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Beneficial use of dredged material in the North Sea

An assessment framework

Rijkswaterstaat North Sea

April 2013
Report

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1 INTRODUCTION

1.1 Cause and problem

In order to keep Dutch ports and waterways accessible millions of m^3 of dredged material are relocated in the North Sea every year. Various relocation areas have been used for several years for this purpose (see fig. 1.1).

The present relocation areas for dredged material from the Port of Rotterdam and Rotterdam waterways are almost filled to capacity with dredged material (-1m under the surface-water bed). This means that, in the short term, the dredged material from the Port of Rotterdam and Rotterdam waterways will need to be relocated elsewhere. However, the Dutch legislative framework for the relocation of dredged material at sea, the Soil Quality Decree, does not immediately make it clear to the parties involved where dredged material can be relocated in accordance with this decree. The aim of this report is to create a clear framework for this purpose.

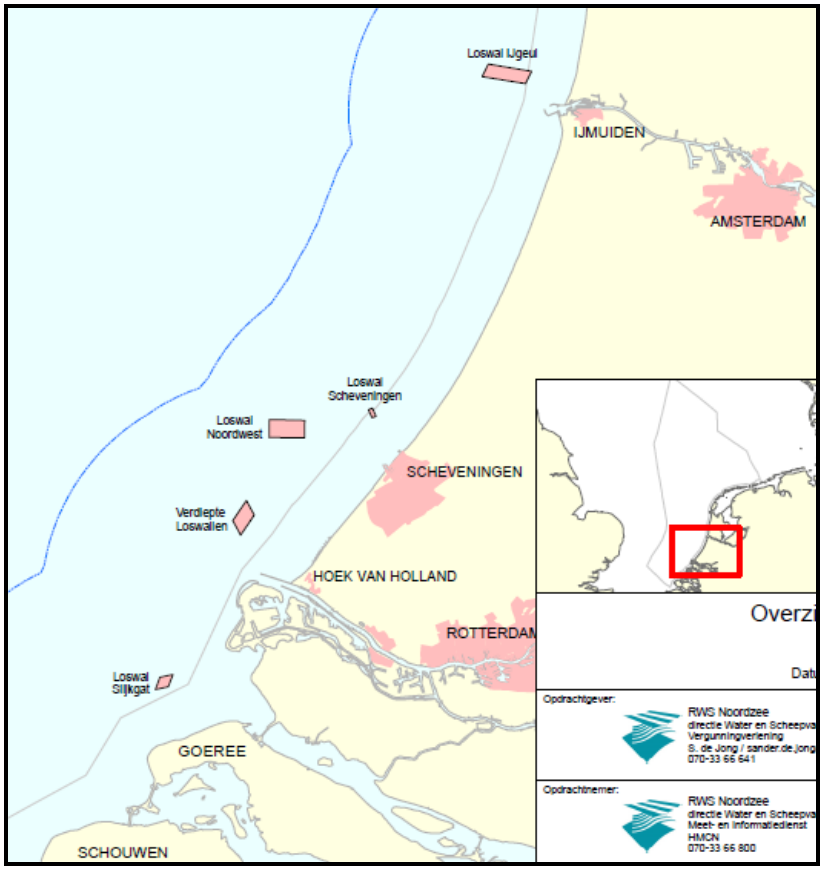

Fig. 1-1 Overview of relocation areas for dredged material in the North Sea

The Soil Quality Decree provides the Dutch interpretation in legislation for the various international treaties that regulate the management of dredged material. A condition that is included is that the relocation of dredged material must be of beneficial use (i.e. the relocation has to contribute to a functional and sustainable fulfilment interpretation of the morphological and ecological functions of the sediment).

In principle, the current relocation areas meet the conditions for beneficial use as outlined in the Soil Quality Decree. When establishing the current locations for relocation (see fig 1-1) in the past, components of these conditions were implicitly taken into account. The relocation of dredged material is functional (no options for use on land and does not negatively impact other activities in the North Sea). In addition, a detailed assessment of ecological effects was carried out in the Environmental Impact Assessment (EIA), which is the basis for the present North West Relocation Area (in Dutch: Loswal Noord West) and the Lowered Relocation Area (in Dutch: Verdiepte Loswal) relocation areas. According to the competent authorities these are locations where experience and research have shown that the relocation activity is not harmful for nature and does not obstruct other functions of use.

The water bed manager of the North Sea, Rijkswaterstaat, has a clear idea which parts of the North Sea are suitable for the beneficial use of dredged material. General considerations on how the relocation of dredged materials can contribute to the morphological and ecological functions of the sediment are already used during day-to-day activities.
However, there is no clear framework as to how new relocation areas can be addressed with a sustainable implementation of the ecological and morphological functions of the sediment and the present views are possibly not yet complete. Rijkswaterstaat, therefore, does not have a complete overview of where dredged material can be beneficially used outside the current relocation areas within the framework of the Soil Quality Decree and other relevant legislation.

An assessment framework for the beneficial use of dredged material in the North Sea has been created to establish the extent to which the relocation of dredged material in the North Sea contributes to the conditions of the Soil Quality Decree. The results of this are presented in this report. The assessment framework was subsequently tested for the situation in the Port of Rotterdam and Rotterdam waterways. It is possible to use the assessment framework to stipulate under which conditions dredged material can be relocated while abiding by the legislation and regulations in force.

1.2 Question and approach

The following steps were taken in order to respond to the problem outlined above.

1. Definition of the current activities at sea with dredged material;
2. Development of a generic assessment framework for the beneficial use of dredged material at sea in which details are provided for both the sustainable implementation of the ecological and morphological functions of the sediment and the functionality requirements from the Soil Quality Decree.
3. Legal implementation of the framework.
4. Test case for the Rotterdam situation.

The assessment framework to be developed must be applicable to the entire Dutch part of the North Sea.
The Dutch Ministry of Infrastructure and the Environment, Rijkswaterstaat, the executing agency for the Ministry, and port managers were involved in the process of making an assessment framework including

the possible relocation areas. Therefore, policy makers, initiators and assessors are involved. A project group was set up that concentrates on planning, progress, coordination and scope. A pool of experts was also used for the development of the assessment framework. The legal implications were discussed by an expert legal team.

In developing the assessment framework, knowledge from relevant environmental impact assessments has been used (including the EIA for the current relocation areas in the Rotterdam area and the EIA for the mining of sea sand for beach nourishments).

1.3 Reading guide

Chapter 2 provides information regarding the current practice of beneficial use of dredged material at sea and the relevant (inter)national legislation and regulations. Chapter 3 describes the developed assessment framework including general considerations. Chapter 4 elaborates further on the framework for the Rotterdam situation. Chapter 5 presents the conclusions and provides more detailed recommendations. Chapter 6 lists the bibliography.

2 BACKGROUND

2.1 Background to activities at sea with dredged material

Large quantities of dredged material are relocated in the Dutch coastal region. The major share of this originates from port basins and channels. The dredged material consists of various combinations of sand and silt. The natural morphological processes are disturbed because there are ports and waterways. In an undisturbed coastal system, sand and silt from the river reaches the North Sea without obstruction and follow the natural current to the north parallel to the Dutch coast ("coastal river"). The combination of a port and outgoing channels interrupt this movement and work together as a large silt and sand trap.

Periodic dredging must take place to keep the ports and waterways navigable. If the quality of the dredged material meets the standards for beneficial use (no or almost no contamination), the dredged material can be relocated to the North Sea in relocation areas for the Port of Rotterdam and Rotterdam waterways, the Port of Scheveningen, the IJgeul ("IJ Trench)/Noordzeekanaal ("North Sea Canal") and the waterways towards Stellendam (Slijkgat). The dredged material from the province of Zeeland is relocated within the same watershed and is, therefore, not relocated at sea. Hardly any relocation activities take place north of the Waddeneilanden (i.e. the West Frisian Islands) in the north part of the Dutch North Sea.

The largest quantities of dredged material originate from the Port of Rotterdam, approx. 8 to 10 million m^3 per year. Around half is made up of sand and the rest consists of silt. This sand and silt originates both from the rivers and from the North Sea. During high tide, sea water flows into the port. The sand movement from the downstream part of the Rhine is possibly around 700,000 m^3 to 900,000 m^3 (ten Brinke et al. 2001)**.** The largest proportion of sand that is dredged in the Port of Rotterdam and Rotterdam waterways, therefore, originates from the sea ('coastal river'). This is less clear for silt.

