

Taking into account the intensity pattern of shipping on the BPNS, the highest impact can be expected on the main accesses to the harbour of Oostende and Zeebrugge. Nevertheless, as different maps demonstrate, shipping lanes are not as well defined as one would expect.

3.5.7 Cables/Pipelines (Maps II.3g-j)

Regarding cables and pipelines on the BPNS, the construction phase will be the main issue in terms of impact evaluation. Even then, impact is estimated rather low (IS $\leq$ 1.0) with a maximum relative impact score of 1.4 for the construction of pipelines. Cables are spread all over the BPNS resulting in a scattered impact map.

3.5.8 Wind turbine parks (Maps II.3k-l)

As for all infrastructure elements the highest environmental disturbance will be during the construction period. During the exploitation of the wind farm the disturbance will be lower. So the impact will only be temporarily high and concentrated within the concession zones for wind energy. The main impacts will be of physical (max. IS: 2.8) and ecological (max. IS: 3.0) nature, while the chemical impact will be considerably low (IS expl: 0.33).

3.5.9 Wrecks (Maps II.3m-n)

The physical and chemical impacts of wrecks are rather low. As wrecks form a new habitat, the ecological impact has been estimated as more important (IS: 1.25). The majority of wrecks are identified within the 12 nautical mile zone; therefore the disturbance will be higher closer to the coast.

3.5.10 Anchorage places (Map II.3o)

In comparison to the other users of the BPNS the disturbance caused by anchorage is low (max. impact score: 1 (chemical)).

3.5.11 MPAs

As in the case of impact analysis, only the impact caused by the activity is considered and not the amelioration of the environment due to a lack of impacts. There are no physical, chemical and ecological impacts connected with Marine Protected Areas.

3.5.12 Coastal defense infrastructure

A distinction is made between soft and hard coastal defense. The intensity of coastal defense is calculated as follows:

- Soft coastal defense: total amount of sand deposition (m^3) per meter for each coastal municipality.
- Hard coastal defense: total length of hard coastal defense structures (HS) (groynes, dikes, breakwaters, piers) per meter for each coastal municipality.

Based on percentile classification the data is further subdivided into three intensity-classes: low (yellow), medium (blue) and high (red) (Table II.3i). These form the basis for the calculation of environmental impact scores.

Table II.3i: Intensity (classes) of the coastal defense infrastructure along the Belgian coast

	DP	*KO*	*NP*	*MK*	*OO*	*BR*	*DH*	*BL*	*ZB*	*KN*
Soft (m^3 sand/ m)	1.07	10.02	15.25	10.60	59.91	512.12	555.38	13.36	32.59	893.58
Hard (total length HS (m)/ m)	0.52	0.50	2.00	1.74	2.73	0.75	0.66	2.37	1.56	1.87

(DP = De Panne, KO = Koksijde, NP = Nieuwpoort, MK = Middelkerke, OO = Oostende, BR = Bredene, DH = De Haan, BL = Blankenberge, ZB = Zeebrugge, KN = Knokke)

The east-coast (from Oostende to Knokke) is characterized by a marked presence of hard and soft coastal defenses. Besides the coastal municipalities with a port (Nieuwpoort, Oostende, Zeebrugge), which demand more hard infrastructure elements, Knokke also has high abundance of hard coastal infrastructure. With respect to soft coastal defense high sand deposition activities take place in Bredene, De Haan and Knokke.

In the following figures the environmental impact is given for the presence of hard and soft coastal defense structures and during their construction phase.

It is obvious that during the construction phase the impact is much higher (Figure II.3b and Figure II.3d). This is however a temporary effect. The impact of hard coastal defense structures (Figure II.3c) is estimated to be lower than that of soft sand deposition (Figure II.3a) as the hard structures not only destroy the underlaying habitat but can also form new habitats for other species, thereby increasing biodiversity.

3.5.12.1 Soft coastal defense

Figure II.3a: Environmental impact of the presence of soft coastal defense

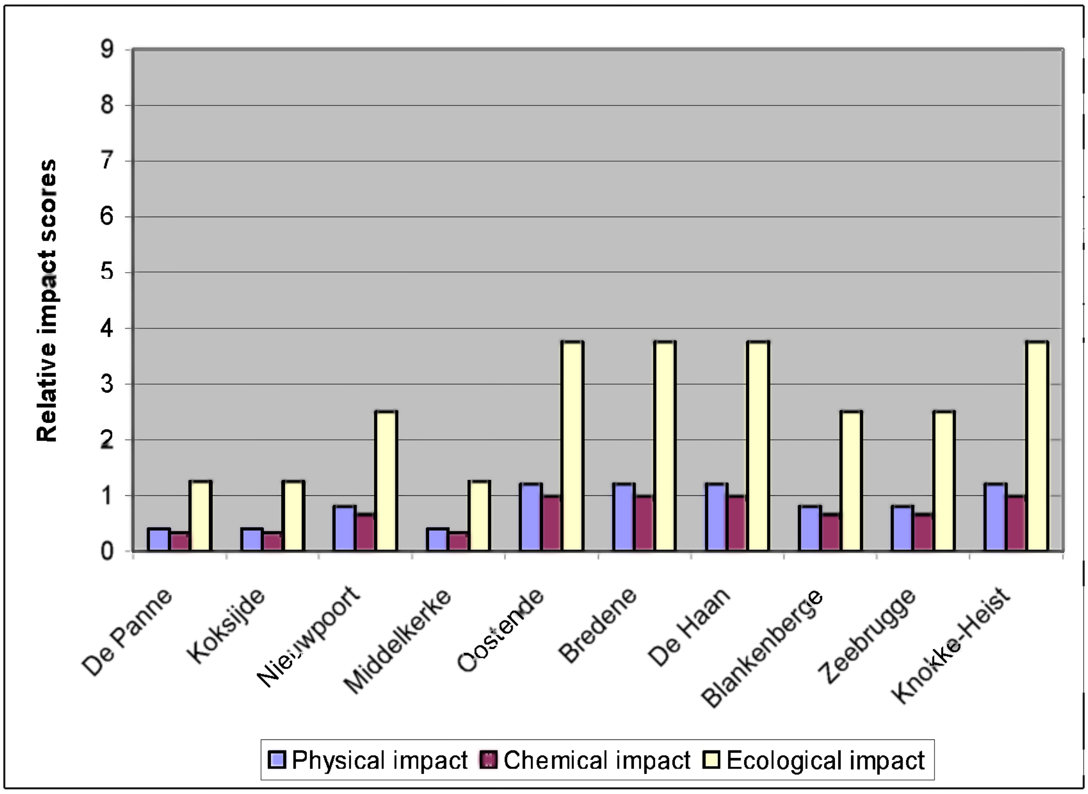
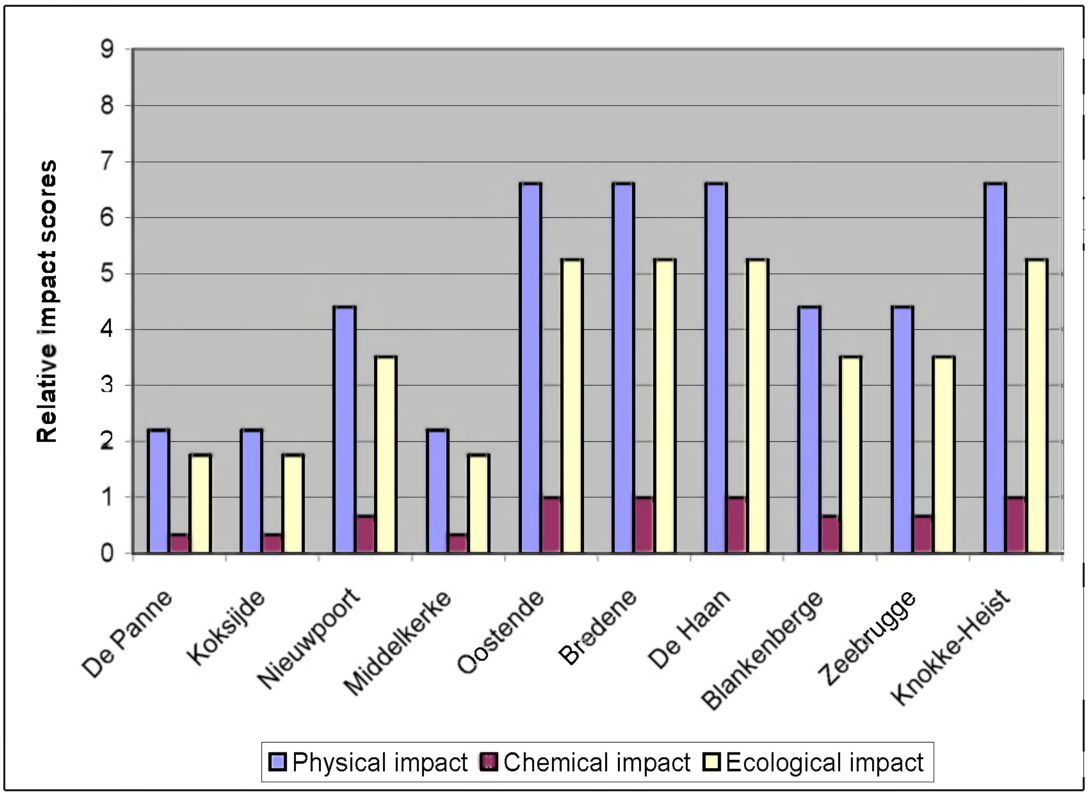


Figure II.3b: Environmental impact of the execution of soft coastal defense



3.5.12.2 Hard coastal defense

FigureII.3c: Environmental impact of the presence of hard coastal defense

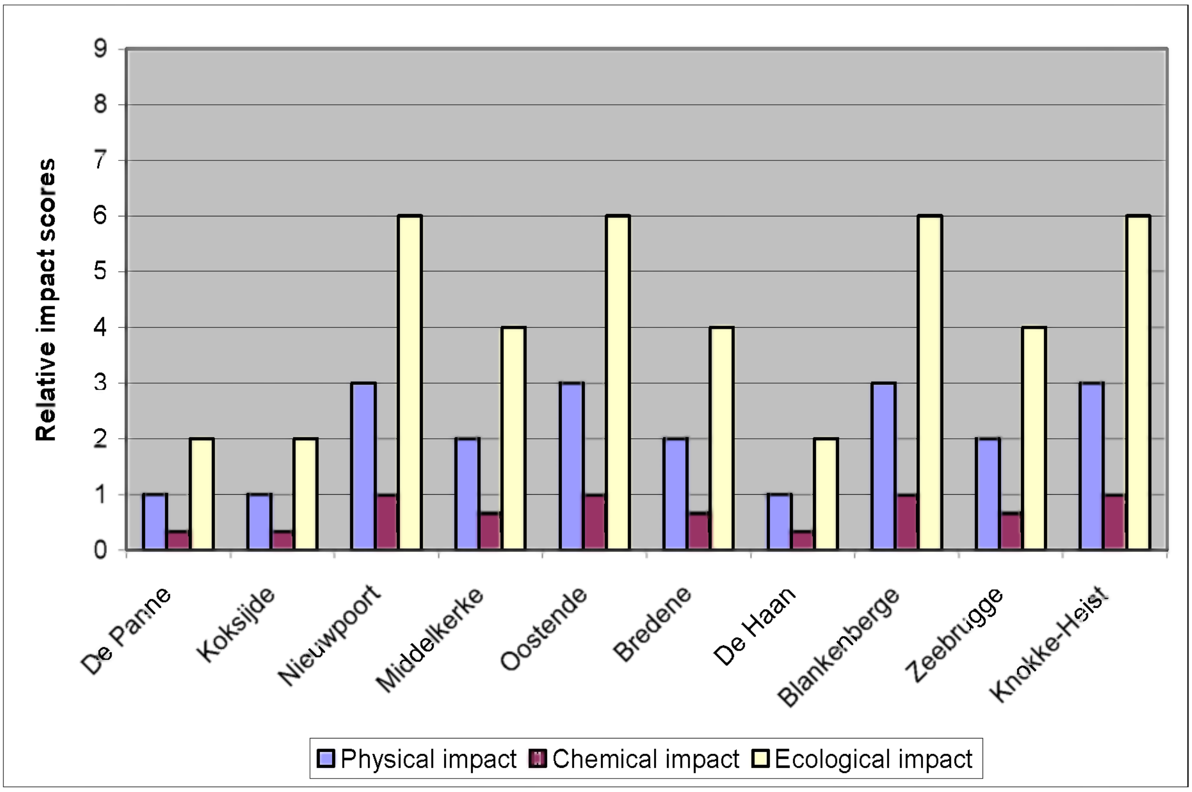
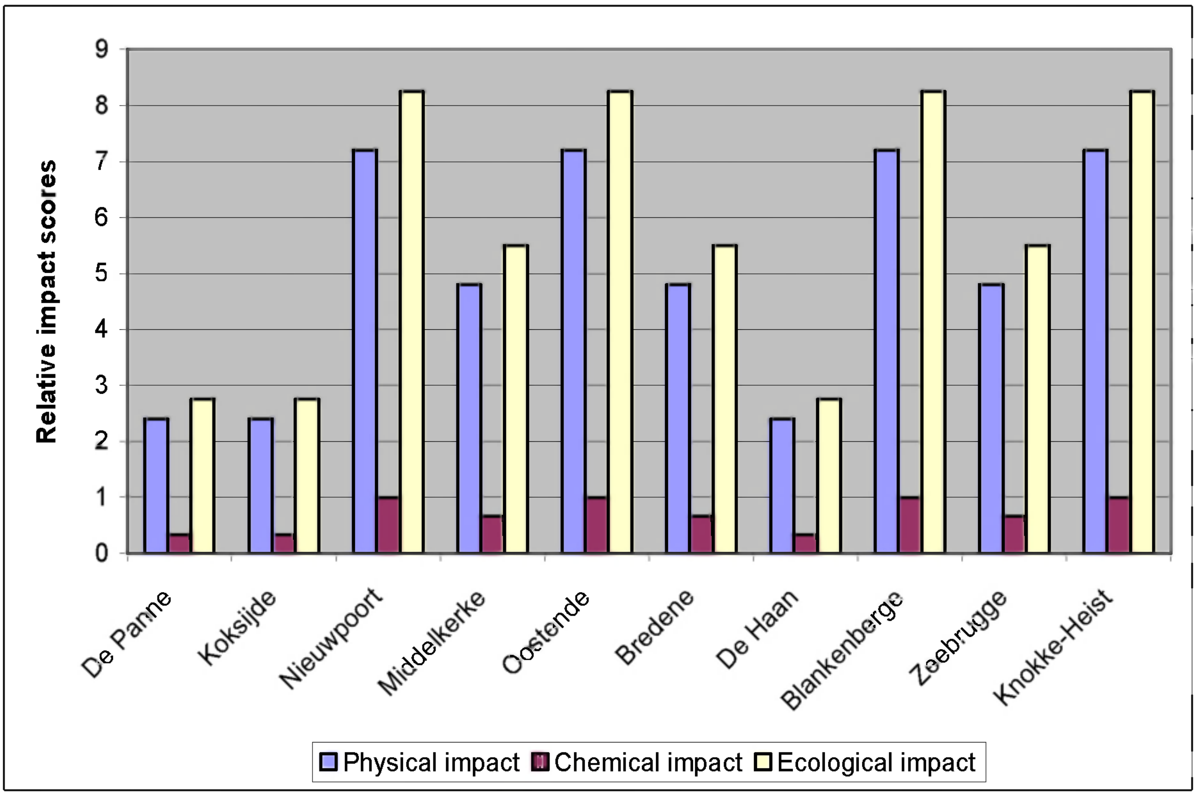


Figure II.3d: Environmental impact of the construction of hard coastal defense



3.5.13 Tourism & Recreation

A distinction can be made between beach recreation that which takes place between the high and low water line, and water recreation that which takes place below the low water line.