Sand is taken from the coastal river and coastal foundation
8 to 10 million m^3 of the dredged material from the Rotterdam harbours and waterways is relocated above the relocation area Verdiepte Loswal. This relocation area is situated just outside the Dutch Coastal Foundation[1]. Approximately 3 to 4 million m^3 of sand are actually "taken" from the coastal foundation through port activities because of this. This is only the case for the Rotterdam area as the IJmuiden Relocation Area and Scheveningen Relocation Area are situated within the coastal foundation.

Before 2007 also around 0.8 million m^3 of sandy dredged material from the Maasgeul, the channel on the North Sea to enter the Rotterdam ports and waterways, was yearly relocated above the Lowered Relocation Area. In order to prevent loss of sand on the Dutch Coastal Foundation the dredged material is now relocated above a northerly located part of the coastal foundation: Coastal Foundation Relocation Area (in dutch: Loswal Kustfundament (Kf)).

The policy is formulated for the coastal foundation that this must be maintained in terms of volume up to the modified Amsterdam Ordnance Datum (AOD) –20 m depth contour and must grow with the sea level (see annex 5 about Dutch coastal management). Adherence to this policy requires large quantities of sand to be supplied on to the coast that entail considerable costs being incurred. For coastal nourishment, a

[1] The Dutch Coastal Foundation is the area between the coastline and the modified AOD -20 meter depth contour. This area is protected: no sand mining is allowed in this part of the sea. See Annex 5 for detail information about Dutch coastal erosion management.

distinction is made between beach nourishment and bank nourishment. From time to time, nourishment is taking place at points where the Basic Coastline (BCL) is no longer guaranteed. The coast has been strengthened at several places in recent years.

Distinction between application and relocation
The Soil Quality Decree has a clear distinction between the application (article 35d) and the relocation (35g) of dredged material. *Application* (35d) includes beach and bank nourishment and all suppletions within the active zone of the coastal foundation, whereas *relocation* (35g) includes the relocation of sediment within the marine ecosystem, this includes the relocation of sandy dredged material within the coastal foundation, but outside the active zone. To avoid any ambiguity regarding the activities, it was apparent to set the transition based on the water depth. This is set at AOD -11,5 m (10m LAT). The reason it is so important to know the difference, is because there is a different quality standard for the two types of activities. For application activities, such as beach nourishments, the quality of the material is required to be equal to, or better than, the quality of the receiving area. For relocation activities the quality of the material has to meet the intervention values and maximum values for relocation in salt waters (also see Annex 4). Therefore, there is a higher quality standard for application activities.

Maintenance of channels is also undertaken in the North Sea in addition to the Maasgeul. This takes place both inside and outside the 12 mile zone. This involves levelling sand ripples in order to be able to maintain the guaranteed water depth. The material is subsequently relocated above neighbouring areas.

Silt is also taken from the coastal system
Silt is also taken from the coastal system through the process of settling in port basins and dredging and relocation in areas outside the coastal foundation. Part of the silt that is relocated stays in the water system due to the current and follows the Dutch ‘Coastal River’ to the north. Part of the silt that is relocated at the Lowered Relocation Area is removed from the coastal system. It is not known what the consequences of this are for the silt content of the water bed and column, for water quality and primary production. Large quantities of nutrients are also withdrawn from the coastal system in conjunction with the silt.

In conclusion
When drawing up the assessment framework, the following activities at sea need to be taken into consideration:

1) Relocation of dredged material above the existing relocation areas;
2) Relocation of sandy dredged material within the coastal foundation;
3) Beach nourishment in the active zone of the coastal foundation to maintain the basic coastline;
4) The levelling of sand ripples in waterways at sea.

2.2 Legal framework for the relocation of dredged material

In the Netherlands, the relocation of dredged material is governed by the concept of beneficial use. Beneficial use is described in the Dutch Soil Quality Decree as the "sustainable fulfilment of the ecological and morphological functions of the sediment". Dredged material that is beneficially used in the North Sea primarily involves dredged material from ports and river mouths in the Wadden Sea, Zeeland and North Sea and dredged material from rivers and lakes to a lesser extent. From the perspective of the natural sediment processes, it is extremely undesirable to have this sediment (repeatedly) removed from the water system. For this reason, the majority of this dredged material is relocated within the water system. This

ensures that the natural movement of the sediment is restored. This sediment performs significant morphological and ecological functions, such as the prevention of the disturbance of the natural flow of silt towards the Wadden Sea (as a breeding ground) and coastal nourishment.

This concept of beneficial use is laid down in the aforementioned Dutch Soil Quality Decree, which regulates the use of dredged material (relocation/application) to the extent that it has a beneficial use and meets quality requirements, as described as the “duty of care”.

Soil Quality Decree: duty of care

In order to obtain a good answer to the question regarding the extent to which the duty of care requires more details, the chemical and ecotoxicological quality of the dredged material to be relocated is taken into account. The intervention values and maximum values for beneficial use in marine surface water bodies, as set out in article 36 of the Soil Quality Decree, must be met for the relocation of dredged material in the North Sea. A special test (TOWABO) has been established to test the chemical and ecotoxicological parameters (see annex 4). Material for which there is no standard for beneficial use in marine waters and/or material which does not meet the quality requirements for relocation in marine waters is not relocated at sea. In these situations, a license will be required under the Dutch Water Act.

It can be concluded that the Dutch management practice of relocating dredged material based on the concepts of beneficial use and the duty of care, meets the requirements of international and European law: the London Convention/London Protocol, the OSPAR Convention and the European Waste Framework Directive (WD).

Nature Conservation Act 1998 (Nbwet 1998)

To be able to relocate dredged material, the conditions of the 1998 Nature Conservation Act (the Dutch implementation of the Birds and Habitats Directive) must be met as well as the conditions of the Soil Quality Decree. The extent to which relocation of dredged material is possible within Natura-2000 areas is included in the separate management plans. These plans indicate which (current) use can be applied without a Nature Conservation licence under which conditions.

A management plan was already drawn up in 2008 for the Voordelta (coastal area in the North Sea, protected under Natura-2000). Dredging activities for the Slijkgat are included under current use here. The Soil Quality Decree should be referred to for more detailed conditions for the relocation of dredged material. No additional conditions for relocating the material are, therefore, included in the management plan. It is necessary to meet the conditions set out in the Soil Quality Decree.

Currently, work is being performed with regard to drawing up management plans for the North Sea Coastal Zone and the Vlakte van de Raan. For the North Sea Coastal Zone, together with the Wadden Sea, a more detailed analysis of effects of various activities that occur within these areas was performed. The framework of dredging activities drawn up is relevant for this section. Hardly any dredging activities are taking place in the North Sea Coastal Zone in the current situation. It only involves dredging activities that are linked to activities in the Wadden Sea. These activities can take place without a Nature Conservation licence under certain preconditions. The most important of these are specified below:

- Aiming for a minimisation of the amount of dredging work by, for example, following the natural morphological developments of the channels for shipping channel maintenance.
- Using as few relocation areas as possible.
- The material to be relocated must meet the quality requirements in accordance with the Soil Quality Decree.

- The current policy where sand that is dredged during waterway maintenance may be removed from the Wadden Sea and that is available for sand trading is continued. The policy "do not extract any sand from the coastal foundation" is, therefore, continued. The Wadden Sea is a sand importing system and the sand extraction is balanced by (additional) nourishment in the North Sea Coastal Zone.
- The maximum amount of sand to be taken annually is set at 0.5 million m^3.
- Dredged material that is dredged by means of suction dredgers must be moved to permanent and relatively deep locations (channels where there is little benthic fauna present) with relatively high current speeds (for optimum relocation) and that do not play a role in other management issues.
- Consultation will take place between bodies authorised by the Nature Conservation Act, licensing bodies and waterway and port managers at least once a year during the first quarter in order to coordinate activities.
- For dredged material with a high silt content (especially in ports), the dredging and relocation should preferably take place during the winter period (since there is less primary production in this period). Work can also be carried out outside this period if nautical or safety reasons deem it impossible to carry them out during this period. The above regulation can also be deviated from if dredging in a concentrated (winter) period leads to an increase in dredging objections.
- Material must not be relocated:
  - within 1000 metres of areas with rich flora and fauna, including mussel, oyster and cockle beds and mussel areas;
  - within 500 metres of bird breeding grounds and high water resting places, preferably not during the turning of the tide;
  - within 1500 metres of the resting and feeding areas of seals.

A more detailed analysis of effects is currently being drawn up for the Vlakte van de Raan in which possible effects of various functions of use are being studied. There are two large waterways in the area: the Wielingen (towards Antwerp) and the Oostgat (towards Vlissingen). These waterways are dredged regularly. A licence on the basis of the Nature Conservation Act has been issued for the waterway management of the Wielingen. There is one relocation area to the north of the Wielingen in the Vlakte van de Raan.

For new plans or projects (no existing use) the framework of conditions forms a testing element for how far a licence based on the Nature Conservation Act is necessary or whether the conditions for exemption are met.

In addition, there may be external effects on Natura 2000 (N2000) areas. The relocation of dredged material can change silt concentrations with a possible negative effect on the existing N2000 areas. In addition to the conditions from the Soil Quality Decree, the responsible entity for the relocation of dredged material must meet legislation based on the Nature Conservation Act.

Marine Strategy Framework Directive

The European Marine Strategy Framework Directive (MSFD, 2008) commits the member states to take necessary measures to attain or maintain a good environmental status for 11 descriptors in their marine waters by 2020. The MSFD was set down in Dutch legislation via an amendment of the Water Decree in the Water Act in 2010. The Dutch government had to take a decision by 15 October 2012 at the latest about the *initial assessment, the good environmental status* to be attained and the associated *targets and*

indicators for the Dutch part of the North Sea. This decision, the Marine Strategy for the Dutch Part of the North Sea, Part I, was accepted by the Council of Ministers on 5 October 2012.

The Marine Strategy for the Dutch part of the North Sea includes the following concerning dredged material:

In 2.4.1 Physical disturbances (Hydrographic interventions - about the deepening/dredging of waterways):
For many years, *dredged material* from ports and channels has been disposed of over various relocation areas at sea (including Lowered Relocation Area, North West Relocation Area and Ijmuiden Relocation Area). This is material that naturally belongs in the sea. Some of the sand from waterway maintenance (Maasgeul) is relocated within the coastal foundation. The destination of dredged material is subject to the Soil Quality Decree (in Dutch: Besluit bodemkwaliteit; Bbk). The silt from waterways is monitored annually based on physical and chemical criteria. Only dredged material that meets the standards for salty dredged material in accordance with the Soil Quality Regulations (in Dutch: Regeling Bodemkwaliteit; Rbk) may be relocated to sea. Pursuant to the Rbk, this requires notification. The rest is stored in controlled depots such as the Slufter on the Maasvlakte. Pursuant to Article 1.1, paragraph 1, of the Dutch Environmental Management Act and Article 2.3 of the Waste Framework Directive (1985), disposal and reuse in accordance with the Soil Quality Decree are only allowed if it serves a useful purpose. In that sense, restoring the silt balance and sand nourishment of the coastal foundation are considered useful purposes. The possibilities of creating an assessment framework for location choices and prerequisites for the beneficial reuse of dredged material are currently being investigated.

Sand extraction strategy
The sand extraction strategy establishes how the Dutch strategic sand stocks in the North Sea can be sustainably utilised in the long term. Greater detail is provided in the assessment framework for this through the intention of not relocating dredged material above future and current sand extraction locations and above abandoned sand extraction locations where there is still suitable sand present for extraction in the longer term.

Integral North Sea Management Plan
The following was included concerning dredged material in the revised Integral North Sea Management Plan 2015:
The policy regarding the disposal of dredged material was changed with the introduction of the Soil Quality Decree. The dredging of the channels is a maintenance measure for which the Soil Quality Decree is applicable. Sand that is released from the channels is returned to the coastal foundation and/or supplied close to it if it comes from the coastal foundation; sand from channels outside the coastal foundation is used as raising sand. Released dredged material has up to now been relocated to the relocation areas if it meets the disposal requirements. The Soil Quality Decree has its own preconditions when assigning relocation areas. Currently, consideration is being given to the assignment of relocation areas within the framework of the Soil Quality Decree in order to give more precise details and possibly link rules to the returning of sand from the channels to the coastal foundation. Sustainable use of the ecological and morphological functions of the sediment will be closer with these relocation areas and rules. Surveys through soundings are performed regularly to monitor the channel depth and, therefore, determine the necessary maintenance.

When assigning the relocation areas for the dredged material itself, the effects on nature are taken into account. This ensures that as much dredged material as possible from areas close by is relocated. The specific possibilities for dispersal of dredged material within the Natura 2000 area are investigated in the Natura 2000 management plans.

3 ASSESSMENT FRAMEWORK: CONSIDERATIONS AND DECISION TREE

The previous chapter covered the morphological situation in the North Sea and also the way in which the relocation of dredged material occurs. This chapter presents the assessment framework in which Rijkswaterstaat North Sea provides a sustainable and functional fulfilment of the beneficial use of dredged material at sea. The assessment framework consists of general considerations and a decision tree that applies to the entire Dutch part of the North Sea.

3.1 Considerations of beneficial use of dredged material at sea

The position of the current relocation areas for dredged material is chosen in such a way that the dredged material has no effect or as small an effect as possible on various functions and nature. The underlying considerations in establishing the locations have, however, never been reported. This paragraph lays down the principles for the beneficial and functional use of dredged material. The general principles are looked at first. Next, the complete concept is presented in the form of a decision tree. This consideration is set up integrally and, therefore, also contains aspects that do not fit in within the framework of the Soil Quality Decree.

Natural sediment management
The role and function of the relocation of dredged material in surface waters is described in the Soil Quality Decree and the associated explanatory note.
The construction of ports and waterways has disturbed the natural morphological processes. In accordance with the Soil Quality Decree, the majority of the dredged material in the ports and waterways should be relocated within the coastal system. With the relocation, the disturbance of the natural flow of silt to the Wadden Sea (as a breeding ground) is prevented and coastal nourishment as a consequence of a lack of sand and silt is limited. (See paragraph 2.2 for a more detailed description.)

The relocation of dredged material from ports and waterways in the sea contributes to natural sediment management if the chemical quality requirements are met. This is comparable to the situation before the construction of ports and waterways.

Maintenance of the coastal foundation
As described above, the policy is formulated that the coastal foundation must be maintained in terms of volume between the modified Amsterdam Ordinance Datum –20 m depth contour and the coastline and must grow with the sea level. The dredged material that forms the sediment in the ports and waterways partly consists of sand that originates from the coastal foundation. Currently, this dredged material is relocated outside the coastal foundation if the upper quality limit for the relocation of dredged material at sea is met. This implies that sand is lost from the coastal foundation, which means that large quantities of sand are necessary for implementing coastal nourishment. By spreading the sandy material within the active zone of the coastal foundation, the material contributes directly to the maintenance of the basic coastline. This ensures that the activity contributes even more to beneficial and functional use. The composition of the sand must, however, meet the requirements set for coastal nourishment. This relates to both the grain size (> 175 µm and < 375 µm) and the quality (meeting the quality of the receiving zone).

Sandy dredged material is by preference relocated within the coastal foundation in the active zone if the sandy dredged material has the correct range of grain sizes and quality.

Relocating dredged material in the system
The relocation of dredged material at sea has the aim of bringing sand and silt back into the system (see chapter 2). In order to allow the relocation to work as beneficially and functionally as possible, the arrangement and location of the relocation area are significant. The relocation areas must, therefore, work as a "silt pump". Silt should return to the system as if it was not removed by the ports and waterways. The closer to the coast this is, the shallower the water and the greater the local influence of wind, tide and waves. As long as no negative effects are anticipated (nature and environment), relocation within the coastal foundation is preferred.

Relocation of dredged material within the coastal foundation is preferred because this situation is comparable with the original situation without ports and ensures a more optimal return rate of dredged material into the water system due to the shallower water.

North Sea: multifunctional
The Integral Management Plan for the North Sea 2015 contains all possible functions for the North Sea. It is important that no conflicting activities occur at the same location to Rijkswaterstaat North Sea. The relocation of dredged material cannot always be combined with other functional uses. Relocation above shipping routes as well as on current and future sand extraction pits causes inconvenience, dangerous situations and non-sustainable use of building materials so it is not functional.

Relocation of dredged material must not conflict with other functional uses.