3.5.13.1 Beach recreation

The pressure of recreation on the beach has been estimated in two ways:

- Ratio beach cabins/km per coastal municipality: as the number of available beach cabins will to a certain extent reflect tourist pressure, the number of beach cabins per km has been adopted as a method of expressing the intensity of beach recreation.
- Relative tourist pressure per coastal municipality: According to the PSEP Beach & Dike (2003) the whole coastline is classified into zones of low, medium and high impact. Taking into account the relative length of each section within a coastal municipality a relative tourist pressure was calculated.

Based on percentile classification the data is further subdivided into three intensity-classes: low (yellow), medium (blue) and high (red) (Table II.3j). These will form the base for the calculation of the environmental impact scores.

Table II.3j: Intensity classes for beach recreation along the Belgian coast

		DP	*KO*	*NP*	*MK*	*OO*	*BR*	*DH*	*BL*	*ZB*	*KN*
Beach recreation	Average tourist impact	2.10	3.60	5.00	2.90	3.50	1.60	3.80	3.80	2.70	3.30
	Cabins/km	111	81	65	87	113	47	98	375	101	274

(DP = De Panne, KO = Koksijde, NP = Nieuwpoort, MK = Middelkerke, OO = Oostende, BR = Bredene, DH = De Haan, BL = Blankenberge, ZB = Zeebrugge, KN = Knokke)

Out of Table II.3j it is clear that both methods lead to different results. Nieuwpoort, for example, is considered to have the highest pressure of beach recreation according to the average tourist impact-method, but according to the number of cabins per km it falls within the lowest intensity class. Nevertheless, we can conclude that Oostende, De Haan, Blankenberge and Knokke are popular recreational beaches, while the pressure on De Panne, Koksijde, Middelkerke and Bredene is lower.

In the following figures the environmental impact is given of beach recreation according to the two described methods. Generally, we have concluded that the environmental impact of beach recreation is low.

Figure II.3e: Environmental impact scores of beach recreation based on # cabins/km

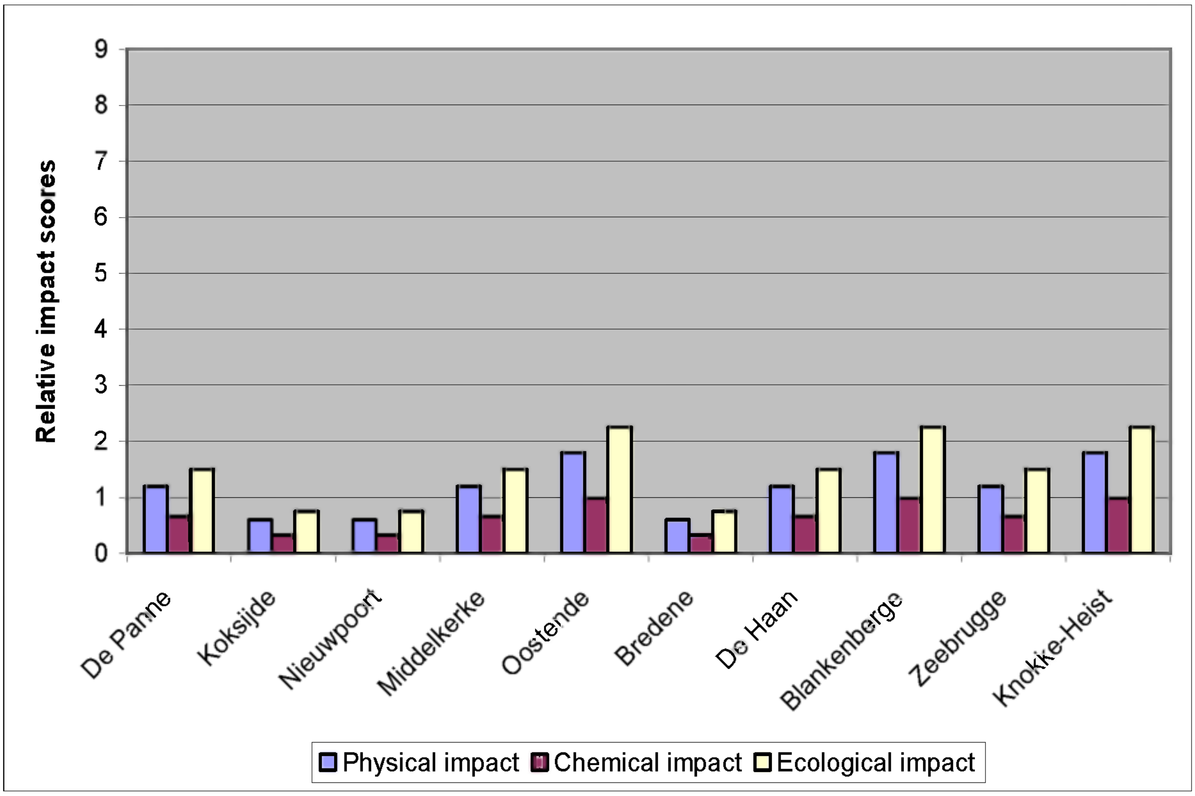
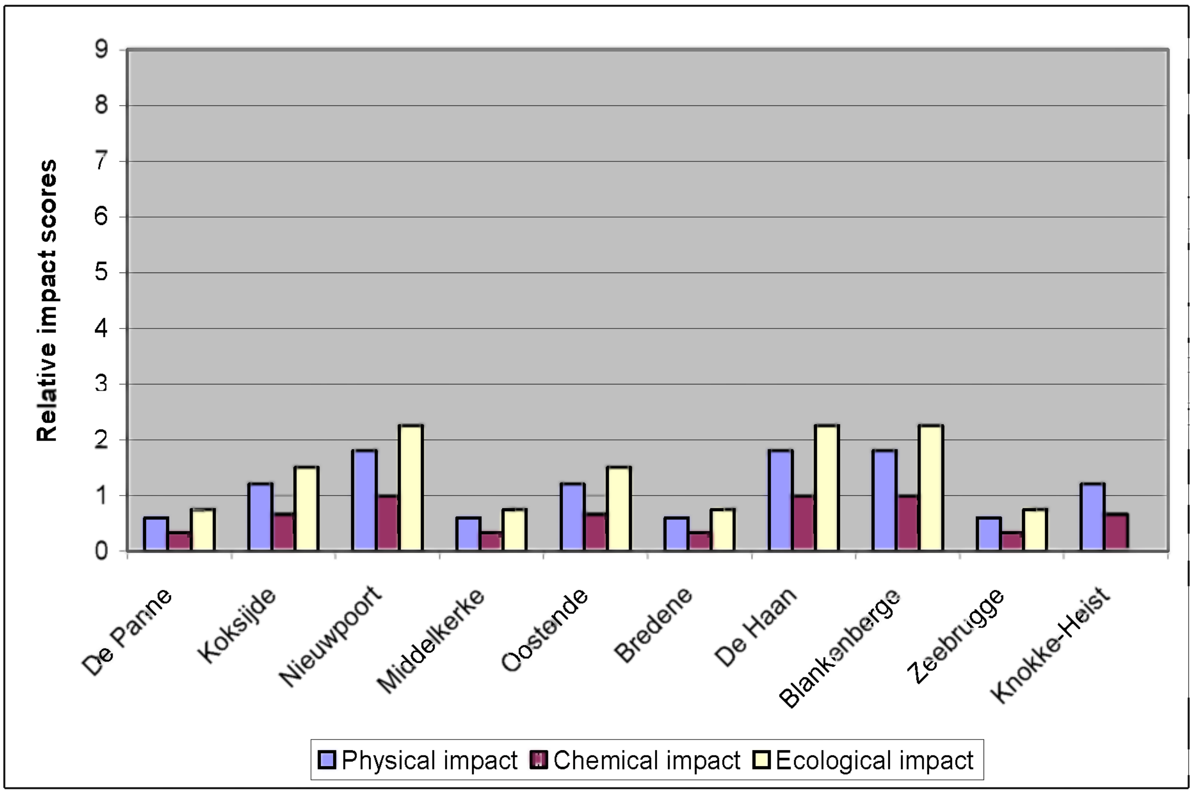


Figure II.3f: Environmental impact scores of beach recreation based on average tourist pressure



3.5.13.2 Water recreation (Map II.3p)

Data exists about water recreation in Flanders, but no clear distinction has been made between coastal and inland water recreation. As no detailed intensity data is found specifically for the Belgian coast, it was not possible to make intensity and environmental impact maps.

The following table shows a summary of the environmental impacts that can be expected on the BPNS due to water recreation. A difference has been made between soft (non-motorised), hard (motorised) water sports and angling at sea. In all cases the relative impact scores are low.

Table II.3k: Relative environmental impact scores of water recreation on the BPNS

Use	*Activity*	*Physical impact*	*Chemical impact*	*Ecological impact*
Water recreation	Non-motorised	0	0	0
	Motorised	0.2	0	0.25
	Angling	0	0	0.5

3.5.14 Weather masts (Maps II.3q-r)

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CHAPTER FOUR INTERACTION AMONG USERS

As stated in the previous chapters, users face different types of interactions when attempting to occupy space within the Belgian part of the North Sea. It is obvious that they can only select environments in which most uses can thrive. The suitability of the environment towards a use is generally the first type of interaction that takes place. This is extensively dealt with under chapter II.2.

Once a use becomes situated in a suitable space, it will have impacts on its surrounding environment. This impact is the second type of interaction that takes place, and dealt with under chapter II.3. In both types of interaction, the environment is seen as a global framework with socio-economic as well as ecological aspects. It is clear, however, that interactions go beyond the environment and also cover interactions among the users themselves. It is this type of interaction that will be dealt with in this chapter, which considers two forms of interaction as discussed below.

1 SPATIAL INTERACTION AMONG USERS

Firstly, individual uses face spatial constraints when trying to occupy a particular spatial area. This is because there is spatial interaction among the different users. The issue of allocating uses to a certain part of the BPNS is faced by the fact that other uses have already been allocated that space. These existing uses may be present pursuant to concessions – which allows an activity to take place – or without any concession whatsoever.

The response of a certain use to the allocation of space to a new user will depend to a large degree on actual or perceived conflict. An existing user can be looked at in terms of its zonation as well as its existing activity. For example, the introduction of soft recreation into a sand and gravel extraction zone will trigger two responses. Soft recreation can be managed, within the entire concession zone for extraction, by avoiding the actual extraction sites in time or by using areas within the concession zone that are not actually used for extraction (Mtr = management in time and space).

A complete overlap in time and space is evidently not possible. The response of the actual extraction sites within the concession area, however, only allows for management in time (Mt). This leads to two spatial interaction matrices (zone and activity). The activity matrix is identical to the zoning matrix but the space factor "r" is deleted (Mtro becomes Mto; Mtr becomes Mt; Mro becomes Mo; and Mr becomes E).

The following tables set out different uses in terms of their specific activity and zones, and in terms how these zones apply to the Belgian part of the North Sea:

Table II.4a: Users in relation to activity and zonation

User function	Activity	Zones in BPNS
Beam trawling	Actual shipping and trawling sites	Entire BPNS unless restricted by suitability
Otter trawling	Actual shipping and trawling sites	Entire BPNS unless restricted by suitability
Commercial line fishing	Actual shipping and fishing sites	Entire BPNS unless restricted by suitability

Standing nets	Actual sites on the beach used for nets	Entire Belgian coastline unless restricted by suitability
Aquaculture algae	Actual aquaculture rack	Future allocated concession zones for aquaculture
Aquaculture shellfish	Actual aquaculture rack	Future allocated concession zones for aquaculture
Aquaculture fish	Actual aquaculture cage	Future allocated concession zones for aquaculture
Sand and gravel extraction	Actual extracted sites	Allocated concession zones for sand and gravel extraction
Dredging	Actual dredged channels	Actual dredged channels
Dredge disposal	Actual sites of dredge disposal	Actual sites of dredge disposal
War ammunition	Actual historic war ammunition site	Paardenmarkt
Industrial waste	Actual historic industrial waste site	Actual historic industrial waste site
Wrecks	Actual wrecks	Actual wrecks
Traffic separation scheme	Entire scheme since it is randomly covered by ship movements	Allocated IMO traffic separation scheme
Coastal shipping	Actual shipping movements	Entire BPNS unless restricted by suitability
Refuge sites	Entire refuge site since it is randomly covered by ship movements and anchoring	Allocated Westhinder refuge site
Research	Actual research sites	Actual research sites
Military navigation	Actual navigation movements	Entire BPNS unless restricted by suitability
Military shooting exercises	Entire shooting zones since they are randomly covered by shooting exercises	Allocated shooting exercise zones
Military mine sweeping	Actual mine sweeping sites	Actual mine sweeping sites
Cables	Actual cables	Actual cables
Pipelines	Actual pipelines	Actual pipelines
Wind turbines	Actual wind turbines	Future allocated concession zones for wind turbines
Hard coastal defense	Actual sites of hard coastal defense	Actual sites of hard coastal defense
Soft coastal defense	Actual sites of soft coastal defense	Actual sites of soft coastal defense
Pylons	Actual pylons	Actual pylons
Soft recreation	Actual sites of soft recreation	Entire BPNS unless restricted by suitability
Hard recreation	Actual sites of hard recreation	Entire BPNS unless restricted by suitability
Recreational fishing	Actual fishing sites and its related shipping	Entire BPNS unless restricted by suitability
Beach recreation	Actual sites of beach recreation	Entire Belgian coastline unless restricted by suitability
Marine protected areas	Actual areas	Actual areas
Managed marine protected areas	Actual areas	Actual areas

The aim of an interaction matrix should be twofold:

- It should be as practical as possible giving an answer to the actual constraints a new user faces when allocated to the BPNS.
- It should be visual in order to make an easy link with GIS and mapping systems.

The matrix as visualised for the spatial interaction among users should be read as follows:

The vertical column of users is the users that are meant to be allocated to the BPNS. These can be users that are already in place, but that want to intensify within their existing space, or they might be users that are new to the BPNS, such as wind turbine parks or aquaculture. The matrix tries to explain how the different actual allocated zones and/or activities would respond to this new user. This response varies according to exclusion or management in the following way:

- E = exclusion: The user that is in the process of being introduced to the BPNS is completely excluded from a certain zone and/or activity within that zone. There is no management possible in time or space. Complete overlap is out of the question.
- Mo = managerial with overlap: The user that is in the process of being introduced to the BPNS is able to overlap with a certain activity in that zone. This means that a complete overlap in space is possible without temporal and/or spatial management. It is clear that both activities will be aware of each other.
- Mt = managerial in time: The user that is in the process of being introduced to the BPNS is able to use the same space as a certain activity already in that zone on the condition that both are separated in time.
- Mr = managerial in space: The user that is in the process of being introduced to the BPNS is able to use the same space as a certain zone on the condition that the activities are separated in space within that specific zone. It is clear that this will lead to an actual exclusion of the new activity in the space of the present activity if no overlap or temporal management is possible.
- Mtr, Mto, Mro and Mtro are possible combinations of the above.
- / = not relevant: This counts for all uses that are by nature separated in space, being uses that are uniquely to be linked either to sea or beach/land.

2 DEMAND DRIVEN INTERACTION AMONG USERS

The interaction among users, however, can go beyond a purely spatial constraint. The actual allocation of a certain use to a part of the Belgian part of the North Sea, may due to intensity, trigger a demand for a limitation of another use. This will mean a change in allocation of space and/or intensity for the second use. This interaction is not a physical but rather a demand driven interaction. It is evident that not only the exploitation or actual application of a use should be taken into account, but also the construction phase that introduces the user into the spatial realm. This interaction matrix therefore is larger than the two previous ones.