Sand extraction strategy
Rijkswaterstaat North Sea is currently working on a new sand extraction strategy to meet the great demand for sand for inland building and for beach nourishment now and in the future. It is clear from this that the stock of sea sand as presently available needs to be handled sustainably. In order to link up with this sand extraction strategy, it is desirable to only relocate dredged material above old sand extraction pits where no suitable sand is stored for the future anymore. This prevents valuable minerals being buried under a layer of dredged material, which would lead to future sand extraction being less efficient.

Relocation of dredged material above old sand extraction pits is beneficial and functional if no suitable sand for the short and long term is covered underneath a layer of dredged material.

Ecological consequences of the relocation of dredged material
The relocation of dredged material has consequences for the benthic fauna. Benthic fauna is lost when buried under dredged material. Relocation is not desired above locations with high densities of (living) banks of shellfish. After the relocation of dredged material, the benthic fauna will recover. However, even after a few years, the composition of the present benthic fauna still differs considerably from the original composition. The consequences for the benthic fauna can be restricted by:

- keeping the current relocation areas as small as possible;
- relocating dredged material above sand extraction pits where the benthic fauna has not yet fully recovered;
- using relocation areas as efficiently as possible.

When establishing relocation activities, the benthic fauna must be considered as much as possible. Caution should be exercised prior to using new relocation areas.

Distance and costs

Periodic dredging takes place to maintain the depth of Dutch ports and waterways. The distance to the relocation areas must be small in order to keep travel costs and emissions to a minimum. A location close to the port, however, is less efficient due to the occurrence of a return flow of sand and silt towards the port. There is an optimum distance between relocation area and dredging location in terms of both costs and environmental effects.

In order to limit the (travel) costs and environmental effects, a relocation area close to the port without a strong return current is preferred.

Chemical quality of dredged material
The standards for the beneficial use of dredged material at sea (maximum values for relocation in salt surface water bodies and intervention values) are recorded in the Soil Quality Decree. This does not mean that all dredged material that meets this can be used beneficially and functionally everywhere. The chemical composition of the dredged material differs and depends on the influence of sea and port activities.

It is not desirable to use dredged material within the active zone with a quality that just meets the maximum value for relocation by a little.

The above starting points are the general considerations and ideas of Rijkswaterstaat. All aspects must be considered in order to enable the relocation of dredged material to occur at a place in a beneficial and functional way.

3.2 Decision tree

A decision tree was created on the basis of the considerations specified above. The decision tree is used to establish the locations where dredged material can be relocated at sea under which conditions, taking into account the requirements of the Soil Quality Decree. The decision tree leads to an overview of locations where the beneficial use of dredged material can take place in a functional and sustainable way.

The decision tree is made up from the following two stages:

1 Exclusion of areas on the basis of functions and effects
   a. regardless of material composition;
   b. dependent on texture and composition;
2 Indication of areas that are the preferred option
   a. on the basis of generic principles;
   b. on the basis of local conditions, the physical and chemical quality of the dredged material to be dispersed and the way in which the maintenance process is given shape.

These stages are examined in more detail in the paragraphs below. The stages are reproduced in diagram form in annex 1.

3.2.1 Step 1: Exclusion of areas on the basis of functions and effects

Regardless of composition

From the revised version of the Integral Management Plan for the North Sea it follows that there is as much multiple use of space as possible. The Dutch government has specified activities of national importance in the National Water Plan (NWP): sand extraction and sand nourishment, sustainable wind energy, oil and gas extraction, CO_2 storage, shipping and military exercises at sea. These areas are indicated on the structural vision map of the National Water Plan. Other activities may take place in these areas provided that these activities do not obstruct the activities of national importance.
In addition, there are a large number of functions with which the beneficial use of dredged material cannot be combined from the viewpoint of safety and suitability or taking into account the effects on nature:

- Nature (living banks of shellfish);
- Active sand extraction areas;
- Areas with a strategic sand extraction stock (nourishment and/or concrete and masonry sand);
- Shipping lanes;
- Wind farms;
- Oil and gas platforms.

Locations with the following functions or usage may only be used for relocation of dredged material under certain conditions where damage to the valid function or use is prevented:

- Shipping: maintenance of the locally valid marked depth;
- Anchor areas;
- Military areas;
- Cables & pipelines;
- Shipwrecks.

The relocation of dredged material above shipwrecks is not seen as a problem from an archaeological perspective. Wrecks on the bed surface are perhaps better preserved if they are "buried". Wrecks, however, have ecological value due to the general lack of hard substrate in the North Sea and, therefore, they attract divers to a large extent. Because of this, it is not always desirable to relocate dredged material above and adjacent to shipwrecks.

Besides the restrictions of the Soil Quality Decree duty of care, in some areas at sea other restrictions are in place for shipping, due to safety regulations. Examples are wind farms, offshore installations, anchoring areas and military areas. In these areas dredged material is not relocated due to other regulations than the Soil Quality Decree.

When dredged material is relocated, a relatively large amount settles in the immediate area before it is absorbed into the (natural) sediment flow. The area of influence depends on local conditions and properties of the dredged material. A distance of 1500 metres (to seals' feeding and resting places), 1000 metres (to living banks of shellfish) or 500 metres (to other functions or use) is, therefore, maintained.

Dependent on the composition
Areas can also be ruled out for relocation on the basis of the composition of the dredged material. This includes the relocation of dredged material with high silt content in the coastal zone. The reasons for this are twofold: (1) the quality of the dredged material with high silt content often does not meet the quality of the receiving area and (2) the image plays a role as silt or dredged material that is encountered on the beach (dust) is linked to this relocation activity. In the past, Rijkswaterstaat North Sea was confronted with negative public opinion on a few occasions as hopper barges were seen close to the beach.

The relocation of dredged material with high silt content from a depth of Amsterdam Ordinance Datum - 11.5 metres up to the coast, therefore, must be ruled out. The same applies with regard to dredged material with high silt content at port mouths. The occurrence of a return flow of silt means that it is not desirable to relocate dredged material too close to ports due to environmental aspects (emissions) and management. As the occurrence of a return flow also increases costs, this is also not desirable for watershed managers. The consideration of the estimated costs for more dredging and travelling further will also play a role in determining the distances to be operated within this context.

3.2.2 Step 2: Indication of areas that are preferred

After ruling out areas in the first stage, the locations remain where the relocation of dredged material contributes to a functional and sustainable implementation of the morphological and ecological functions of the sediment, whether or not under certain conditions. There may, however, still be significant differences in preference between these locations. The following considerations play a role in assessing the locations:

A Generic considerations

1. The use of existing relocation areas;
2. The use of old sand extraction pits that are fully exhausted so no future sand extraction stocks are buried under a layer of dredged material;
3. The limitation of the total area in which dredged material is relocated.

Explanation of generic considerations
It is possible that a large area may be suitable for the relocation of dredged material in a functional and sustainable way. The vision shows, however, that the total surface over which this occurs is also significant. These generic considerations ensure that the local benthic fauna is disturbed as little as possible and that the sand extraction stocks present are handled in a sustainable way.

B Area specific considerations

Considerations on the basis of local conditions, the physical and chemical quality of the dredged material to be relocated and the way in which the maintenance process is given shape:

1. Beneficial use of non-contaminated sand (meeting the values of the receiving zone) from waterways in the North Sea for the maintenance of the basic coastline (application of dredged material);
2. Use of sandy (> 60% above 63 µm) dredged material to maintain the coastal foundation;
3. Optimisation of the design of the relocation area where the aim of relocation, that is, dispersal in the whole system, is attained as well as possible.
4. Optimisation of the relocation areas related to travel distances, occurrence of a return current and the locations of sand extraction areas in order to arrange the dredging cycle as well as possible.

Maintenance dredged material from the North Sea (sand) with an equal or better quality than the ground receiving it is used as much as possible within the framework of maintenance of the basic coastline (BCL) if there are local erosion sensitive points on the coast. This ensures that the quantity of sand that needs to be extracted for nourishment is reduced and the total emissions are also reduced provided that there is a local requirement for maintenance on the coast. Another condition is that this material meets local requirements and preferences regarding the grain size distribution (D50 > 175 µm and < 350 µm). Maintenance dredging work can also contribute to the maintenance of the coastal foundation. Relocated sandy dredged material in the coastal foundation contributes to keeping the coastal foundation up to the mark or even allowing it to increase. A reduction in the amount of sand that is necessary for nourishment is realised here as well.

The aim of the relocation of dredged material (Soil Quality Decree, Article 35g) involves bringing the dredged material back into the system. The fact that part of the dredged material at a relocation area will remain there does not change anything. Attempts must be made to choose a relocation area that works best as a "silt pump" when the physical conditions are taken into account.

The possible relocation area must lie close to the point of origin of the dredged material and any operational sand extraction areas. This will ensure that travel distances are limited (less emissions) and that it is possible to arrange the dredging cycle in such a way that combined journeys (out with dredged material and back with sand) are possible. A location too close to the port entrance is also not desirable from the perspective of a return current being present (when relocating dredged material with a high silt content).

3.3 Test of the assessment framework with regard to existing legislation and regulations

The assessment framework for the beneficial use of dredged material on the North Sea has been created to establish the extend to with the relocation of dredged material in the North Sea contributes to the conditions of the Soil Quality Decree. Hereby other existing (inter)national legislation and regulations as described in paragraph 2.2 were taking into account.

Nature Conservation Act 1998
For new plans and projects (no existing use) it is necessary to check if the relocation of dredged material doesn't interfere with the Nature Conservation Act 1998. Also external effect has to be taken into account.

Marine Stategy Framework Directive
In the Dutch Marine Strategy reference is made to drawing up an assessment framework without supplementary conditions. The dredged material has to meet the standards for salty dredged material for the Regulation on Soil Quality (RSQ). The assessment framework does not change the present standards. Therefore the assessment framework meets the Marine Strategy Framework Directive (MSFD).

Sand Extraction Strategy
In the assessment framework greater detail is provided how the Dutch strategic sand stocks in the North Sea can be sustainably exploited in the long-term. Therefore the assessment framework meets the Sand Extraction Strategy.

Integral North Sea Management Plan
In the Integral North Sea Management Plan the assessment framework is already mentioned, including the relocation of sandy dredged material within the Dutch Coastal Foundation. An important consideration of the framework is that the relocation of dredged material does not conflict with other functional uses. Because of this the assessment framework meets the Integral North Sea management Plan.

3.4 Spatial representation of the assessment framework

The result of the first two steps of the decision tree is given in annex 2. Step 2b, the *Optimisation of the location by means of the local conditions, physical and chemical quality of the dredged material and the way in which the maintenance process is given shape* cannot be set down on a generic map. The map indicates:

(1) which areas are ruled out for the relocation of dredged material on the basis of effects and functions (red);
(2) locations where dredged material can be relocated under certain conditions (orange);
(3) preferred locations for relocation of dredged material (green).

This map was drawn up on the basis of the current spatial situation in the North Sea. The North Sea does, however, have functions that are subject to change. The discovery of new living banks of shellfish could also change the situation. The map that is presented in annex 2 should be seen as a snapshot. We recommend updating the map on at least an annual basis with the most up-to-date information.

3.5 Legal establishment of the assessment framework

A large number of possibilities emerged from the sessions carried out with the legal experts for the laying down of the assessment framework presented above. These possibilities were both within and beyond the scope of the existing Soil Quality Decree.

It was decided to set down the assessment framework by drawing up a new policy regulation on the basis of the enforcement authorisation of the Soil Quality Decree. There are three different 'hooks' to achieve this:

1. The terms beneficial and functional use (Article 5 of the Soil Quality Decree);
2. The term **sustainable** implementation of the ecological and morphological functions of the sediment (Article 35 g Soil Quality Decree);
3. More detail on the duty of care stipulation (art. 7 Soil Quality Decree).

An advantage of this working method is that instructions can be coordinated with the preferred goals of Rijkswaterstaat and that they can be realised in the short term.
The result of the assessment framework, the map with possible locations for relocation areas, must be checked for accuracy periodically through the recent data concerning living banks of shellfish and spatial division of the North Sea. The map does not need to make up part of the policy regulation, it is a visualisation of the assessment framework. This will ensure that the need for periodic amendment of the policy regulation is prevented.

4 TEST-CASE: PORT OF ROTTERDAM AND ROTTERDAM WATERWAYS

In chapter 3 the general assessment framework including a map was presented. Taking into account the issues concerning the current locations for the relocation of dredged material coming from the Port of Rotterdam and the Rotterdam waterways, the assessment framework, including the decision tree, was applied to the Rotterdam situation. The results of this are presented in this chapter.

4.1 Approach via the decision tree

The map was presented in paragraph 3.4 (Annex 2) on the basis of the generic assessment framework with areas that meet the functionality requirements of the Soil Quality Decree and that also give sustainable fulfilment to the ecological and morphological functions of the sediment. The generic principles are also used to indicate preferred areas that are most suitable for the relocation of dredged material. Annex 3 shows the part of the North Sea that is relevant for the relocation of dredged material from the Port of Rotterdam and Rotterdam waterways.

In order to come to both a short-term and a long-term solution for the Rotterdam situation, the assessment was made on the basis of area-specific considerations (step 2b, see paragraph 3.2.2). The following considerations are involved here:

1. Using sand from waterways in the North Sea that meets the quality criteria for the maintenance of the basic coastline;
2. Use of sandy dredged material to maintain the level of the coastal foundation;
3. Optimisation of the conditions of the relocation areas where the aim of the Soil Quality Decree (art. 35g), dispersal in the whole system, is attained as well as possible.
4. Optimisation of the relocation areas related to travel distances, occurrence of a return current and the locations of sand extraction areas in order to arrange the dredging cycle as well as possible.

This is elaborated in more detail in the next paragraph.

The above considerations were studied in detail during the meeting of experts. As already indicated in paragraph 3.3, the requirements of the Nature Conservation Act 1998 must be met as well as the Soil Quality Decree. Taking into account the annual quantities of dredged material to be relocated from the Port of Rotterdam and Rotterdam waterways, any change to the relocation areas has a possible effect on both the local silt concentrations and also the silt concentrations of Natura 2000 areas such as the North Sea coastal zone, the Voordelta and the Wadden Sea. In order to prevent a situation where new relocation areas are not desirable on the basis of any possible external effect from the Nature Conservation Act 1998, additional silt dispersal calculations were carried out by Deltares. The results of these calculations and the possible effect on the establishment of relocation areas for dredged material around the Port of Rotterdam are dealt with in paragraph 4.3.

4.2 Preferred areas for relocation with regard to the Port of Rotterdam and Rotterdam waterways

There are already a number of preferred areas for the relocation of dredged material to compare on the basis of the figure in paragraph 4.1 (Annex 3). It concerns the following locations:

- Existing relocation areas: Lowered Relocation Area, North West Relocation Area and Coastal Foundation Relocation Area;
- Abandoned relocation areas : Loswal Noord (with a depth > 11.5 metres);
- Abandoned sand extraction pits for the Delflands coast/Sand Engine (Zandmotor).

Local conditions
To be able to determine the ultimately preferred areas for the relocation of the Port of Rotterdam dredged material, insight into the chemical and physical quality of the dredged material is required. The quality in the Port of Rotterdam and Rotterdam waterways has been monitored via an annual monitoring campaign for several decades. There is, therefore, a detailed overview of the quality of the dredged material in the various parts of the port and the trend over the different years. The quality of the dredged material from the Euro-Maasgeul is not included in the sample campaign as standard. Measurements for this area were taken following the Soil Quality Decree in 2010. In addition, managers and policymakers from Rijkswaterstaat North Sea, Rijkswaterstaat Zuid-Holland and the Port of Rotterdam were involved in the expert sessions.

The following aspects are of importance for making a local assessment of the preferred locations for the relocation of dredged material:

- Between 5 and 12 Mm^3 of dredged material are relocated at sea annually;
- All dredged material to be relocated at sea meets the quality standard for *relocation in marine waters*;
- The dredged material from the Maasgeul does not meet the quality levels of the *receiving area*;
- Only one single sample area from the Port of Rotterdam and Rotterdam waterways meets the quality levels of the *receiving area*;
- The majority of the annual dredged material to be relocated has a silt percentage that is greater than 50 %;
- From the Port of Rotterdam and Rotterdam waterways around 700,000m^3 of the dredged material is classified as sandy (> 60% above 63 µm).