The degree of interaction can be negative, positive or neutral. The intensity of dredging, for example, will positively impact the demand for space for dredge disposal. On the other hand, the construction of soft coastal defense could diminish the demand for space for dredge disposal since dredged material can be used. Within each negative or positive category different levels of impact levels can be distinguished. These are difficult to obtain on an objective basis. Accordingly, the final matrix is the result of intensive discussion and corrections by the interdisciplinary team working on the GAUFRE project.

A first attempt to visualise these interactions on a map is made in Maps II.4a-k. The uses tourism and recreation, dredging and dumping of dredge disposal, sand and gravel extraction, military exercises, fisheries, and shipping are set against other uses and this confrontation is indicated as being either positive (green) or negative (red = conflicts). It is clear that this confrontation should ideally be finetuned in terms of degrees (see matrices). These maps must be considered as draft. They give however a first view on how detailed GIS methods might analyse these databases.

Legend for Tables II.4b and II.4c

/	not relevant
Mtro	manageable in time, space and overlap
Mtr	manageable in time and space
Mto	manageable in time and overlap
Mro	manageable in space and overlap
Mt	manageable in time
Mr	manageable in space
Mo	manageable in overlap
E	Exclusion

Legend for Table II.4d

/	not relevant
0	neutral
0*	almost negligible beneficial
1	small beneficial effect
2	average beneficial effect
3	large beneficial effect
-1	small hazardous effect
-2	average hazardous effect
-3	large hazardous effect
?	not known

Table II.4b: The response of a certain user (X axis) to the introduction or allocation of a certain activity (Y axis) in its zone

	beam trawling	otter trawling	line fishing from ship	standing nets on coast	algae aquaculture	shellfish aquaculture	fish aquaculture	aggregate extraction	dredging	dredge disposal	war ammunition	industrial waste	wrecks	traffic separation scheme	coastal shipping	places of refuge	research	military navigation	military shooting	military mine sweeping	cables	pipelines	Wind turbine parks	hard coastal defense	soft coastal defense	pylons	soft water recreation	hard water recreation	recreational fisheries	beach recreation	MPAs	Managed MPAs
beam trawling	Mtr	Mtr	Mtr	/	Mr	Mr	Mr	Mtr	Mt	Mt	E	Mo	E	Mt	Mtr	E	Mt	Mtr	Mt	Mt	E	E	Mr	E	Mt	E	Mtr	Mtr	Mtr	/	E	Mo
otter trawling	Mtr	Mtr	Mtr	/	Mr	Mr	Mr	Mtr	Mt	Mt	E	Mo	E	Mt	Mtr	E	Mt	Mtr	Mt	Mt	E	E	Mr	E	Mt	E	Mtr	Mtr	Mtr	/	E	Mo
line fishing from ship	Mtr	Mtr	Mtr	/	Mr	Mr	Mr	Mtr	Mt	Mt	E	Mo	Mo	Mt	Mtr	E	Mt	Mtr	Mt	Mt	Mo	Mo	Mr	E	Mt	E	Mtr	Mtr	Mtr	/	E	Mo
standing nets on coast	/	/	/	Mtr	/	/	/	/	/	/	E	Mo	E	/	/	/	Mt	/	Mt	Mt	Mo	Mo	/	Mo	Mt	E	/	/	/	Mt	E	Mo
algae aquaculture	Mr	Mr	Mr	/	Mro	Mr	Mr	Mr	E	E	E	Mo	Mo	E	Mr	E	Mo	Mr	Mto	E	Mo	E	Mr	Mo	E	E	Mr	Mr	Mr	/	E	Mo
shellfish aquaculture	Mr	Mr	Mr	/	Mr	Mro	Mr	Mr	E	E	E	Mo	Mo	E	Mr	E	Mo	Mr	Mto	E	Mo	E	Mr	Mo	E	E	Mr	Mr	Mr	/	E	Mo
fish aquaculture	Mr	Mr	Mr	/	Mr	Mr	Mro	Mr	E	E	E	Mo	Mo	E	Mr	E	Mo	Mr	Mto	E	Mo	E	Mr	Mo	E	E	Mr	Mr	Mr	/	E	Mo
aggregate extraction	Mtr	Mtr	Mtr	/	E	E	E	Mtr	Mo	Mt	E	Mo	E	E	Mtr	E	Mt	Mtr	Mt	Mt	E	E	E	E	E	E	Mtr	Mtr	Mtr	/	E	Mo
dredging	Mtr	Mtr	Mtr	/	E	E	E	Mr	Mt	E	E	Mo	Mto	Mt	Mtr	E	Mt	Mtr	Mt	Mt	E	E	E	E	E	E	Mtr	Mtr	Mtr	/	E	Mo
dredge disposal	Mtr	Mtr	Mtr	/	E	E	E	Mtr	E	Mt	Mo	Mo	Mo	E	Mtr	E	Mt	Mtr	Mt	Mt	E	E	E	E	E	E	Mtr	Mtr	Mtr	/	E	Mo
traffic separation scheme	Mtr	Mtr	Mtr	/	E	E	E	Mr	Mt	E	E	Mo	Mto	Mt	Mtr	E	Mt	Mtr	E	E	Mo	Mo	E	E	E	E	Mtr	Mtr	Mtr	/	E	Mo
coastal shipping	Mtr	Mtr	Mtr	/	Mr	Mr	Mr	Mtr	Mt	Mt	Mo	Mo	Mo	Mt	Mtr	E	Mt	Mtr	Mt	Mt	Mo	Mo	Mr	E	Mt	E	Mtr	Mtr	Mtr	/	E	Mo
places of refuge	Mr	Mr	Mr	/	E	E	E	Mr	E	E	E	Mo	Mo	E	Mr	Mt	Mt	Mr	E	E	E	E	E	E	E	E	Mr	Mr	Mr	/	E	Mo
research	Mtro	Mtro	Mtro	Mtro	Mro	Mro	Mro	Mtro	Mto	Mto	Mo	Mo	Mo	Mto	Mtro	Mto	Mto	Mtro	Mt	Mt	Mo	Mo	Mro	Mo	Mto	Mo	Mtro	Mtro	Mtro	Mto	Mo	Mo
military navigation	Mtr	Mtr	Mtr	/	Mr	Mr	Mr	Mtr	Mt	Mt	Mo	Mo	Mo	Mt	Mtr	E	Mt	Mtr	Mt	Mt	Mo	Mo	Mr	E	Mt	E	Mtr	Mtr	Mtr	/	E	Mo
military shooting	Mtr	Mtr	Mtr	Mtr	Mto	Mto	Mto	Mtr	Mt	Mt	Mo	Mo	Mo	E	Mtr	E	Mt	Mtr	Mto	Mt	Mo	Mo	E	Mo	Mt	E	Mtr	Mtr	Mtr	Mt	E	Mo
military demining	Mtr	Mtr	Mtr	Mtr	E	E	E	Mtr	Mt	Mt	E	Mo	Mo	E	Mtr	E	Mt	Mtr	Mt	Mto	E	E	E	E	Mt	E	Mtr	Mtr	Mtr	Mt	E	Mo
cables	Mr	Mr	Mro	/	Mro	Mro	Mro	Mr	E	E	E	Mo	E	Mo	Mo	E	Mto	Mo	Mo	E	E	E	E	E	Mo	E	Mo	Mo	Mro	/	Mo	Mo
pipelines	Mr	Mr	Mro	/	Mro	Mro	Mro	Mr	E	E	E	Mo	E	Mo	Mo	E	Mto	Mo	Mo	E	E	E	E	E	Mo	E	Mo	Mo	Mro	/	Mo	Mo
wind turbine parks	Mr	Mr	Mr	/	E	E	E	E	E	E	E	Mo	Mto	E	Mr	E	Mo	Mr	E	E	E	E	Mr	E	E	E	Mr	Mr	Mr	/	E	Mo
hard coastal defense	Mr	Mr	Mro	Mro	E	E	E	Mr	E	E	E	Mo	Mto	E	Mr	E	Mo	Mr	Mo	E	E	E	E	Mo	E	E	Mr	Mr	Mro	Mo	E	Mo
soft coastal defense	Mtro	Mtro	Mtro	Mtro	E	E	E	Mr	E	E	Mo	Mo	Mo	E	Mtro	/	Mt	Mtro	Mto	Mt	Mo	Mo	E	E	Mo	E	Mtro	Mtro	Mtro	Mto	E	Mo
pylons	Mr	Mr	Mr	/	Mr	Mr	Mr	Mr	E	E	E	Mo	E	E	Mr	E	Mo	Mr	Mo	E	E	E	Mr	Mo	E	E	Mr	Mr	Mr	/	Mo	Mo
soft water recreation	Mtr	Mtr	Mtr	/	Mr	Mr	Mr	Mtr	Mt	Mt	Mo	Mo	Mo	Mt	Mtr	E	Mt	Mtr	Mt	Mt	Mo	Mo	E	E	Mt	E	Mtr	Mtr	Mtr	/	E	Mo
hard water recreation	Mtr	Mtr	Mtr	/	E	E	E	Mtr	Mt	Mt	Mo	Mo	Mo	Mt	Mtr	E	Mt	Mtr	Mt	Mt	Mo	Mo	Mr	E	Mt	E	Mtr	Mtr	Mtr	/	E	Mo
recreational fisheries	Mtr	Mtr	Mtr	/	Mr	Mr	Mr	Mtr	Mt	Mt	E	Mo	Mo	Mt	Mtr	E	Mt	Mtr	Mt	Mt	Mo	Mo	Mr	E	Mt	E	Mtr	Mtr	Mtr	/	E	Mo
beach recreation	/	/	/	Mtro	/	/	/	/	/	/	E	Mo	Mo	/	/	/	Mt	/	Mt	Mt	/	/	/	Mo	Mt	/	/	/	/	Mto	E	Mo
MPAs	Mr	Mr	Mr	Mr	Mr	Mr	Mr	Mr	E	E	E	Mo	Mo	E	Mr	E	Mo	Mr	E	E	Mo	Mo	E	Mo	E	Mo	Mr	Mr	Mr	E	/	/
managed MPAs	Mro	Mro	Mro	Mro	Mro	Mro	Mro	Mro	Mo	Mo	Mo	Mo	Mo	Mo	Mro	Mo	Mo	Mro	Mo	Mo	Mo	Mo	Mro	Mo	Mo	Mo	Mro	Mro	Mro	Mo	/	/

Table II.4c: The response of a certain user activity (X axis) to the introduction or allocation of a certain activity (Y axis) in its activity radius

	beam trawling	otter trawling	line fishing from ship	standing nets on coast	algae aquaculture	shellfish aquaculture	fish aquaculture	aggregate extraction	dredging	dredge disposal	war ammunition	industrial waste	wrecks	traffic separation scheme	coastal shipping	places of refuge	research	military navigation	military shooting	military mine sweeping	cables	pipelines	Wind turbine parks	hard coastal defense	soft coastal defense	pylons	soft water recreation	hard water recreation	recreational fisheries	beach recreation	MPAs	Managed MPAs
beam trawling	Mt	Mt	Mt	/	E	E	E	Mt	Mt	Mt	E	Mo	E	Mt	Mt	E	Mt	Mt	Mt	Mt	E	E	E	E	Mt	E	Mt	Mt	Mt	/	E	Mo
otter trawling	Mt	Mt	Mt	/	E	E	E	Mt	Mt	Mt	E	Mo	E	Mt	Mt	E	Mt	Mt	Mt	Mt	E	E	E	E	Mt	E	Mt	Mt	Mt	/	E	Mo
line fishing from ship	Mt	Mt	Mt	/	E	E	E	Mt	Mt	Mt	E	Mo	Mo	Mt	Mt	E	Mt	Mt	Mt	Mt	Mo	Mo	E	E	Mt	E	Mt	Mt	Mt	/	E	Mo
standing nets on coast	/	/	/	Mt	/	/	/	/	/	/	E	Mo	E	/	/	/	Mt	/	Mt	Mt	Mo	Mo	/	Mo	Mt	E	/	/	/	Mt	E	Mo
algae aquaculture	E	E	E	/	Mo	E	E	E	E	E	E	Mo	Mo	E	E	E	Mo	E	Mto	E	Mo	E	E	Mo	E	E	E	E	E	/	E	Mo
shellfish aquaculture	E	E	E	/	E	Mo	E	E	E	E	E	Mo	Mo	E	E	E	Mo	E	Mto	E	Mo	E	E	Mo	E	E	E	E	E	/	E	Mo
fish aquaculture	E	E	E	/	E	E	Mo	E	E	E	E	Mo	Mo	E	E	E	Mo	E	Mto	E	Mo	E	E	Mo	E	E	E	E	E	/	E	Mo
aggregate extraction	Mt	Mt	Mt	/	E	E	E	Mt	Mo	Mt	E	Mo	E	E	Mt	E	Mt	Mt	Mt	Mt	E	E	E	E	E	E	Mt	Mt	Mt	/	E	Mo
dredging	Mt	Mt	Mt	/	E	E	E	E	Mt	E	E	Mo	Mto	Mt	Mt	E	Mt	Mt	Mt	Mt	E	E	E	E	E	E	Mt	Mt	Mt	/	E	Mo
dredge disposal	Mt	Mt	Mt	/	E	E	E	Mt	E	Mt	Mo	Mo	Mo	E	Mt	E	Mt	Mt	Mt	Mt	E	E	E	E	E	E	Mt	Mt	Mt	/	E	Mo
traffic separation scheme	Mt	Mt	Mt	/	E	E	E	E	Mt	E	E	Mo	Mto	Mt	Mt	E	Mt	Mt	E	E	Mo	Mo	E	E	E	E	Mt	Mt	Mt	/	E	Mo
coastal shipping	Mt	Mt	Mt	/	E	E	E	Mt	Mt	Mt	Mo	Mo	Mo	Mt	Mt	E	Mt	Mt	Mt	Mt	Mo	Mo	E	E	Mt	E	Mt	Mt	Mt	/	E	Mo
places of refuge	E	E	E	/	E	E	E	E	E	E	E	Mo	Mo	E	E	Mt	Mt	E	E	E	E	E	E	E	E	E	E	E	E	/	E	Mo
research	Mto	Mto	Mto	Mto	Mo	Mo	Mo	Mto	Mto	Mto	Mo	Mo	Mo	Mto	Mto	Mto	Mto	Mto	Mt	Mt	Mo	Mo	Mo	Mo	Mto	Mo	Mto	Mto	Mto	Mto	Mo	Mo
military navigation	Mt	Mt	Mt	/	Mr	Mr	Mr	Mt	Mt	Mt	Mo	Mo	Mo	Mt	Mt	E	Mt	Mt	Mt	Mt	Mo	Mo	E	E	Mt	E	Mt	Mt	Mt	/	E	Mo
military shooting	Mt	Mt	Mt	Mt	Mto	Mto	Mto	Mt	Mt	Mt	Mo	Mo	Mo	E	Mt	E	Mt	Mt	Mto	Mt	Mo	Mo	E	Mo	Mt	E	Mt	Mt	Mt	Mt	E	Mo
military demining	Mt	Mt	Mt	Mt	E	E	E	Mt	Mt	Mt	E	Mo	Mo	E	Mt	E	Mt	Mt	Mt	Mto	E	E	E	E	Mt	E	Mt	Mt	Mt	Mt	E	Mo
cables	E	E	Mo	/	Mo	Mo	Mo	E	E	E	E	Mo	E	Mo	Mo	E	Mto	Mo	Mo	E	E	E	E	E	Mo	E	Mo	Mo	Mro	/	Mo	Mo
pipelines	E	E	Mo	/	Mo	Mo	Mo	E	E	E	E	Mo	E	Mo	Mo	E	Mto	Mo	Mo	E	E	E	E	E	Mo	E	Mo	Mo	Mro	/	Mo	Mo
wind turbine parks	E	E	E	/	E	E	E	E	E	E	E	Mo	Mto	E	E	E	Mo	E	E	E	E	E	E	E	E	E	E	E	E	/	E	Mo
hard coastal defense	E	E	Mo	Mo	E	E	E	E	E	E	E	Mo	Mto	E	E	E	Mo	E	Mo	E	E	E	E	Mo	E	E	E	E	Mo	Mo	E	Mo
soft coastal defense	Mto	Mto	Mto	Mto	E	E	E	E	E	E	Mo	Mo	Mo	E	Mto	/	Mt	Mto	Mto	Mt	Mo	Mo	E	E	Mo	E	Mto	Mto	Mto	Mto	E	Mo
pylons	E	E	E	/	E	E	E	E	E	E	E	Mo	E	E	E	E	Mo	E	Mo	E	E	E	E	Mo	E	E	E	E	E	/	Mo	Mo
soft water recreation	Mt	Mt	Mt	/	E	E	E	Mt	Mt	Mt	Mo	Mo	Mo	Mt	Mt	E	Mt	Mt	Mt	Mt	Mo	Mo	E	E	Mt	E	Mt	Mt	Mt	/	E	Mo
hard water recreation	Mt	Mt	Mt	/	E	E	E	Mt	Mt	Mt	Mo	Mo	Mo	Mt	Mt	E	Mt	Mt	Mt	Mt	Mo	Mo	E	E	Mt	E	Mt	Mt	Mt	/	E	Mo
recreational fisheries	Mt	Mt	Mt	/	E	E	E	Mt	Mt	Mt	E	Mo	Mo	Mt	Mt	E	Mt	Mt	Mt	Mt	Mo	Mo	E	E	Mt	E	Mt	Mt	Mt	/	E	Mo
beach recreation	/	/	/	Mto	/	/	/	/	/	/	E	Mo	Mo	/	/	/	Mt	/	Mt	Mt	/	/	/	Mo	Mt	/	/	/	/	Mto	E	Mo
MPAs	E	E	E	E	E	E	E	E	E	E	E	Mo	Mo	E	E	E	Mo	E	E	E	Mo	Mo	E	Mo	E	Mo	E	E	E	E	/	/
managed MPAs	Mo	Mo	Mo	Mo	Mo	Mo	Mo	Mo	Mo	Mo	Mo	Mo	Mo	Mo	Mo	Mo	Mo	Mo	Mo	Mo	Mo	Mo	Mro	Mo	Mo	Mo	Mo	Mo	Mo	Mo	/	/