Local consideration
Because of the sea's influence, much sea material is suspended in the Port of Rotterdam and Rotterdam waterways. There is, therefore, sandy dredged material available that is being relocated above the present Lowered Relocation Area and/or North West Relocation Areas within the management area of Rijkswaterstaat Zuid-Holland in particular. This material can, however, be used beneficially by using it for protection of the *coastal foundation*. By relocating sandy dredged material from the Port of Rotterdam and Rotterdam waterways within the coastal foundation as well as the sandy dredged material from the Maasgeul, the total quantity of sea sand that is extracted from the sea (seaside of the coastal foundation) for the protection of the coastal foundation is significantly reduced.
Taking into account the quality of the sandy dredged material from the Maasgeul, though, no dredged material can be used as standard for maintenance of the *basic coastline*.

Sandy dredged material from the Maasgeul has not been relocated above the Lowered Relocation Area since 2007. The monitoring data of the Lowered Relocation Area suggests that the Lowered Relocation Area is functioning better as a "silt pump" due to a reduction in sandy dredged material: the percentage of silt that is dispersed to the water system is higher compared with the situation prior to 2007. It is expected that this effect will increase further if all sandy dredged material is no longer relocated above the Lowered Relocation Area.

On the basis of the Environmental Impact Assessment (EIA) that was done prior to the start of the North West Relocation Area and the Lowered Relocation Areas, detailed consideration was given to the occurrence of a return current with models. During the utilisation of the Lowered Relocation Area, a great deal of research was done into the occurrence of a return current. Parties have, however, not been able to ascertain the extent to which the return current towards the port occurred from the Lowered Relocation Area. From the perspective of a return current it is, however, not recommended to relocate dredged material too close to the Rhine-Maas mouth.

Short-term solution

- Dredged material with a high silt content is relocated above the Lowered Relocation Area;
- Sandy dredged material from the Maasgeul is relocated within the Coastal Foundation Relocation Areas (as much to the east as possible);
- Sandy dredged material from the Port of Rotterdam is relocated at the Coastal Foundation Relocation Area (the more silt, the further from the active zone).

Sandy dredged material within the Coastal Foundation Relocation Area

In order to come to an optimal solution between (1) use of sandy dredged material within the coastal foundation, (2) allowing the Lowered Relocation Area to function better as a silt pump, (3) the prevention of silty dredged material arriving immediately in the active zone (does not meet quality levels of the *receiving area*) and (4) the occurrence of a return current, a good assessment must be made of which parts are relocated where. The following is proposed:

- The result of the monitoring campaign is the guiding factor (the actual material dredged by the hopper gives a better indication, but clarity for the relocation area is desired in advance when practical aspects are taken into account;
- Dredged material with a sand percentage greater than 63 µm between 70 and 90% is relocated in the eastern, landwards part within the Coastal Foundation Relocation Area;
- Dredged material with a sand percentage of >63 µm between 50 and 70% is relocated in the western, seawards part within the Coastal Foundation Relocation Area;

Depending on the amount of sandy dredged material that must be taken into consideration annually and the annual quantity of sand that is relocated from the Maasgeul above the Coastal Foundation Relocation Area, there is still room for approximately 8 years of operations. .

The short-term solution is presented in figure 4-1.

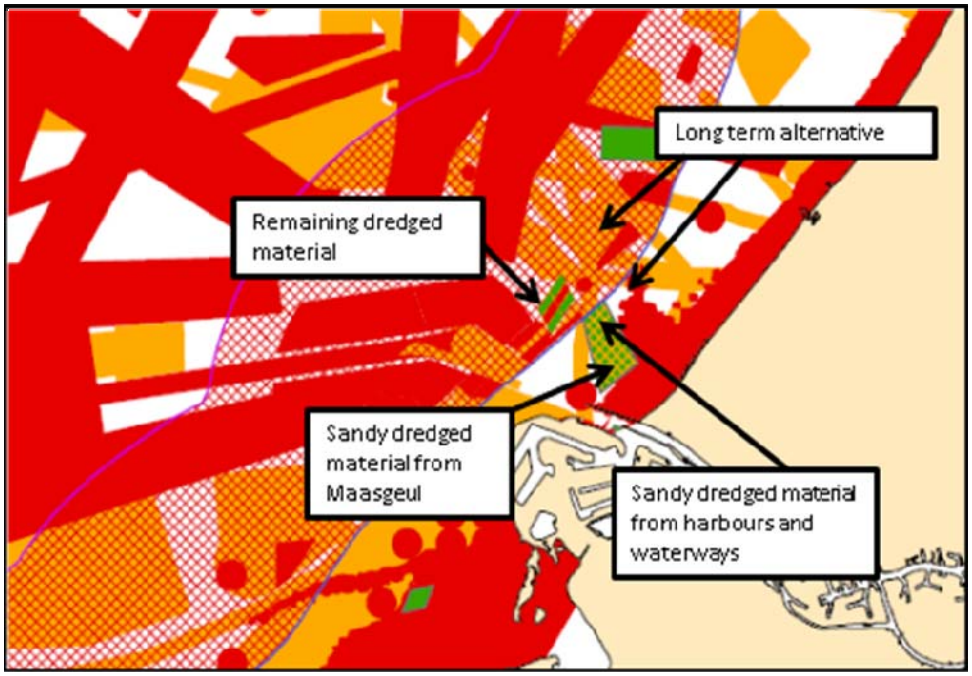

Figure 4-1 Overview of solutions for dispersing Rotterdam dredged material for both the short and long term.

Long term solution

There is sufficient space for relocating dredged material above the Lowered Relocation Area with the approach described above for the years ahead. If an alternative location is necessary in the long run, it is possible to deviate to a location north of the Lowered Relocation Area. There are a number of old sand extraction pits between the Lowered Relocation Area and North West Relocation Area that are used for the Sand Motor/reinforcement of the Delflands coast. These sand extraction areas go down to about 6 metres (below the seabed). It is recommended that the remaining layers of sand are extracted before this location is used as a relocation area for dredged material so that the sand stocks present in the North Sea can be handled sustainably.

It is possible to deviate to the area north of the Coastal Foundation Relocation Area for sandy dredged material. Round the old Loswal Noord there are areas that are deeper than the minimum required depth for shipping of LAT -10 m.

Another long-term option involves the old sand extraction pits that were used for the construction of Maasvlakte 2. These are at a comparable distance to the old sand extraction pits for the Sand Motor/Delflands coast. Taking the depth of these pits into account (>10 metres), the aim of the Soil Quality Decree, dispersal within the system, will be met in a lesser degree.

Alternative levelling of the Loswal Noord relocation area

The alternative of dredging part of the old Loswal Noord relocation area was brought up during the expert sessions. The silt that is still present (that was not yet tested with the salt dredge test at the time) is becoming available for the benefit of the system. The sand can, subsequently, be used for the reinforcement of the coast. The space that will then emerge can, next, be reused as a relocation area for sandy dredged material.

The choice of Rijkswaterstaat North Sea to only use material that meets the quality of the receiving zone for the bank and beach nourishment means that this is, however, not a realistic alternative. In addition to the fact that the material may possibly not meet the requirements for coastal nourishment in terms of grain size, it is expected that this material will not meet the quality criteria. In addition, there is no substantial extraction requirement for the benefit of coastal maintenance in the short term.

4.3 Test on conservation legislation

Silt relocation amounts[2] were calculated by Deltares in order to also establish the possible influence of change of silt relocation on Natura2000 areas. Four different scenarios were used to look at the relative effect of the shifting of the relocation areas. The ZUNO-DD model was used for this that was also used in the study for the Environmental Impact Report for Extraction of Nourishment Sand 2013-2017 and the construction of Maasvlakte 2.

The following scenarios were investigated:

0. Reference: dispersal of dredged material above Lowered Relocation Area and North West Relocation Area in accordance with the 2007 -2011 average years;
1. Dispersal of 100% material on the Lowered Relocation Area (Ref B);
2. Dispersal of 100% in coastal foundation (approx. Amsterdam Ordinance Datum -12 m);
3. Dispersal of 100% above the Delflands coast/Zandmotor sand extraction pits;
4. Dispersal of 100% to the north of the Loswal Noord relocation area (coastal foundation passive).

As dredged material has also been relocated above the Lowered Relocation Area for years in succession, scenario 1 can also be conceived as a reference scenario. The scenarios examined are reproduced on a map in Figure 4-2, Overview of scenarios 1 up to and including 4.

As the silting up in the port is not coordinated with the necessary silt relocation at sea in the current model, only the relative effects of the shifting of the silt relocation area are examined. It is, therefore, not possible to assess the absolute effects. The model would need to be calibrated for an assessment of that nature.