Table II.4d: The effect of a certain user (axis Y) on the demand for another user (axis X) (part 1)

	beam trawling	otter trawling	line fishing from ship	standing nets on coast	algae aquaculture	shellfish aquaculture	fish aquaculture	aggregate extraction	dredging	dredge disposal	war ammunition	industrial waste	wrecks	wreck removal	traffic separation	coastal shipping	places of refuge	research	military navigation	military shooting	military mine sweeping	construction of cables	exploitation of cables	construction of pipelines	exploitation of pipelines	construction of wind turbines	exploitation of wind turbines	construction hard coastal defense	presence hard coastal defense	construction soft coastal defense	presence soft coastal defense	construction pylons	exploitation pylons	soft water recreation	hard water recreation	recreational fisheries	beach recreation	MPAs
beam trawling	-2	-1	-1	-1	0	0	0	0	0	0	/	/	0*	0*	0	0	0	0*	0	0	0	0	0	0	0	0	0	0*	0*	0	0	0	0	0	0	0	0	0
otter trawling	-1	-2	-1	-1	0	0	0	0	0	0	/	/	0*	0*	0	0	0	0*	0	0	0	0	0	0	0	0	0	0*	0*	0	0	0	0	0	0	0	0	0
line fishing from ship	-1	-1	-2	-1	0	0	0	0	0	0	/	/	0*	0*	0	0	0	0*	0	0	0	0	0	0	0	0	0	0*	0*	0	0	0	0	0	0	-2	0	0
standing nets on coast	-1	-1	-1	-2	0	0	0	0	0	0	/	/	0	0	0	0	0	0*	0	0	0	0	0	0	0	0	0	0*	0*	0*	0*	0	0	0	0	0	-1	0
algae aquaculture	0	0	0	0	0	0	0	0	0	0	/	/	0	0	0	1	0	0*	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	?	?	0	0	0
shellfish aquaculture	0	0	0	0	0	0	0	0	0	0	/	/	0	0	0	1	0	0*	0	0	0	0	0	0	0	0	0	1	1	0*	0*	0	0	?	?	0	0	0
fish aquaculture	0	0	0	0	0	0	0	0	0	0	/	/	0	0	0	1	0	0*	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	?	?	0	0	0
aggregate extraction	0	0	0	0	0	0	0	-2	0	0*	/	/	0	0	0	1	0	0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dredging	0	0	0	0	0	0	0	0	0	3	/	/	0	0	1	0	1	0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dredge disposal	0	0	0	0	0	0	0	0*	0	0	/	/	0	0	0	0	0	0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
war ammunition	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	2	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
industrial waste	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
wrecks	1	1	1	0	0	0	0	0	0	0	/	/	1	2	-1	-1	-1	0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	2
wreck removal	0	0	0	0	0	0	0	0	0	0	/	/	0	0	0	0	0	0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
traffic separation	0	0	0	0	0	0	0	0	2	2	/	/	2	2	0	0	0	0*	0	0	0	0	0	0	0	0	0	1	1	0	0	?	?	0	0	0	0	0
coastal shipping	0	0	0	0	0	0	0	0	0	0	/	/	1	1	0	0	0	0*	0	0	0	0	0	0	0	0	0	1	1	0	0	?	?	0	0	0	0	0
places of refuge	0	0	0	0	0	0	0	0	0	0	/	/	0	0	0	0	0	0*	0	0	0	0	0	0	0	0	0	0	0	0	0	?	?	0	0	0	0	0
research	0	0	0	0	0	0	0	0	0	0	/	/	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table II.4d: The effect of a certain user (axis Y) on the demand for another user (axis X) (part 2)

	beam trawling	otter trawling	line fishing from ship	standing nets on coast	algae aquaculture	shellfish aquaculture	fish aquaculture	aggregate extraction	dredging	dredge disposal	war ammunition	industrial waste	wrecks	wreck removal	traffic separation	coastal shipping	places of refuge	research	military navigation	military shooting	military mine sweeping	construction of cables	exploitation of cables	construction of pipelines	exploitation of pipelines	construction of wind turbines	exploitation of wind turbines	construction hard coastal defense	presence hard coastal defense	construction soft coastal defense	presence soft coastal defense	construction pylons	exploitation pylons	soft water recreation	hard water recreation	recreational fisheries	beach recreation	MPAs
military navigation	0	0	0	0	0	0	0	0	1	1	/	/	0	0	0	0	0	0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
military shooting	0	0	0	0	0	0	0	0	0	0	/	/	0	0	0	0	0	0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
military mine sweeping	0	0	0	0	0	0	0	0	0	0	/	/	0	0	0	0	0	0*	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
construction of cables	0	0	0	0	0	0	0	1	1	0	/	/	0	0*	0	0	0	0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
exploitation of cables	0	0	0	0	0	0	0	0	0	0	/	/	0	0	0	0	0	0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
construction of pipelines	0	0	0	0	0	0	0	1	1	0*	/	/	0	1	0	0	0	0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
exploitation of pipelines	0	0	0	0	0	0	0	0	0	0	/	/	0	0*	0	0	0	0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
construction of wind turbines	0	0	0	0	0	0	0	1	1	0	/	/	0	1	0	1	0	0*	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
exploitation of wind turbines	0	0	0	0	?	?	?	0	0	0	/	/	1	0*	0	1	0	0*	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
construction hard coastal defense	0	0	0	0	0	0	0	0	1	0	/	/	0	0	0	0	0	0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
presence hard coastal defense	0	0	0	0	1	1	0	0	0	0	/	/	0	0	0	0	0	0*	0	0	0	0	0	0	0	0	0	0	0	-1	-1	0	0	-1	-1	1	1	0
construction soft coastal defense	0	0	0	0	0	0	0	3	1	-1	/	/	0	0	0	0	0	0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	-1	-1	-2	0
presence soft coastal defense	0	0	0	0	0	0	0	0	0	0	/	/	0	0	0	0	0	0*	0	0	0	0	0	0	0	0	0	-1	-1	0	0	0	0	0	0	0	2	0
construction pylons	0	0	0	0	0	0	0	0*	0	0	/	/	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
exploitation pylons	0	0	0	0	0	0	0	0	0	0	/	/	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
soft water recreation	0	0	0	0	0	0	0	0	0	0	/	/	0	0	0	0	0	0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
hard water recreation	0	0	0	0	0	0	0	0	0	0	/	/	0	0	0	0	0	0*	0	0	0	0	0	0	0	0	0	0*	0*	0	0	0	0	0	0	0	0	0
recreational fisheries	-1	-1	-2	-1	0	0	0	0	0	0	/	/	0	0	0	0	0	0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	0	0
beach recreation	0	0	0	0	0	0	0	0	0	0	/	/	0	0	0	0	0	0*	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	1	0	0	-2	0
MPAs	0	0	0	0	0	0	0	0	0	0	/	/	0	0*	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0

SECTION THREE INTEGRATION

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CHAPTER ONE: SYNTHESIS AND VISION

1 INTRODUCTION

1.1 METHODOLOGICAL BACKGROUND FOR STRUCTURAL PLANNING

The methodology described in this chapter is borrowed from the methodology used for spatial structural planning "on land" in Flanders. In structural planning space is seen as an area of structural unity, in which structural decisions need to be balanced against each other. In contrast with so-called 'end situation' planning, structural planning does not aim to identify and allocate every single piece of space in detail. Therefore, the structural plan is rather a global and strategic vision of the desired spatial development of a particular area. It aims to be a framework for sustainable spatial content and is represented by structural maps rather than the final planning maps (known in Dutch as 'eindbestemmingsplannen'), which set out the zones in which different types of uses may take place.

Structural planning tries to detect inter-connected units or 'structures' and structural elements, and formulate these into a strategic vision that is relevant within the scope and scale of the studied area. The resulting structure plans intend to make provision for existing issues and problems, as well as potential opportunities. Another difference to 'end-situation' planning is that structural planning involves continuous refinement and adaptation in order to react to societal changes. The motto is 'flexibility' since the concept of 'space' involves constant evolution.

1.2 SITUATING THE BELGIAN PART OF THE NORTH SEA (BPNS)

The North Sea is situated between Norway, Sweden, Denmark, Germany, the Netherlands, Belgium, France and the UK (OSPAR 2000). It is connected with the Atlantic Ocean, the Channel and the Baltic Sea. The North Sea takes up less then 1/500 of the total seawater mass on earth. In this context it is little more than a shallow, small puddle (Map III.1.1a).

Heavily populated and industrialized countries surround the North Sea. In most of its coastal areas, coastal tourism and recreation are well developed. Also the Belgian coastline attracts intense tourism. A variety of activities takes place on the North Sea that all intervene on one of the busiest shipping routes in the world. The delimitation of the continental shelves of the North Sea coastal states is the result of agreements made in the 60s and 70s. The delimitation of the BPNS with its neighbours France, UK and the Netherlands dates back to 1990, 1991 and 1996 respectivily.

The BPNS has a maximum width of about 66 kms and extends about 87 km from the coast. Its surface is comparable with an average Belgian province (about 3600 km^2). It only consists of a small proportion of the entire North Sea (merely 0.5%). Shallow waters characterise that part of the North Sea that faces the Belgian coast (average of 20 metres and a maximum of 35 metres). This contrasts with depths of about 200 meters when nearing the Atlantic Ocean. One of the typical characteristics is a complex system of sand banks almost parallel with the coastline, some of which are exposed during low tide.

This report focuses on the BPNS. Relations with neighbouring countries are identified where needed or possible. Maps are used to guide the reader through the planning process. They all use a basic outline map on which the BPNS contours and those of the northern part of the Province of West-Flanders are indicated. White dots indicate the coastal towns of Nieuwpoort, Ostend and Zeebrugge and the city of Bruges. Additionally, the groynes at the port of Zeebrugge are indicated on each map.

1.3 BRIDGING THE GAP BETWEEN SCIENCE AND STRUCTURAL PLANNING

This chapter tries to build a bridge between the scientific information and maps - as outlined in the previous chapters of this report – and the need for a structural plan for the BPNS. It addresses issues that are typical for marine planning in a general context as well as issues that need to be addressed within the specific context of the BPNS. Both general and specific issues pertaining to the BPNS, and addressed through structural planning under this Chapter, indicate that the BPNS is:

- part of a vaster mass of marine water interconnected by currents, flows and tides (Map III.1.1b)
- composed of a three dimensional structure including space in both horizontal and vertical direction going from seabed to water column and to air (Figure III.1.1a)
- occupied by an extensive array of jursidictional zones, infrastructure, and uses (Maps III.1.1c-d)

A number of maps have been created in order to bridge the gap between the scientific text under previous chapters and the discussion of structural plans under this Chapter. These include in sequential order:

- GIS maps, which are geographically accurate, to scale, and show the exact location of existing uses and their impacts. For example, whereas the GIS maps show the location of fisheries;
- Overview maps, which are not geographical accurate or to scale, but illustrate specifically chosen information in a more practical way for planners. For example, the overview maps show the relationship between the numbers of fishing vessels leaving each port and the fisheries that they are fishing;
- Synthesis maps, which are based on the overview maps and give a summary of all the activities and uses found within the BPNS;
- Vision maps (or planning maps), which are based upon both the overview and synthesis maps and provide possible secenarios for the management and use of the various resources found within the BPNS. In effect the vision maps are structural planning maps insofar as they match the discription of structural plans discussed above in section 1.1 of this Chapter.

2 SYNTHESIS: EXISTING SPATIAL STRUCTURE IN THE BPNS

2.1 THE SUB-AREAS OF THE BPNS

The BPNS consists of five characteristic sub-areas. The identity of each one of them is characterized by the interplay between the different physical elements in the area, such as relief, depth, structure of sand banks and its relationship with the land (Maps III.1.2.1a-e). These conditions in turn impact on the use of the sub-area. The five sub-areas are:

- The deeper sea: this is the sub-area that is furthest away from the land, characterised by its depth and therefore by a water column that is less influenced by the underlying seabed than in the other sub-areas;

- The Flemish banks and Hinder banks: this sub-area consists of two sand bank systems that are almost completely oriented in a north-south axis;
- The Zeeland banks: this sub-area is very comparable with the previous but its axis is more parallel to the coastline. The sand banks are also less shallow. The variation of banks and channels within these two sub-areas strongly influences the use. Differences are therefore local and depend on the conditions of certain sand banks e.g. the composition of its sediment will impact on the extraction possibilities;
- The mouth of the Westerscheldt: this sub-area only covers a small part of the BPNS. It is mainly characterized by the fact that it covers a river mouth. The river mouth contributes to siltation, input of pollutants from land, and the mixture of freshwater and seawater. Those aspects are, however, mainly important in the Dutch part of the North Sea, which is a delta area formed by the Scheldt-Rhine-Meuse mouth;
- The coastal area: this sub-area links up with the coastal landside. It is a shallow area in which uses and activities are mainly connected with land activities, tidal aspects and shallow waters.

2.2 THE DYNAMICS OF THE BPNS

The BPNS – though being very small – is intensively used. Its dynamics – both natural as well as human – are very strong in this part of the North Sea (Maps III.1.2.2a-h). Dynamics are another way to subdivide the BPNS into zones (Map III.1.2.2i).