Figure 4-3 and Figure 4-4 reproduce the relative effect of the relocation of the relocation areas for the N2000 North Sea Coast and Voordelta areas. It is possible to conclude that annual average silt concentrations are sensitive to the choice of the relocation area of the dredged material based on the results. The conclusions suggest that if the dredged material is relocated completely within the coastal foundation (landwards of the Lowered Relocation Area, scenario 2), the annual average silt concentrations for both the North Sea Coast Zone (8.0 mg/l) and the Voordelta (2.5 mg/l) will decrease.

[2] Deltares (2012) Slibverspreidingssommen Loswallen Kenmerk 1206091-000-ZKS-0005

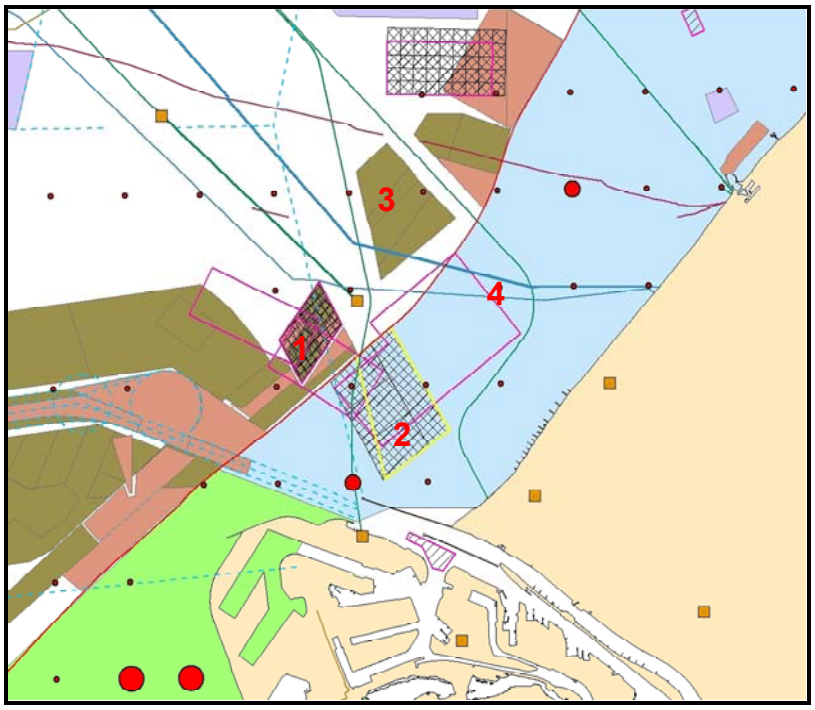

Figure 4-2 Overview of scenarios 1 up to and including 4

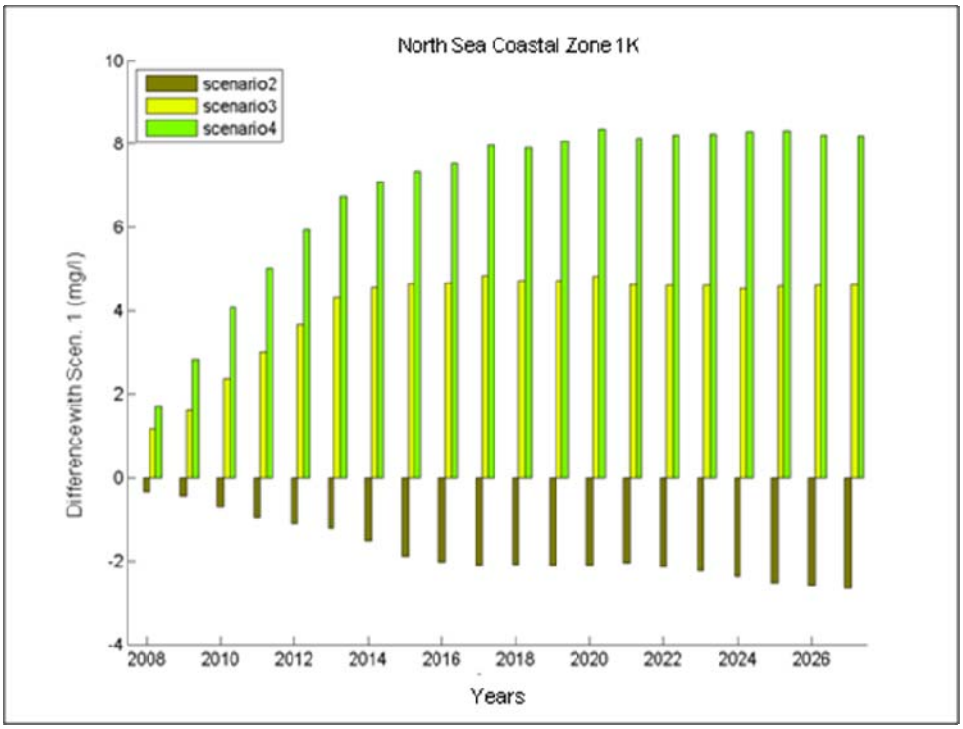

Figure 4-3 Relative effect for all scenarios in the N2000 North Sea Coast Zone area 1K

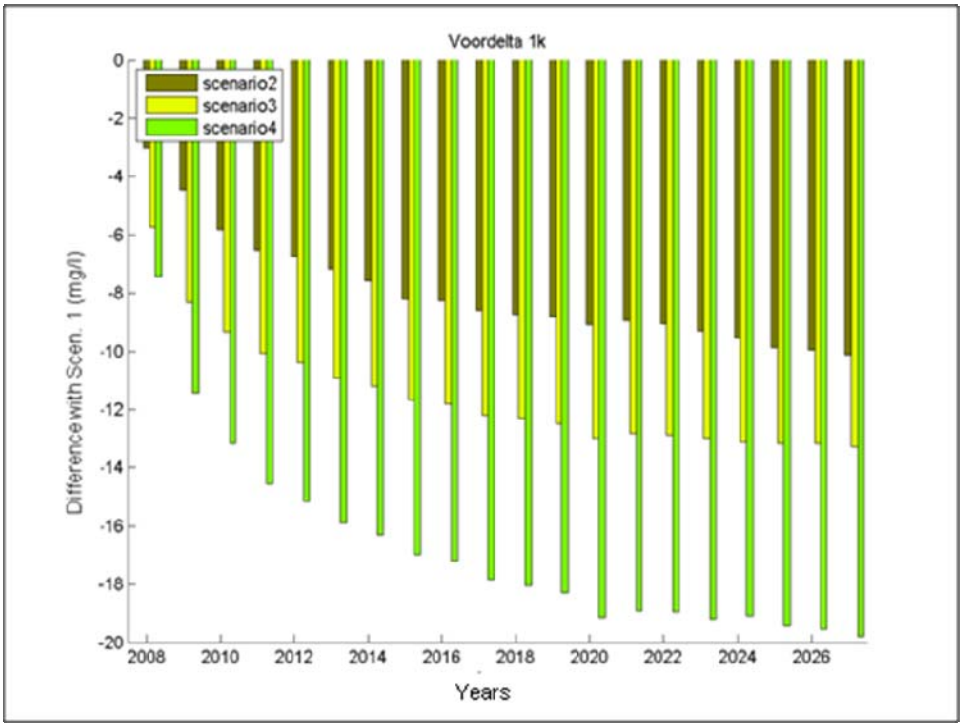

Figure 4-4 Relative effect for all scenarios in the N2000 Voordelta area 1K

The solution proposed for the Rotterdam dredged material in paragraph 4.2 is, however, a combination of scenarios 1 and 2. In total, around 70% of the dredged material will be relocated above the Lowered Relocation Area (scenario 1) annually. The remaining 30% will be relocated above the area between the Lowered Relocation Area and the eastern part of the Coastal Foundation Relocation Areas depending on the silt percentage (scenario 2). It should, however, be noted within this context that the material with the highest silt percentage is to be relocated closest to the Lowered Relocation Area. The changes to silt percentages for the N2000 Voordelta and North Sea Coast Zone areas will, in this way, turn out to be lower when compared to the above results for scenario 2. The scenario presented in paragraph 4.2 was not calculated by Deltares. On the basis of expert judgement, Deltares states that the average annual silt concentration in both the Voordelta and North Sea Coast Zone will be comparable to or somewhat lower than the current situation. The possible reduction goes hand-in-hand with an increase in a return current towards the port.