- The transit zone: dynamics in this zone mainly consist of shipping movements both on an international and national level, and the use of traffic separation schemes. This part of the North Sea is the busiest shipping area in the world;
- The dredging zone: being an extension of the transit zone, dynamics in this zone are even more intense than those in the transit zone. Permanent dredging activity needs to be carried out to fight the shallowness of the area and constant sedimentation build up from the Scheldt mouth and the groynes at the port of Zeebrugge. This dredging zone covers the direct access routes to the ports of Ostend, Zeebrugge and Antwerp;
- The activity zone: this zone accommodates a rapidly increasing use of mobile and fixed activities. Almost all current uses and infrastructure within the BPNS are situated here. Different natural resources are exploited, including such things as wind energy, sand extraction, fisheries … etc. Those areas closest to the coast face the heaviest exploitation due to their short distance to coastal ports;
- The coastal zone: the ports, coastal towns and the beach all impact on the activities that take place within the 3 nautical mile zone, which runs along the coast. It is consequently the most intensely used area of the BPNS. This is not only limited to economic and recreational activities, but also includes a high degree of natural and ecological activities, such as continuous coastal erosion.

2.3 THE NATURAL VALUES IN THE BPNS

Physical elements such as wind, water and sand reign at sea, in contrast to the ways in which human development has curbed the force of the elements on land. To this extent the physical elements have safeguarded the natural values of biodiversity and seascape. However, these natural values have increasingly come under pressure because of the intensified use of the coast and the sea. The natural values of the BPNS are diverse, but they are also dependent on specific communities and/or populations (Maps III.1.2.3a-d). Although biodiversity is enormous and widely spread throughout the BPNS, certain core areas can be identified as being of higher natural value than others. Two areas identified within the GAUFRE project include (Map III.1.2.3e):

- A strip about 10 kms wide and more or less parallel with the coastline. This strip is divided into a marine and terrestrial part. The marine strip is widest in the western part. This part contains the most valuable coastal sand banks with large and rich benthic communities and their connected flora and fauna.The marine strip is less wide in the eastern part as a consequence of the high level of dynamics around the port of Zeebrugge. The most valuable area on this side is therefore situated on land. These are the internationally well-known bird areas of the polders, such as the Zwin and the hinterland of Zeebrugge. This coastal stretch also coincides with the wide strip being used as a migratory route for birds to and from northern and southern Europe.
- Perpendicular to the coastal strip, several faunal movements interconnect the landward with the seaward side of the coastal area. These patterns are mainly important for birds searching for feeding grounds during migration to and from the British Isles, and fish migrating between the shallow coastal banks and the deeper sea.

More natural values also occur deeper at sea but these are less well known and are mainly connected with specific local habitats, such as wrecks (Map III.1.2.3f).

The natural values of the BPNS are intrinsically linked to existing and potential threats from pollution and disturbance generated by infrastructure and other types of uses (Maps III.1.2.3g-j)

2.4 THE INFRASTRUCTURE IN THE BPNS

The BPNS has two types of fixed infrastructural systems. These can be characterised as exposed infrastructure and submerged infrastructure.

Exposed infrastructure consists of the port infrastructure (e.g. jetties and groynes) of Zeebrugge, coastal defense in general, survey and monitoring infrastructure, and the future wind turbine park on the Thorntonbank (Maps III.1.2.4a-d).

Submerged infrastructure is located on the seabed and mainly includes cables and pipelines (Map III.1.2.4e). Although the layout of this type of infrastructure can appear chaotic, a certain structure can be identified in the shape of 'bundles' (Map III.1.2.4f):

- Perpendicular to the coastal strip: two bundles leave the groyne of the port of Zeebrugge. Each one of them consists of a communication cable running parallel with a gas pipeline. A second bundle leaves from Ostend. Three cables run parallel in this bundle. Additionally many cables leave the area of De Panne-Koksijde-Oostduinkerke. The distance between these cables is larger and some of them are no longer in use.
- Parallel to the coastal strip: several communication cables have been installed parallel to the Norfra-gas pipeline.

On the landward side, the entire coastal strip can be identified as one stretched infrastructural lane. Different infrastructure (cables, coastal defense, construction, roads … etc) is bundled parallel to the coastline. Accordingly, access routes are perpendicular to the coastline. No connections are made along the coast for energy network infrastructure (gas and high voltage), and there are only dead-end or passing connections towards the sea. Nevertheless, some dead-end cables are meant to be connected to the sea cables of future wind turbine parks.

2.5 THE STRUCTURE OF THE COASTAL STRIP

The coastal strip itself consists of a landward and seaward side. Both sides impact each other. Although the sea has an impact on the total length of the coastal strip, this strip can still be divided into a number of structurally distinct categories. These categories are mainly based on different physical characteristics, types of use and mechanisms for defense against the sea. Specifically these categories include (Map III.1.2.5a):

- The concrete coast: this type occurs in the area between Knokke and Heist and between Ostend and Nieuwpoort. The coastline is characterized by concrete structures such as dykes, high levels of construction, high pressure and completely depressed natural sea dynamics towards the land. An exception is the Zwin in Knokke;
- The port of Zeebrugge: this is an industrial landscape in which the link with the sea is purely based on shipping and port activities. The groynes are meant to protect incoming vessels against currents;
- The narrow dunes: the area between Blankenberge and Bredene has less hard infrastructure than the above categories. Although part of the coast is still comprised of dunes, natural dynamics between the sea and the dunes is limited. Furthermore, the dunes that are present are very narrow and immediately turn into a polder landscape or coastal forest;
- The broad dunes: the area between Nieuwpoort and De Panne contains a broad dune belt. Although intensive construction has heavily impacted on the dune belt, natural dynamics are still present. A recent example of natural dynamics are the artificially introduced breakthroughs from the sea to the dunes (sea inlets or the so-called 'slufters');
- The polders: these occur behind the coastal strip.

3 DEVELOPMENTS AND TRENDS

Besides current uses and the existing spatial structures within the BPNS, important trends can also be identified in the natural and societal development of the area. These trends illustrate the challenges that a future North Sea policy would have to face and are therefore guidelines in formulating a spatial vision for the BPNS. The most important trends are:

- Climate change: The effects of future climate changes will heavily impact on densely populated coastal areas, such as those along the North Sea. The pressure on those areas from the water, as a consequence of the greenhouse effect will only increase in the years to come. Sea level rise for the North Sea is estimated to be between 20cm and 110cm (Van Ypersele and Marbaix 2004). But the climate will also change due to changes in the North-Atlantic gulfstream. The consequent increase in the risk of inundation, coastal erosion, siltation … etc needs to be anticipated. All these effects will have a tremendous impact on the use of the North Sea, its coastal strip and existing ecosystems.
- (Over) exploitation of fish stocks: Coastal seas such as the North Sea are very productive areas. They deliver about 80% of the fish catch and about 20% of the biological production in the world. Additionally, the demand for fish as a source of nutrition is constantly increasing. As a consequence, a large part of the most important fishing grounds is being overexploited. This of course raises questions about the sustainability of exploiting natural resources.
- Pollution and degradation: The quality of the marine environment is under a lot of pressure. The intense use and proximity to industrialised areas make the North Sea one of the most polluted areas in the world. Current and historical pollutants are a constant threat to the North Sea's natural ecosystem. It is necessary to develop a system to protect the North Sea's ecological and

physical assets. This protection is necessary not only to ensure preservation of the sea's natural value but also its importance as a productive and stocking area.

- Under-utilisation of diverse natural resources: The North Sea has an enormous potential, but only part of its natural resources are really being used. There are many additional resources that are under-utilised or which might be applied to further uses. It is presently thought that additional applications can be found in the pharmacology, biotechnology and the chemical industries. It is believed that the demand for electricity will increase from 22170 mW in 2001 to around 35500 mW in 2030. Although the North Sea is presently restricted to gas and oil exploitation, new forms of energy exploitation are becoming likely. New areas where energy may be increasingly exploited in the future include tidal power, sea currents and wind energy.
- Increased spatial claims: While the demands for space on land increase, the amount of land available to meet that demand is decreasing. This has resulted in the wide areas of space at sea being increasingly sought after as an alternative location for uses and activities that previously took place on land. At the same time activities that have been traditionally based at sea are placing increasing demands on sea space. Although marine space appears unlimited, it is not, and it will soon be challenged by the same demands as those that are faced on land.

4 SPATIAL VISION FOR THE BELGIAN PART OF THE NORTH SEA (BPNS)

4.1 THE NEED FOR A SPATIAL VISION

The surface of the BPNS is approximately 3600 km^2, which is approximately 1/9 of the surface of Belgium itself. The BPNS gives the impression of being immense with an enormous potential for new uses. Nevertheless, the current demand for space shows that the BPNS already has a high exploitation rate. The current need for space at sea is larger than generally thought. The sum of all demand for space at sea is around 2.6 times larger than the available space (if space allocations are based on current legislation and if this space would actually be used) (Figure III.1.4.1a). Apparently, some activities do not occupy all their legally allocated space (both in time and space) and some activities or infrastructures can be perfectly combined without spatial or temporal conflicts (e.g. cables and pipelines versus shipping).

Nevertheless, future requirements for space will continue to increase. The increasing requirement for space within the BPNS, as a result of current and future plans, in turn increases pressure on current uses and existing (natural) systems. It is important to note that the need for space changes in two directions. The fixed activities (such as wind energy, cables and pipelines, coastal defense, port structures, aquaculture and land extension) are gaining importance in comparison with the mobile uses. The mobile uses (such as fisheries, shipping, air transport, military use, water recreation, sand and gravel extraction and dredging activities) do not increase their spatial occupation, but rather intensify their action in the zones they already occupy.

Space within the BPNS is limited and in most cases the use of space for one type of use restricts possibilities for other types of uses. In simple terms, there is not enough space within the BPNS to accommodate all the claims for space. Accordingly, structuring and planning is required for the BPNS and choices will have to be made about space allocation. The BPNS cannot just be seen as an extension of the land. The sea has a unique and typical structure and dynamics. It is not a 'waste' space for activities that can no longer take place on land. Therefore, each activity needs to be examined in terms of whether it can be performed more effectively on land or in an alternative form.

4.2 FOUR STEPS TOWARDS A SPATIAL POLICY OF THE NORTH SEA

The GAUFRE project goes beyond mapping the current uses of the North Sea. Rather, the aim of the project is to produce plans and maps that enable policy makers and users to envisage different ways in which the BPNS might be spatially managed in the future. Based on this approach GAUFRE has formulated a 4 step approach that policy makers might utilise in order to prepare and implement a spatial plan for the BPNS.

Step 1. Determination of the core values of the North Sea

Identification of the core values that determine each use within the North Sea (i.e. ecological, economic and social well-being).

Step 2. Development of various scenarios for the BPNS

Placing different emphasis on the core values to identify new scenarios under which the BPNS might be managed and formulate a vision, spatial strategies and preferential areas of use within specific scenarios.

Step 3. Drawing of the structure plan for the BPNS

Formulation of a single vision based on the different scenarios under one structure plan. This vision would form the foundation for the future management of the BPNS.

Step 4. The transnational approach

A structure plan for the BPNS could set an example within the international policy context. Ultimately, a combination of national structure plans may result in a structure plan for the whole North Sea.

The last two steps indicate how various visions based on different scenarios can be implemented in policy. The realization of these two steps is considered a government task. Therefore, these two steps will not be discussed in this report.

4.2.1 Step 1. The core values of the North Sea

The core values of the North Sea determine each use within the coastal and marine area (Figure III.1.4.2a). The three core values are: the value of well being, ecological and landscape value, and economic value.

- **Well-Being**
  The North Sea is an area for recreation. In particular, the coast is a place to relax, take holidays and get a breath of fresh air. Consumers of the sea view it as a large, empty space in contrast with the density of the land. The social value of the Belgian part of the North Sea is caused by its potential for consumption: the sea offers space, consumer goods and entertainment.
- **Ecology and Landscape**
  The second core value emanates from the combination of the ecological and the landscape value. In Belgium, the North Sea is a scarce 'landscape' with a large ecological importance. The North Sea has a highly diverse natural wealth formed through an ecological network of benthos, fish, marine mammals and birds. Moreover, its natural wealth covers the entire ecosystem through the combination and inter-relation of topography, currents, wind … etc. Examples include such things as sand banks, dunes, tidal areas and more specific habitats on hard coastal structures. Furthermore this value concerns the landscape with its free horizon and the 'heritage' of this landscape, such as ship wrecks.

- **Economic Value**

  The BPNS is a very wealthy area, with resources and conditions that are unavailable on land. The maximum extraction of these resources, or making use of these specific conditions provide a surplus value. For example: transforming wind into valuable energy, the extraction of sand and gravel, the capture of fish and the development of aquaculture. In addition, the North Sea has an important role as transport area. The North Sea is still one of the most extensive shipping areas in the world.

In addition to the three core values the GAUFRE project identified three general principles that have an influence upon the management of the BPNS. These include the precautionary principle, sustainable management and sustainability, and finally security.

The 'precautionary principle' is based on international agreements, such as the OSPAR Convention 1992 (for the protection of the Marine environment of the North East Atlantic). This basically provides that 'preventive measures are to be taken when there are reasonable grounds for concern that substances or energy introduced, directly or indirectly, into the marine environment may bring about hazards to human health, harm living resources and marine ecosystems, damage amenities or interfere with other legitimate uses of the sea, even when there is no conclusive evidence of a causal relationship between the inputs and the effects. This principle is a core principle in the Belgian law for protection of the marine environment (1999).

The principle of 'sustainability' is based on the Bruntland Report (1987) which defines 'sustainable development' as: 'development which meets the needs of the present without compromising the ability of future generations to meet their own needs'. This principle has been translated in the Belgian law for protection of the marine environment (1999) as the principle of sustainable management of sea areas.

The Spatial Structure Plan Flanders (Ministry of the Flemish Community 1997) provides for sustainability as the guiding principle for land management. Analysis of the existing spatial structure of the North Sea revealed that uses on the BPNS are highly connected with the contiguous land parts. This means that sustainability must be implemented in the North Sea in the same way that it is implemented on land, so that the adverse effects of land use are not simply transferred to the sea. Stated more strongly, activities that are no longer welcome on land cannot simply be relocated to the sea.

The principle of 'security' can be interpreted as meaning such things as: the protection of land against floods and the power of the sea; the protection of nature values against pollution, disruptions and destruction; the protection of shipping against disaster and collision and the protection of the territory against invaders (e.g. military, coast guard, etc.).

4.2.2 Step 2: Development of scenarios for the BPNS

In this chapter six scenarios are developed for the future of the BPNS (Figures III.1.4.2b-c). These scenarios are based on the core values specified in the chapter above.

Three of the scenarios strongly focus on one of the core values. The other three scenarios are based on crossovers between two of the core values. Schematically, the six scenarios are respectively presented on the six angles of a hexagon. Each scenario has been elaborated to produce relatively extreme and conflicting results. These extreme scenarios provide an opportunity to consider a larger and less obvious picture. They reveal new possibilities and are designed to encourage the development of a policy that not only reflects present trends, but also anticipates future movements within the North Sea environment. It is not the intention of this project to provide the ultimate spatial structure plan for the BPNS (step 3). A spatial structure plan for the BPNS should rather try to balance the core values, and would therefore be situated at the centre of the hexagon.

Each 'use' of the North Sea (nature, cables and pipelines, coastal defense, wind energy, aquaculture, fishery, shipping, military, tourism and recreation, sand and gravel extraction, dredging and dumping) is considered under each of these six scenarios in terms of its development potential. These are presented in an array of 11 maps for each scenario. These maps represent zones of varying suitability towards a certain use for a specific scenario.

4.2.2.1 General 'decision rules' for the scenarios

There are a few 'fixed principles', which are applicable for each scenario. These are shortly explained below (Map III.1.4.2a).

- Shipping
  Shipping is regulated by international agreements and therefore in terms of planning is regarded as inflexible. Other uses that potentially conflic with shipping need to take shipping as a dominant use into account. This is mainly for safety reasons. Therefore, in the case of conflict, other uses are secondary. Shipping routes not regulated by international agreements (< 80 meters of length) have more potential to be fine-tuned with respect to other uses.
- Dredging and dumping
  Shipping routes and port channels require dredging. Dumping of dredged material has to take place as close as possible to the dredging zones (economic considerations). The main flow of the BPNS has a south-western/north-eastern direction. Accordingly, the dumping sites have to be located eastwards of the dredging zones.
- Sand and gravel extraction
  In principle, sand and gravel extraction are allowed and permitted anywhere within the BPNS with the exception of the main shipping routes. Additional factors in the allocation of sites for extraction of sand and gravel are the quality of the sediment (grain size: the sand must not be too fine, which excludes sand in the coastal zone) and the distance to the coast (economic considerations).
- Fisheries
  In principle, fisheries are allowed anywhere in the BPNS, although a 3 miles zone is reserved for fishing vessels with a gross tonnage of less than 70 GT. Determining factors in fisheries are the cost-effective distance between the fishing ground and the ports of call (related to the specific fleet segments) and its relationship with shipping (fisheries are of secondary importance to shipping, as is the case for other uses).
- Nature conservation
  It is preferable that the most valuable zones are protected. This study departs from the hypothesis, for which the basis is outlined in the analytical section, that the shallow coastal waters have the largest natural value or potential.
- Cables and pipelines
  In general, new cables and pipelines tend to be bundled with existing ones if possible. The most suitable bundles are those that leave Zeebrugge and Ostend. Several cables and pipelines already have connecting points in coastal towns and the terrestrial infrastructure is well developed in these areas. The bundle that leaves the western part of the coast is less suitable because the cables are more spread out (some of them are not even used) and the terrestrial infrastructure is less developed. The most suitable approach for new cables and pipelines that cross the BPNS parallel to the coastline is to bundle them with existing infrastructure on the level of the Bergues Bank in the direction of the Bligh Bank – Thornton Bank. Bundling with existing solitary cables is also possible but is less advisable. Priority is given to the existing large bundles.

- Wind turbine parks
  Wind turbines are in principle allowed anywhere on the BPNS, with the exception of internationally recognized shipping lanes and the war ammunition dumping site called the 'Paardemarkt'. Their location is very much dictated by economic considerations (such as proximity to the coastline) and issues in terms of profit (as many turbines as possible on sites with optimal wind speeds: considering the present technology, this will be between 5 and 35 kms from the coastline).
- Aquaculture
  Aquaculture can in principle be located in any marine space, except in internationally recognized shipping lanes. Economic considerations play a role with issues such as distance from the coastline influencing location. Aquaculture requires areas that have few disturbances and should avoid highly dynamic zones. It is possible to allocate aquaculture and wind turbine parks to the same area. This approach is followed in most of the scenarios.
- Military use
  This use is not frequently carried out and has a low impact. So in principle, this use will be allowed to take place anywhere in the BPNS. Moreover, it is a flexible use that can interact with many other uses within the BPNS. Again, however, its use should be in accordance with major shipping activities.
- Tourism and recreation
  Tourism and recreation are (depending on the kind of recreation) rather neutral in terms of their interaction with other uses or activities. Therefore they can be located on any site within the BPNS.
- Coastal defense
  Coastal defense can in principle be located anywhere within the BPNS. There are types of defense that can be located in deeper parts of the sea. New coastal defensce structures should be in accordance with other uses, in particular with tourism or recreation. They should also ideally act as an extension of existing soft and hard coastal defense structures.

The description of the following scenarios provides a rough sketch of some (rather extreme) future possibilities for the BPNS. These scenarios are intended to be specific aids to assist and inspire thought about the preparation and implementation of a spatial structure plan for the BPNS. The ideas go further than 'the obvious' in order to challenge future planning decisions. Nevertheless, the methodology that was used in this research can also be used to assist decision makers to make spatial planning decisions.

4.2.2.2 Scenario 1: The Relaxed Sea (Figure III.1.4.2d; Maps III.1.4.2b-e)

Theme

In this scenario, attention is mainly given to the issue of consumer 'welfare' in the North Sea. The welfare of the consumers, being the tourist, the recreationist, and also the consumer of fish and shellfish, pharmaceutical and beauty products… etc, is central in this scenario. The Relaxed Sea, therefore, is mainly experienced from a landward point of view. The North Sea exists of two parts: the coastal zone and the deeper sea. The Relaxed Sea overlaps the coastal zone and can therefore be reduced to a narrow strip of about 70 kms along the coastline in which the consumers can meet their various demands.

The Belgian coast is one of the most densely developed coastlines of the world. All major activities are situated within a narrow strip of about 5 kms wide that covers both the concrete strip as well as the shallow coastal waters.

In this scenario, the North Sea stands for sunbathing and sports on the beach, strolling along dykes, swimming, sailing and surfing, enjoying the scenery with an icecream or delicious seafood. In short, it aims at refilling the welfare battery. The structure and the use of the BPNS in this scenario therefore are meant to maintain, protect and further develop this narrow space for recreation and consumption purposes. The infrastructure of the hinterland is arranged entirely to assist access to the coastal strip, whereas mainly hard coastal defense structures are used to keep the sea under control, either on land or in sea. Each area within the coastal zone develops into a sub-zone with its own profile. The area deeper at sea and therefore further away from the coast seems to be of less importance here. In fact, it does not form part of the Relaxed Sea whatsoever. This space, being an area that is seen as separate from coast and land, is mainly used for activities that are not suitable on land, on the condition that they do not disturb the relaxing activities as discussed above.

Spatial concepts

Concentration and intensification of activities in the coastal strip

Since the coastal strip is most important in this scenario, several activities are concentrated within the coastal strip. Both the terrestrial and marine side are of significance.

Coastal strip as network of complementary activities

Tourism and recreation are not the only 'welfare' related activities that take place within the coastal strip. Other suitable 'welfare' related activities include such things as marine development that can be undertaken on land, for instance certain types of aquaculture. These new types of activities that are related to the sea will in turn contribute towards enhancing the identity of the coastal area. This in turn should lead to a coastal network of complementary 'nodes'.

Activities that hinder tourism and recreation deeper at sea

Activities that might hinder the welfare of the 'consumer of the coastal strip' are avoided as much as possible in this scenario. The degree of impact on the consumer (both tourist as well as inhabitant) will largely depend on the distance of an activity from the coast.

The potential for marine development on land within the Relaxed Sea scenario

An extended and long term view of this scenario could eventually give way to the cultivation of marine organisms in closed production systems (fish, shellfish, salty vegetables, algae, sponges or corals) on land. This could possibly lead to a new development of the coastal area in the future. Though the development of aquaculture on land might seem far off, Luiten (2004) defends its future potential by stating several advantages.

4.2.2.3 Scenario 2: The Playful Sea (Figure III.1.4.2e; Maps III.1.4.2f-i)

Theme

The North Sea provides many opportunities for different kinds of tourism and recreational activities. The Playful Sea places emphasis on exploring and exploiting the opportunities that are available to 'experience' the sea. Current recreational development is mainly linked with the beach, as is discussed in the scenario for the Relaxed Sea. This scenario, however, goes beyond the beach and attempts to zone the entire sea for recreational purposes. The BPNS turns into a space entirely devoted to recreational activities where recreationists can take advantage of a range of environments including the dynamic dune environment with sea inlets (known in Dutch as 'slufters') and marshes; coastal islands with opportunities for sport in the tidal zone and for wind recreation; valuable wrecks as nature hotspots for divers and historians; cruises and excursions at sea … etc. Spatially the term 'seascaping' is central in this scenario: the sea therefore is seen as one big attractive landscape that can give shape or that is given shape. Thus, diversity of the marine landscape as well as the recreational response to that landscape is intensified. Increasing the significance of the North Sea as a tourist attraction will of course lead to high levels of development along the coastal strip. This will need to be managed within the framework of landscape values.

Spatial concepts

The entire North Sea as a space for recreational experience

The recreational potential of the sea is no longer restricted to the coastal strip alone. An extension of the recreational possibilities will see recreation activities spread and evolve into the deeper waters of the North Sea.

Visualise the landscape of the sea

The sea is a dynamic environment. Its landscape diversity is much more varied than that of the fixed coastline and the open horizon. The development of new structures at sea may have the effect of revealing the hidden patterns of the underlying topography. For example, the construction of wind turbines may serve to denote the existence of sand banks.

The potential for coastal islands within the Playful Sea scenario

Coastal islands render a particular coastal profile. Extending the fixed coastline with a range of coastal islands (comparable with the Dutch Waddenzee islands) would add to the tourism potential of the coastal strip. Different sub-areas of the coast could be given a renewed identity by constructing a variety of different islands ranging from shallow sand banks to surfing reefs and holiday islands. The islands could also have a function in coastal defense.

4.2.2.4 Scenario 3: The Natural Sea (Figure III.1.4.2f; Maps III.1.4.2j-m)

Theme

This scenario envisages maintaining the North Sea as a natural reserve. The sea is a much more wild and rough environment than the natural environment on land. It is one of the only remaining natural landscapes that are intact in Western Europe today. Clear-cut differences can be observed between the natural environment on land and the natural environment at sea. These differences can be broadly defined under the following headings: the sea's dynamics, the open landscape and the coast. These three categories are crucial in the Natural Sea scenario.

Preservation of the sea's natural dynamics could lead to the delimitation of large parts of the BPNS, where every form of use and consumption is banned or restricted and where natural values in their broadest sense are given priority. These become places of absolute wilderness.

The vast open landscape and clear horizon are images that typify the natural landscape of the North Sea. Here restrictions are imposed by leaving the horizon vacant.

On the border of land and sea lies the coast. Here, the sea meets the land and vice versa. At present this transitional environment is rigidly controlled to ensure that the land is protected from the dynamics and wilderness of the sea. Under this scenario, natural solutions would need to be devised to defend the land against the sea, in order to leave the sea as free as possible to follow its natural processes.

Spatial concepts

Protection of the natural wealth

In this scenario attention is focused on safeguarding and strengthening the natural resources of the North Sea. Protection of the most valuable areas is also essential. Limitations would be imposed in 'marine protected areas', on different types of uses. Some activities would be prohibited in the MPAs. It is generally accepted that the shallow coastal zone (western coastal banks and 'Vlakte van de Raan') would be suitable for such protection. The protected areas would be extended to land in order to protect beaches, dunes and coastal polders.

Moving activities to deeper sea areas

Protecting the shallow coastal zone implies that activities that were prohibited from taking place in these zones need to be relocated to other areas where they cause less nuisance to the ecosystem. This would lead to many activities being moved to deeper sea areas.

Reducing (the intensity of) activities that are harmful to nature – banning activities whose impact on nature is too large

In some cases, relocating activities will not be sufficient to protect the natural value of the North Sea. Some activities will have to be reduced or transformed (e.g. transformation of the trawling fishery into more ecologically sound alternatives), and other functions will have to be banned completely because their impact on the ecosystem in the BPNS is too large (e.g. wind turbine parks, as fixed installations that form an atypical rock-like habitat in the BPNS).

The potential for marine protected areas within the Natural Sea scenario

Attention in this scenario is focused on safeguarding and strengthening the natural resources of the North Sea. Protection of the most valuable areas is also essential to ensure that natural resources are safeguarded and strengthened for future generations. 'Marine protected areas', would impose limitations on some types of uses while other activities would be prohibited altogether within the MPAs.

4.2.2.5 Scenario 4: The Mobile Sea (Figure III.1.4.2g; Maps III.1.4.2n-q)

Theme

In this scenario the use of the BPNS starts from the combined action of economic and ecological processes and the connected dynamics of the North Sea. 'Dynamics' means the constantly changing intensity, quantity and movement of natural elements including (amongst other things): the movement of sand and sediments, the transition between fresh and saltwater, water currents, wind directions, the spread of nutrients and biodiversity of the North Sea. Dynamics also refers to temporal factors including: the periodicity of low and high tide, changes from day to night and the passage of the seasons.

Contrary to the Natural Sea scenario, the use and consumption of natural resources is possible under this scenario, provided that such use and consumption is controlled. In this manner the North Sea is treated as a storage room of resources where economy and ecology go hand in hand. Every use and exploitation is flexible or mobile, based on the natural dynamics of the sea. The emphasis in this scenario is on mobile structures that can follow the sea's dynamics. Immobile structures are therefore limited and in some cases even prohibited.

Spatial concepts

Concentrate alternating activities on sandbanks

In this scenario, activities are preferably located on sandbanks. This is because sandbanks provide a highly dynamic system that is capable of quickly regenerating following intervention. As many suitable sandbanks need to be found as possible to ensure a sustainable rotation system. Working with rotation systems prevents one specific location from becoming exhausted (which was the case with sand and gravel extraction at the 'Kwinte Bank') and causing long-term adverse effects on the ecosystem. Furthermore, using rotation systems protects the environment during vulnerable periods.

Mobile energy platforms

The emphasis in this scenario is put (as much as possible) on mobile activities that can follow the sea's dynamics. For immobile structures, such as wind turbine parks, mobile alternatives will need to be sought.

Coastal currents can provide natural dredging of harbours and shipping lanes

It is necessary that as many natural alternatives as possible are sought to present activities. For instance, the force of the sea could be used and controlled to undertake natural dredging in some locations. Lessons can be learned from port construction. In Ostend the 'Spuikom' was built to enable natural dredging of the port. However, this never succeeded because the 'curve current' of the Spuikom was constructed using incorrect dimensions. In addition judicious breaks in the groynes of the port of Zeebrugge would contribute to a natural dredging of the port channel.

The potential for rotation systems for sustainable management of the natural resources of the sea within the scenario of the Mobile Sea

In this scenario, one needs to look for as many rotation systems as possible. Rotation systems are already being used in the BPNS for sand and gravel extraction, but this could be expanded to other activities in the North Sea, like fishery, military use, tourism and recreation.

4.2.2.6 Scenario 5: the Rich Sea (Figure III.1.4.2h; Maps III.1.4.2r-u)

Theme

The North Sea is rich in natural resources, living and non-living. In this scenario economic development is the most important objective, and the sea is considered as a production space where many more resources can be exploited than at present. Accordingly, the maximisation of exploitation is the priority in this scenario. The different uses of the sea's wealth should be geared to complement one another in order to maximise the return on exploitation. If necessary, conflicting uses that do not contribute to the economic exploitation of the BPNS must yield in favour of exploitation, or even disappear. In the Rich Sea scenario, many criteria must be considered in order to spatially plan for different activities. Firstly, the suitability of the local marine environment needs to be considered. Secondly, new methods and structures must be applied to optimise exploitation. Economic criteria are decisive, and include such things as the distance to the ports, the exploitation techniques and the intensity of the exploitation.

Spatial concepts

Concentration of economic activities in a core zone

In this scenario it is very important to use the economic potential of the North Sea as efficiently as possible. Each different economic activity must take place in the best location, considering the distance to the ports and the physical qualities of the location. Since we can assume that the range of exploitation activities will increase, a rather large area is reserved for these economic activities. Economic criteria (distance to the coast, substrate, intensity of activities) favour locations in the southern and central parts of the BPNS.

Concessions in the economically most suitable locations

The most important economic activities in this scenario (fishing, sand and gravel extraction and wind turbine parks) are geared to one another as closely as possible. The aim is that they will be allocated to a specific location in which the physical conditions, combined with the distance to the coast, are optimal. To avoid mutual conflicts, a system of (temporal and spatial) concessions will be used. An additional advantage of the concession system is that each user has responsibility for the location of his activity. Users effectively become the 'managers' or 'wardens' of their concession zone and must take care of that zone in order not to overexploit the available wealth.

Natural and 'sheltered' zones act as storage rooms

'Natural' zones (zones with few or no activities) and wind turbine parks have additional uses as storage rooms for fishing and aquaculture. Aquaculture can easily be combined with wind turbine parks, and wind turbine parks and natural areas can serve as shelter for fish (fishing and other 'interfering' activities are not possible in and around nature zones and wind turbine parks). In this way the use of these areas is maximised by rendering extra advantages to fisheries.

The potential for concession zones for fishing within the Rich Sea scenario

An extended and long term view of this scenario could eventually give way to the idea of concession zones for beam trawler fisheries (Luiten 2004). These 'fishing fields' are believed to provide self-organising ecosystems in which an optimal turnover would lead to a maximum harvest. This confirms nothing more than an ongoing pattern in the current fisheries. Surveys indicate that fishermen tend to return to the same favourite fishing spots instead of using the entire sea.

Eventually these fields could be managed by the concession holders without having to deal with strict European rules and quota. It would be up to them to decide what fishing intensity would be most sustainable for the catch in that area in the long run.

The banning of fishing for other areas would eventually lead to other economic uses taking over and therefore stimulating the economic turnover of the Belgian part of the North Sea.

4.2.2.7 Scenario 6: the Sailing Sea (Figure III.1.4.2i; Maps III.1.4.2v-y)

Theme

In the Sailing Sea scenario the North Sea becomes a place of both social and economic importance. The BPNS is seen as more than just an area for exploitation, from which as many resources as possible should be extracted. It is also a place where social needs should be addressed. In this scenario a lot of attention is given to immobile structures that have a social value, such as communication infrastructure, hard coastal defense, wind turbine parks that deliver sustainable energy and even (in the long run) the development of port activities at sea. A project such as the airport island near the Dutch coast is a good example. Unlike the Relaxed Sea scenario the focus in this scenario lies on the deeper sea, as opposed to the coastal area.

The BPNS is a place of transit in this scenario. Attention is given to new means of transport. On the one hand, this means larger ships on the international shipping lanes, maybe in combination with port activities at sea. On the other hand, more flexible and small-scale coastal navigation between the different coastal ports (short sea shipping in a hub system) could be developed.

Spatial concepts

Development of a differentiated transport network

Mobility issues are very important in an area that belongs to one of the busiest sea-routes of the world. To increase the efficiency a strongly differentiated transport network should be developed. This network will consist of mobility nodes and transfer points, short sea shipping, tourist routes, economic routes,… etc.

Concentration of other economic activities

Other economic activities would be located where they cause minimal disturbance to fast transport to other ports. The area in the central and eastern part of the BPNS currently has minimal transport movements and is therefore most suitable for the concentration of other activities.

The potential of the development of an (air)port island within the Sailing Sea scenario

It is possible to develop a combined airport and port island at the 'exit' of the international shipping lane to the ports of Zeebrugge, Gent and Antwerp. This island could provide relief to the current ports on land and for people that live near cargo airports (Ostend, Zaventem). The development of such an island would save a lot of time for large cargo vessels. The cargo could be transported from the island to the surrounding ports by short sea shipping. In extension the island could also serve other ports in the whole southern part of the North Sea (including the port of London, Rotterdam … etc).

This system would enable Belgium to be further developed as a logistic centre. In this respect the (air)port would be an example of the spatial 'hub-and-spoke'-principle as applied at sea.

4.2.3 Step 3 and 4: the making of the spatial structure plan and trans-national issues

It is clear that marine spatial planning must include an integrated vision of all the uses within the North Sea. It is not possible to plan with just one user in mind. The combined actions of uses as they relate to other uses, and as they relate to the environment, should also be taken into account. A sectoral approach or strict zoning is not suitable for managing the sea's dynamic system. To have a sustainable North Sea, we need the integration and participation of many different parties in the policy making process. The sea cannot be seen as separate from the coastal area (on land). As discussed above, this approach would place a structural plan for the North Sea somewhere in the middle of the hexagon representing the above scenarios. In other words, there should be a consideration and weighing of the different values of well-being, ecology and landscape, and economy.

The aim of a vision should be to provide a sufficiently flexible framework for the further sustainable development of the Belgian part of the North Sea. Eventually, the resulting 'structure plan' should be translated into international policy (step 4). The North Sea is a very dynamic system that cannot be delineated by the territorial borders of the BPNS. The sea and sea organisms do not care about territorial boundaries, neither does pollution or waste. Accordingly, a good policy should take an international approach in which the specific issues of the BPNS are considered in the context of the whole North Sea, and perhaps even beyond. Finally, activities should be geared to complement one another on an international scale and international agreements should be established to ensure that this occurs.

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CHAPTER TWO DECISION RULES

1 INTRODUCTION TO DECISION RULES

One of the main outcomes of the workshop that was carried out within the GAUFRE framework (January 2004, see chapter on Expert Workshop), was the conclusion that decision rules are needed within the context of marine spatial planning. Decision rules need to be considered for each sector in order to identify all the potentially allowable uses within the Belgian part of the North Sea, These decision rules should be operating principles for the best option and the most ideal location for each sector related use. They should be based on a general strategic vision (see Synthesis and Vision) and should take political issues into account.

The decision rules cannot be isolated from inter-sectoral interests, conflicts and synergies. These interactions should be taken into account "as far as practicable" when identifying decision rules for each sector. The consideration of inter-sectorial interactions should go beyond the marine realm and also concentrate on links with land use. The types of decision rules that might be applied to the different sectors are varied and encompass:

- Legislative requirements: These requirements are on a single use level such as EIA or on a multiple use level. Examples are "as of right" rules and permit and licensing systems
- Political and policy requirements on a single and multiple use level
- Scientific requirements leading to quantitative decision rules based on the socio-economic state of the activity and on the state of the environment

Existing rules should be used as a starting point for the drafting of new decision rules. Use should then be made of public participation, expert knowledge and relevant literature. The consultative process between government, different sectors and the public is a very important tool for obtaining sector specific data and resolving conflict. The aim of the planning process should be to identify problems and then formulate possible solutions that might be implemented through the use of decision rules. This process therefore follows 3 steps:

- Define clear goals and objectives per sector i.e. outline the decision rules per sector in interaction with other sectors (see above)
- Define the type and the resolution of data needed: Decision rules as generated under step 1 should lead to the identification of required information. These data gaps then need to be addressed by focused research. Immediate research priorities should directly contribute to the planning process. Long term research priorities should be targeted at fine-tuning plan revisions at a later stage
- Make a management plan with different scenarios using a multiple objectives analysis in order to balance the objectives of the decision rules for different sectors. By the time the actual planning process has started, decision rules should only require minor changes.

Having gone through the whole process of analysis and synthesis, an array of open decision rules was produced in order to guide the final stakeholder workshop. Since they should be based on general strategic visions, we decided to take the extreme scenarios as developed under "Synthesis and Vision" and use them as starting point for the development of the decision rules. Five types of spatial uses in the Belgian part of the North Sea were chosen as key uses since they are expected to be most important in the actual design and dynamics of future spatial demand. Other uses are also dealt with, but primarily in terms of their relationship to the 5 key uses.

2 OPEN DECISION RULES BASED ON SYNTHESIS AND VISION

2.1 MARINE PROTECTED AREAS

- Is the allocation of one or more MPAs necessary in the Belgian part of the North Sea?
- If yes
  - What should be its purpose?
    - ~ The experience of nature?
    - ~ Protection and regeneration of nature?
    - ~ Protection and regeneration of certain species and communities?
      - Should these MPAs be flexible or exclusive or a combination based on their aim?
      - Where should these MPAs ideally be allocated?
    - ~ Within or outside the 3nm zone depending on the recreational pressure?
    - ~ Within or outside the coastal zone (about 25km) depending on the recent knowledge of natural value and biological valuation?
    - ~ Focus on the "Westhoek"?
    - ~ Focus on the coastal "Vlaamse Banken"?
    - ~ Focus on the "Vlakte van de Raan"?
  - Should they be continuous with protected areas on land?
  - Do shipping routes have priority to MPAs?
  - Do we need a few big areas or several small?
  - Specific target values for
    - ~ Protection and regeneration of nature
    - ~ Protection and regeneration of a specific species or community
  - Location
    - ~ Number
    - ~ Size and fragmentation

2.2 WIND TURBINES

- Is the introduction of wind turbine parks (WTP) necessary to meet the demand for green energy, which is 3500 mW or 10% of the total electricity by 2020?
- If yes
  - Should these WTPs be flexible or exclusive in other words should they allow for overlap with other user functions such as aquaculture, fisheries … ?
  - Where should these WTPs ideally be allocated?
    - ~ Within or outside the 3nm zone depending on the recreational pressure?
    - ~ Within or outside the coastal zone (about 25km) depending on the need to:
      - ~ keep the horizon as open as possible?
      - ~ limit the transport distance of energy to the coast?

- Do shipping routes always have priority to WTPs?
- Should they be installed in lines following the contours of the sand flats and is this more related to a societal value?
- Should they be mobile to prevent disturbance of natural dynamics of the system?
- Weighing against other economic users on the basis of:
  - ~ spawning, nursery and feeding areas for fish and thus for fisheries?
  - ~ … etc
- What should be the size of these WTPs?
  - ~ A contribution of 10% by 2020 asks for a total surface of WTPs at sea of about 350 km²
  - ~ Should more than 350km² be allocated?
  - ~ Should exactly 350 km² be allocated leading to a complete contribution of 10% at sea?
  - ~ Should less than 350 km² be allocated leading to a demand for other sources or wind energy on land in order to reach the 10% value? Possible reasons for this scenario could include:
    - o Too many WTPs at sea disturb the structure of the marine landscape?
    - o WTPs disturb the natural value of the sea?
  - ~ If less, in what proportions?
- What shape should these WTPs ideally have?
  - ~ One big area encompassing the total desired surface?
  - ~ Several smaller areas of which the sum equals the total desired surface?
  - ~ Uni- or bi-dimensional WTPs depending on
    - o The scenic structure?
    - o The return value?
- Specific target values for
  - ~ 10% rule against 2020 or more
  - ~ Total surface of WTPs => less or more than 350 km²
  - ~ Location
  - ~ Shape

2.3 SAND AND GRAVEL EXTRACTION

- Is the allocation of concession areas for sand and gravel extraction necessary to meet the demand for sand and gravel?
- If yes
  - What should be their purpose??
    - ~ Focus on beach replenishment and coastal defense?
    - ~ Focus on industrial use?
    - ~ Focus on land extension such as harbour islands and airport islands?
  - Should these areas be managed in a sustainable or exclusive way?
    - ~ Taking into account the natural carrying capacity of the extracted area?
    - ~ Making use of a rotational system on the basis of
      - o The dynamics of the morphology?
      - o Fisheries?
  - Where should these areas ideally be allocated?
    - ~ Within or outside the 3nm zone depending on the recreational pressure?

- ~ Within or outside the strip that is being used for coastal defense?
- ~ Within or outside the coastal zone (about 25km) depending on the recent knowledge of natural value?
- ~ Those areas in which the economically most viable sand and gravel fractions are to be found?
- ~ On or off the tops of the sand flats?
- ~ Do shipping routes always have priority to these areas?

- What should be the size of these areas?
  - ~ Large areas that completely meet the economic demand for sand and gravel?
  - ~ Sufficiently to just meet the demand for beach replenishment and coastal defense?
  - ~ Sufficiently to take the natural values and biological valuation into account?

- Specific target values for
  - Maximum volume in m^3 extracted sand/gravel per m^2 en per time unit
  - Minimal surface of concession areas and/or actively extracted areas
  - Rotational systems => frequency and surface of closed and open areas
  - Location

2.4 FISHERIES

- Is the safeguarding of fishing grounds in the Belgian part of the North Sea necessary?
- If yes
  - What should be the purpose?
    - ~ Safeguarding the traditional sector that is focused on social, culinary and recreational value?
    - ~ The local consumption of fish?
    - ~ The national consumption of fish?
    - ~ International consumption?
  - Should these fishing grounds be sustainable or exclusive?
    - ~ Exclusive fisheries in the richest fishing grounds (so called fishing fields)?
    - ~ Taking into account the natural carrying capacity of the fished area?
    - ~ Searching alternative and ecologically more acceptable fishing techniques?
    - ~ Making use of a rotational system on the basis of
      - o The dynamics of the fish biology?
      - o The sand and gravel extraction?
  - Where should these fishing grounds ideally be allocated?
    - ~ Within or outside the 3nm zone depending on the recreational pressure?
    - ~ Within or outside the coastal zone (about 25km) depending on the recent knowledge of natural value and biological valuation?
    - ~ Variation in location (distance to coast, depth, west vs. east) to generate variation in catch?
    - ~ On or off the tops, slopes or channels of the sand flats?
    - ~ Everywhere except on the "Paardenmarkt" and in the WTPs
    - ~ Do shipping routes always have priority to these fishing grounds?
- Specific target values for
  - Minimal surface of fishing grounds

- Maximum intensity and catch per unit effort in these fishing grounds
- Rotational systems => frequency and surface of closed and open areas
- Location

2.5 TOURISM

- Are tourism and recreation necessary?
- If yes
  - What should be the purpose?
    - Importance for recreation and welfare of the population?
    - Importance for experiencing nature?
    - Economic importance?
  - How should zones for tourism and recreation be developed??
    - Soft and/or hard recreation?
    - With restrictions?
      - Only soft recreation?
      - Hard recreation limited in
        - Time? => seasonal
        - Space? => rotational systems
    - Are these restrictions dependent on
      - The impact on the natural value?
      - The impact on the natural dynamics of the ecosystem?
      - The impact on the economic functioning?
      - The impact on shipping?
    - Other recreational aspects to render the scenic experience optimal (excursions, cruises, diving, recreational islands at sea…)?
    - Should these types be mixed within the same zone or should they be spread over different locations?
  - Where should tourism and recreation ideally be allocated?
    - Exclusively in the coastal strip on land (hinterland) as well as at sea hence within the 3nm zone with a focus on the cultural background?
    - Within or outside the 3nm zone?
    - Landing only at certain locations of the coastal strip?
    - Soft recreation (swimming) in exclusive MPAs?
    - Soft and hard recreation in flexible MPAs with restrictions for soft and hard recreation?
      - In time?
      - In space?
    - Spread over the entire Belgian part of the North Sea
    - Do shipping routes always have priority to tourism and recreation?
  - What should be size of these areas?
    - Small limited areas possibly overlapping the exclusive and/or flexible MPAs
    - Large zones possible overlapping the coastal strip or the deeper zones at sea
    - Spread over the entire Belgian part of the North Sea?
- Specific target values for
  - Minimal surface for tourism and recreation

~ For soft recreation
~ For hard recreation
- Rotational systems => time and space
- Location

3 OPEN DECISION RULES USED FOR THE STAKEHOLDER WORKSHOP

These open decision rules were used as a basis for a concise and focused listing of decision rules covering all relevant uses and all aspects of these uses. Since this list was therefore going to be used during debates and work discussions the following guidelines were set:

- simple and to the point
- multiple choice with limited degree of personal input
- answers should be sufficient to guide a vision or scenario as a product of public input

The actual workshop and its outcomes are summarised in the chapter on "Stakeholder workshop".

ECOLAS Environmental Consultancy & Assistance

CHAPTER THREE STAKEHOLDER WORKSHOP

1 INTRODUCTION

The second workshop of the GAUFRE-project took place on the 11th of February 2005 in the Provincial house "Boeverbos" in Bruges (Provincial Hall, Hall 3 & 4). The goal of the GAURE-project is to offer a basis for the development of a spatial structure plan that contributes towards a sustainable management of the North Sea. The invited guests were all involved with the use of the Belgian part of the North Sea.

In the following report a short overview of the program will be given, followed by a discussion of the most important conclusions of the workshop.

2 PROGRAM OVERVIEW

Morning

8.30	Registration of the participants of the workshop.
9.00	Welcome and introduction of the workshop. *Prof. Dr. Frank MAES, Maritime Institute (UG) & co-ordinator GAUFRE project*
9.10	Presentation of the GAUFRE-project: goal, location & methodology *Dr. Bart DE WACHTER, Ecolas N.V.*
9.30	'Decision rules' as a basis for scenarios of spatial structure planning on sea. *Dr. Jan SCHRIJVERS, Maritime Institute (UG)*
9.50	Coffee/tea break.
10.20	Introduction of the discussion in groups about the 'decision rules' for the North Sea. *Dr. Bart DE WACHTER, Ecolas N.V.*
10.30	Discussion in groups: appreciation of the 'Decision rules'.
12.30	Lunch

Afternoon

14.00	Landvision on spatial planning applied on the marine environment. *An VANHULLE, Ir. Peter VANDENABEELE, Maritime Institute (UG)*
14.45	Summary of the debate. *Ir. Dirk LE ROY, Ecolas N.V.*
15.15	Coffee/tea break.
15.45	Feedback of the results of the discussion groups
16.30	End of the workshop + reception

3 MAIN CONCLUSIONS

3.1 SELECTION OF THE DECISION RULES

The main finding was that there was a high degree of concensus among the participants who attended the workshop (total of 45). The members of a group mostly chose the same decision rules, but there was also a large degree of unanimity between the different groups. Out of the 15 decision rules, there was complete unanimity (score 6 to 6) between the groups for 8 of the rules, and an almost complete unanimity (score 5 to 6) for 4 of the other rules. Opinions were more divided with respect to the remaining (3) rules (see Table III.3a).

For more detail about the selection of the decision rules by each group see attachments 2 to 8.

Table III.3a: Overview of the group choice decision rules

Unanimity (6 to 6)		
Dredging	2b	Yes, but the dumped material must be recycled as source for aggregates and dumped on locations that cause the least ecological damage.
cables & piping	3a	They must be laid in clusters.
Military use	5b	Military use (zones and time) is subordinate to economic use and ecological conditions
Marine protected areas	6b	Yes, and they need to have a flexible status (that means that other activities can occur in accordance with the regulations as long as the nature value doesn't decrease).
Shipping	8a	Professional shipping always has priority on all other activities or user functions.
Wind energy	12b	Yes , but limited
	13c	Yes, and the concession areas must be delineated on the basis of a minimal impact on landscape (visual) and ecology.
Sand & gravel extraction	15a	The concession areas and the extraction must be realized in balance with the natural dynamics (like rotation systems, restriction of the extraction on the location … etc).
Almost unanimity (5 to 6) (alternative 1/6)		
Marine protected areas	7c (7b)	Yes, with preference for one or a few big areas, that preferably connect to protected areas on land or internationally. (Yes, with preference for several small zones)
Tourism & recreation	9b (9a)	The recreational value of the coast must be strengthened (active and passive), with enough space for nature. (The recreational and tourist value of the coast (active and passive) is sufficiently covered).
Fishing	10b (10a)	Fishing is limited by quota, and alternative fishing techniques etc., so that the natural carrying capacity would not be crossed. Fishing is restricted neither in space nor in fishing techniques (maximise economic return within the Common Fisheries Policy of the EC)
Wrecks	14a	Wrecks, that pose no safety risk to navigation or the environment,

	(14b)	need to get a protected status on the basis of their ecological, recreational or cultural-historical value. (Wrecks that pose no safety risk to navigation or the environment do not need to have a protected status, but they may remain.)
For discussion		
Aquaculture		All the three possibilities
Coastal defence	4b 4c	Maximise safety, and with preference for soft coastal defence Maximise preservation of the natural coastline and its dynamics whereby safety is being guaranteed
Fishing	11a 11b	The present fishing needs are to be preserved as long as possible. Belgium must aim for a fishery that is economically based on social, cultural and recreational values instead of consumption

3.2 PRIORITY OF THE DECISION RULES

After the establishment of the choice of the group, every participant gave a priority to the selected decision rules (group choice). These scores were adapted very little during the discussion. The results of the (adapted) prioritisation of the decision rules (by group) are represented in Table III.3b. Also the average priority is calculated. The prioritisation by the groups was more ambiguous than the selection of the decision rules, yet some patterns could be detected. These patterns will be discussed in the scenarios (3.3).

Table III.3b: Priority of the selected decision rules

Nr	Activity		Decision rules	G1	G2	G3	G4	G5	G6	$\bar{x}$
4	Coastal Defence	A	Maximum safety, and with preference for hard coastal defence.						3	3.5
		B	Maximum safety, and with preference for soft coastal defence.		8			2		
		C	Maximum preservation of the natural coastline and dynamics whereby safety is guaranteed.	4		2	2			
10	Fishing	A	Fisheries are neither in restricted space nor in fishing techniques (maximise economic return within the Common Fisheries Policy of the EC)						4	3.7
		B	Fisheries are limited by quota, and alternative fishing techniques etc. Accordingly, the natural carrying capacity is not be surpassed	1	8	3	4	2		
8	Navigation	A	Professional shipping always has priority over all other activities and uses.	10	1	3	7	1	1	3.8
6	Marine protected areas	B	They need to be treated preferentially but retain a flexible status (that means that other activities can occur in accordance with the regulations as long as the nature value doesn't decrease)	6	7	3	1	6	2	4.2
2	Dredging	B	Yes, but the dumped material must be recycled maximally as source for aggregates and dumped on locations that cause the least ecological damage.	1	6	11	5	4	4	5.2
15	Sand & gravel extraction	A	The definition of the concession areas and the extraction must be realized in balance with the natural dynamics (like rotation systems, and restriction of the extraction on the location … etc).	1	8	9	6	6	11	6.8
11	Fishing	A	The current fisheries need to be preserved as long as possible.	6	8		8		9	7.5

Nr	Activity		Decision rules	G1	G2	G3	G4	G5	G6	$\bar{x}$
		B	We must go for a fishery that is economically based on social, cultural and recreational values instead of consumption.			8		6		
3	Cables & piping	A	They must be laid in clusters	10	4	9	8	9	6	7.7
7	Marine protected areas	B	Yes, with preference for several small areas		14					8.3
		C	Yes, with preference for one or a few large areas that preferably connect to protected areas on land or internationally	5		13	3	9	6	
9	Tourism & recreation	A	The recreational and tourist uses of the coast (active and passive) are sufficiently developed.	13						8.3
		B	The recreational function of the coast must be strengthened (active and passive), with enough space for nature.		4	1	10	12	10	
13	Wind energy	C	Yes, and the concession areas must be designated on the basis of a minimal impact on landscape (visual) and ecology.	8	2	6	12	11	13	8.7
12	Wind energy	B	Yes, but limited in space (please indicate how much)	10	8	6	11	13	12	10
14	Wrecks	A	Wrecks that do not pose any safety risk to navigation or environment should be provided with protected status on the basis of their ecological, recreational or cultural-historical value.	8	12		14	14	13	12.7
		B	Wrecks, that do not pose any safety risk to navigation or the environment, do not need to get a protected status, but they may stay on the spot.			15				
5	Military use	A	Military zones are essential and it can perform its activities here with priority.						15	13
		B	Military use (zones and time) is subordinate on economic use and ecological conditions.	14	16	12	15	6		
1	Aquaculture	A	No, no future for aquaculture on the BPNS.	15						14.6

Nr	Activity		Decision rules	G1	G2	G3	G4	G5	G6	$\bar{x}$
		B	Yes, and with preference connected to wind turbine parks.		15	14	13	15		
		C	Yes, in exclusive zones reserved for aquaculture.						16	

3.3 SCENARIOS

Concerning the choices and the priority of the decision rules, 6 scenarios were visually presented and the following agreements were found (Maps III.3a-f).

- Safety is very important, both on land and on sea. There is a clear preference for soft coastal defence, and most participants were of the view that the natural coastline must be preserved where possible. In cases where (old) wrecks do not cause danger, they may stay in place. Some of them need to be preserved because of their ecological, cultural and historical value.
- A second important agreement reached is that activities must be carried out within the capacity of the environment. We must pay attention that "natural capacity" is not used as an empty concept. This implies certain regulations for both sand and gravel extraction and the fishery industry.
- Existing uses may continue with fisheries as the highest priority. Military use can occur if there is consultation with the other sectors (other option: in the NATO framework, demarcation on European scale).
- There is room for a demarcation of the marine protected areas (ranking: 4), in the case that they are given a flexible status. Some were of the opinion that some places should be guarded against fisheries. The preference is given to large areas instead of small ones.
- The tourist and recreational use of the coast must be strengthened (ranking: 9), but mainly in a qualitative way (not to build more) and in a sea direction
- There is also room for wind energy (ranking: 11-12), but this is limited. The location needs to take into account the visual and ecological disturbance, but economic feasibility must also be taken into account.
- The military use of the BPNS is considered as less important (ranking: 14)
- Finally, a place for aquaculture can be foreseen, but only for a nursery of bivalves (mussels, oysters, spisula) (not an intensive fishing nursery). By preference, these places must be connected with wind turbine parks. Some participants doubted the economical feasibility of aquaculture if the distance from the coast becomes too large (in contrast with other countries where aquaculture is done close to the coast.).

Furthermore, two new decision rules were formulated:

- Integration: Spatial planning must be integrated with representations of neighbouring countries, and a co-ordinated management that treats all the different sectors as being necessary.
- Angling must be limited both in space and in quota.

The selected decision rules with a priority of each group were translated into a visual scenario, which was presented and discussed at the workshop (look at the main remarks above). This is only a first draft, developed during the workshop, which provides an indicative presentation of a few important trends that were observed.

4 APPRECIATION OF THE WORKSHOP

According to the received evaluation forms (53% of the participants filled out an evaluation form), the workshop was a success and the most important goals were reached:

- To communicate the specific results of the project by bringing together a wide delegation of stakeholders and users.

- To start a discussion that forms the basis for creating possible scenarios for optimal allocation of the sea to the different uses. These scenarios were created taking into account the vision of the most important users and the agencies involved in the management of the North Sea

The different aspects of the workshop were quoted as follows:

- Presentations (clarity, completeness, time spent): good;
- Interactive group discussion on 'decision rules': good to very good. The interactive character and the personal contribution especially received a high score.

Interest in the workshop was dependant of the participant. Other aspects to receive favourable mention included the information made available, the new insights that the project provided and the interaction between the users and the stakeholders.

Annex 1: Individual and group choices by decision rules

Remark: in some cases not all the choices were marked on the received answer forms, and sometimes two rules were marked.

Nr	Activity		Decision rule	% answ.	Choice of the group after the discussion					
					GR 1	GR 2	GR 3	GR 4	GR 5	GR 6
1	Aquaculture	A	No, no future for aquaculture on the BPNS.	21	X					
		B	Yes, and with preference connected to wind turbine parks.	48		X	X	X	X	
		C	Yes, in exclusive zones reserved for aquaculture.	24						X
2	Dredging	A	No, dumping of dredged material is not permitted on the BPNS.	0						
		B	Yes, but the dumped material must be recycled as source for aggregates and dumped on locations that cause the least ecological damage.	95	X	X	X	X	X	X
		C	Yes, without further restrictions	7						
3	Cables & piping	A	They must be laid in clusters.	79	X	X	X	X	X	X
		B	They need to follow the shortest route to the coast.	10						
4	Coastal defence	A	Maximum safety, and with preference for hard coastal defence.	0						
		B	Maximum safety, and with preference for soft coastal defence.	36		X			X	
		C	Maximum preservation of the natural coastline and his dynamics whereby the safety is being guaranteed.	48	X		X	X		X
5	Military use	A	Military zones are essential and it can perform its activities here with priority.	19						
		B	Military use (zones and time) is subordinate to economic use and ecological conditions.	81	X	X	X	X	X	X
6	Marine protected areas	A	No, they are not necessary	0						
		b	Yes, and they should have preferential, but flexible status (that means that other activities can occur in accordance with the regulations as long as the nature value do not decrease).	100	X	X	X	X	X	X

Nr	Activity		Decision rule	% answ.	Choice of the group after the discussion					
					GR 1	GR 2	GR 3	GR 4	GR 5	GR 6
		c	Yes, and they need to be exclusively preserved for nature protection and they will be delineated only on the basis of their natural value.	0						
7	Marine protected areas	a	No, they are not necessary	5						
		b	Yes, with preference for several small areas	14		X				
		c	Yes, with preference for one or a few big areas that preferably connect to protected areas on land or internationally	81	X		X	X	X	X
8	Navigation	a	Professional shipping has always priority over all other activities or uses.	79	X	X	X	X	X	X
		b	Professional shipping has no priority over all other activities or uses.	21						
9	Tourism & recreation	a	The recreational and tourist use of the coast (active and passive) is sufficiently developed.	33	X					
		b	The recreational use of the coast must be strengthened (active and passive), with enough space for nature.	48		X	X	X	X	X
		c	The recreational and tourist use of the coast must be strengthened (active and passive), on the basis of a maximum economic output.	7						
		d	The recreational and tourist function of the coast (active and passive) must be strengthened in the direction of the sea.	0						
10	Fishing	a	Fisheries are not restricted either in space or in fishing techniques (maximum economic return within the Common Fisheries Policy of the EC).	17						X
		b	Fisheries are limited by quota and alternative fishing techniques etc., so that the natural carrying capacity is not surpassed.	71	X	X	X	X	X	
		c	Fishing is limited to exclusive delineated concession zones on rich fishing grounds.	5						
		d	Fishing is limited both in space (defined concession zones) and in fishing techniques.	7						

Nr	Activity		Decision rule	% answ.	Choice of the group after the discussion					
					GR 1	GR 2	GR 3	GR 4	GR 5	GR 6
11	Fishing	a	The current fisheries need to be preserved as long as possible.	29	X	X		X		X
		b	We must go for a fishery that is economically based on social, cultural and recreational values instead of consumption.	43			X		X	
		c	Aquaculture will be developed on the BPNS as an alternative to the consumption directed fishery.	12						
12	Wind energy	a	No, no future for windmills on the BPNS.	10						
		b	Yes, but limited (please indicate how much).	62	X	X	X	X	X	X
		c	Yes, and 10% of the renewable energy must be realized by wind energy (±350 km^2).	17						
13	Wind energy	a	No, no future for windmills on the BPNS.	7						
		b	Yes, and the concession areas must be designated on the basis of the maximum economical profitability.	24						
		c	Yes, and the concession areas must be designated on the basis of a minimal impact on landscape (visual) and ecology.	69	X	X	X	X	X	X
14	Wrecks	a	Wrecks that do not pose any safety risk to the navigation or the environment need to get a protected status on the basis of their ecological, recreational or cultural-historical value.	50	X	X		X	X	X
		b	Wrecks that do not pose any safety risk to navigation or the environment do not need to get a protected status, but they may stay where they are located.	38			X			
		c	Wrecks must be removed.	2						
15	Sand & gravel extraction	a	Concession areas for extraction must be in balance with the natural dynamics (like rotation systems and restriction of the extraction on the location … etc).	93	X	X	X	X	X	X
		b	The size and location of the concession areas and the extraction of sand and gravel is primarily determined by economic dynamics and the profitability.	7						

LIST OF TABLES

LIST OF FIGURES