On the basis of the Deltares calculations, we do not expect any great changes in the silt pattern and, therefore, no great effects at system level either. We recommend improving the silt model by including the sedimentation in the ports and the relocation of dredged material at the various locations for Rotterdam, Scheveningen and IJmuiden in the model. This would make it possible to make absolute statements regarding the changes in the silt content.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

General starting points were formulated in order to meet a sustainable and functional fulfilment for the beneficial use of dredged material. These points go beyond the application area for the Soil Quality Degree and were formulated as follows:

- The relocation of dredged material from ports and waterways in the sea contributes to natural sediment management if the chemical quality requirements are met. Comparable with the situation before the construction of ports and waterways.
- Sandy dredged material (> 60% above 63 µm) is relocated preferably within the coastal foundation if the quality meets the criteria for relocation is salt water;
- Sandy dredged material with a quality that is equal to the receiving zone, is even preferred to be used in the active zone of the coastal foundation, to maintain the basic coastline.
- To be able to relocate the dredged material optimally in the system, relocation within the coastal foundation is preferred, which is linked to the original situation without ports;
- Relocation of dredged material must not conflict with other functional uses;
- Relocation of dredged material above old sand extraction pits is beneficial and functional as long as no suitable concrete sand or masonry sand and/or suitable sand for nourishment is covered by a layer of dredged material;
- When establishing relocation areas, the benthic fauna present must be considered as much as possible. Caution should be exercised prior to using new relocation areas;
- In order to limit the (travel) costs and associated environmental effects, a relocation area close to the port without a strong return current is preferred;
- It is not desirable to use dredged material within the active zone with a quality that just meets the maximum value for relocation by a little.

The following steps need to be taken to ensure that the above general starting points can be converted into an overview of areas:

- Exclusion of areas on the basis of functions and effects
  - regardless of material composition;
  - dependent on texture and composition;
- Indication of areas that are the preferred option
  - on the basis of generic principles;
  - on the basis of local conditions, the physical and chemical quality of the dredged material to be relocated and the way in which the maintenance process is given shape.

5.1.1 Legal establishment of the assessment framework

Consideration was given to how the assessment framework could be established legally in this report. The following conclusions can be arrived at regarding this:

- The assessment framework can best be established legally via a policy regulation on the basis of the enforcement authorisation of the Soil Quality Decree;
- The result of the assessment framework, the map with possible relocation areas, must be checked periodically for accuracy through the recent data concerning the living banks of shellfish and spatial division of the North Sea;

- The map does not need to be part of the policy regulation. This will ensure that the need for periodic amendment of the policy regulation is unnecessary.

5.1.2 Application of the assessment framework to the Rotterdam situation

The developed assessment framework including the decision tree is applied to the Rotterdam situation in this report. The following solutions emerge in the short term:

- Dredged material with a high silt content is relocated above the Lowered Relocation Area;
- Sandy dredged material from the Maasgeul is relocated within the Coastal Foundation Relocation Area (as far to the east as possible);
- Sandy dredged material from the Port of Rotterdam is relocated within the Coastal Foundation Relocation Area (the more silt, the further from the active zone, therefore, as far west as possible).

For the years ahead there is sufficient space for relocating dredged material above the Lowered Relocation Area and Coastal Foundation Relocation Areas. If an alternative area is necessary in the long term, it is possible to deviate to old sand extraction pits that were used for the Sand Motor/reinforcement of the Delflands coast. It is possible to deviate to the area north of the Coastal Foundation Relocation Area for sandy dredged material.

5.2 Recommendations

DHV makes the following recommendations on the basis of this report:

- For the legal establishment of the policy framework it should only include those elements of the considerations that may legally be regulated within the Soil Quality Decree;
- Amend the map on which the spatial conversion of the assessment framework is reproduced on at least an annual basis after new data becomes available regarding living banks of shellfish;
- An item to be addressed for the legal establishment involves the ability to manage the framework. As no relocation areas are assigned but a framework is drawn up with a location-specific part, a part of the proof of the beneficial use of dredged material at sea is left to the user. In practice, there are just a few operators who relocate dredged material at sea on a large scale and they will engage in intensive consultation with the North Sea operators when looking for new areas. Without this consultation, the risk exists that the intermediate areas that are not directly ruled out by the generic framework or that are preferred will be overburdened. The principle that the current relocation areas may not be too large and must, therefore, be established on a proper legal basis.
- The adjustment of the silt relocation model where the sedimentation in the ports and the relocation of dredged material at the various areas for Rotterdam, Scheveningen and IJmuiden are included in the right way. This will ensure that absolute judgements can be made about changes in the silt content.

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7 EDITING, DESIGN AND PRODUCTION

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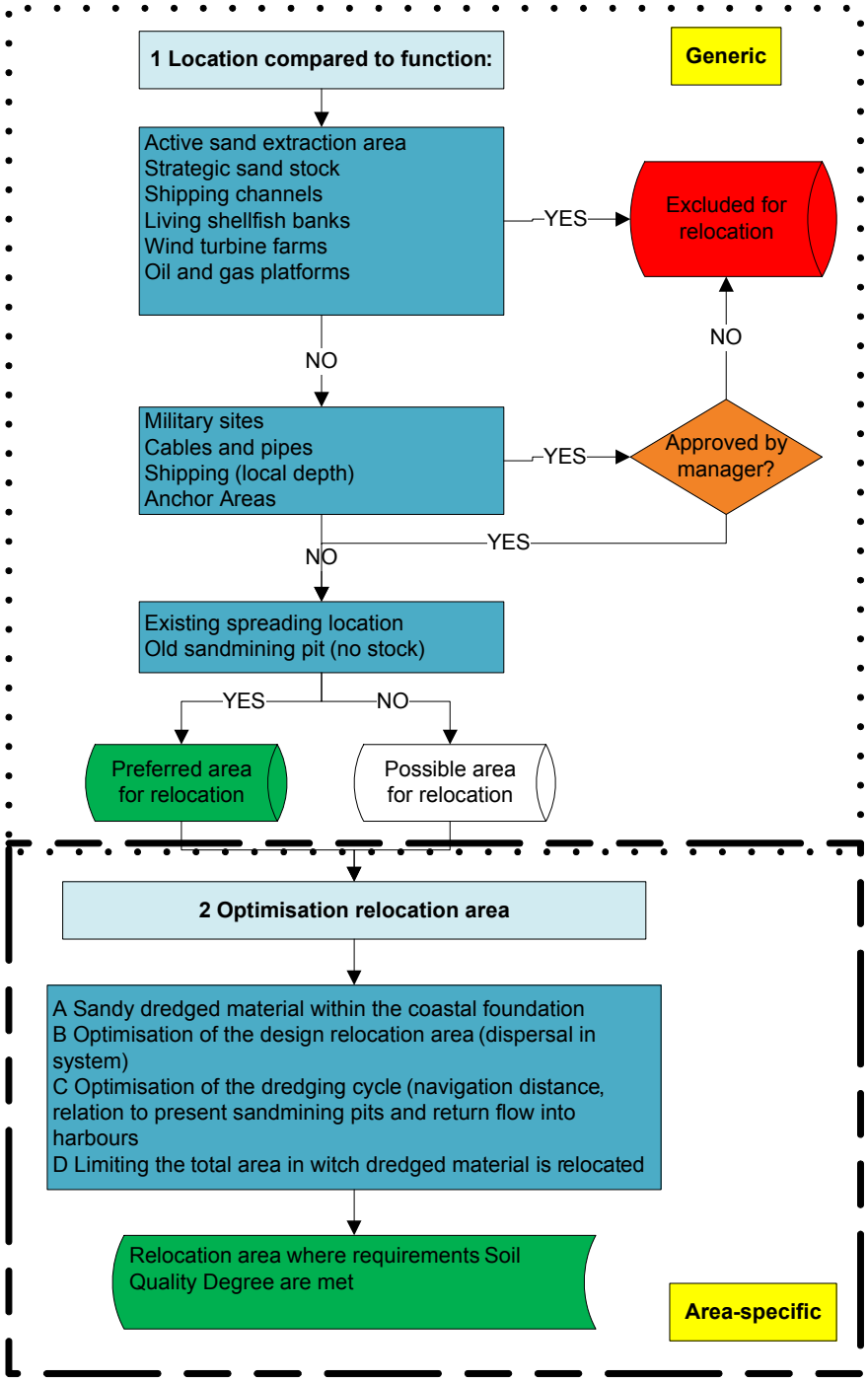
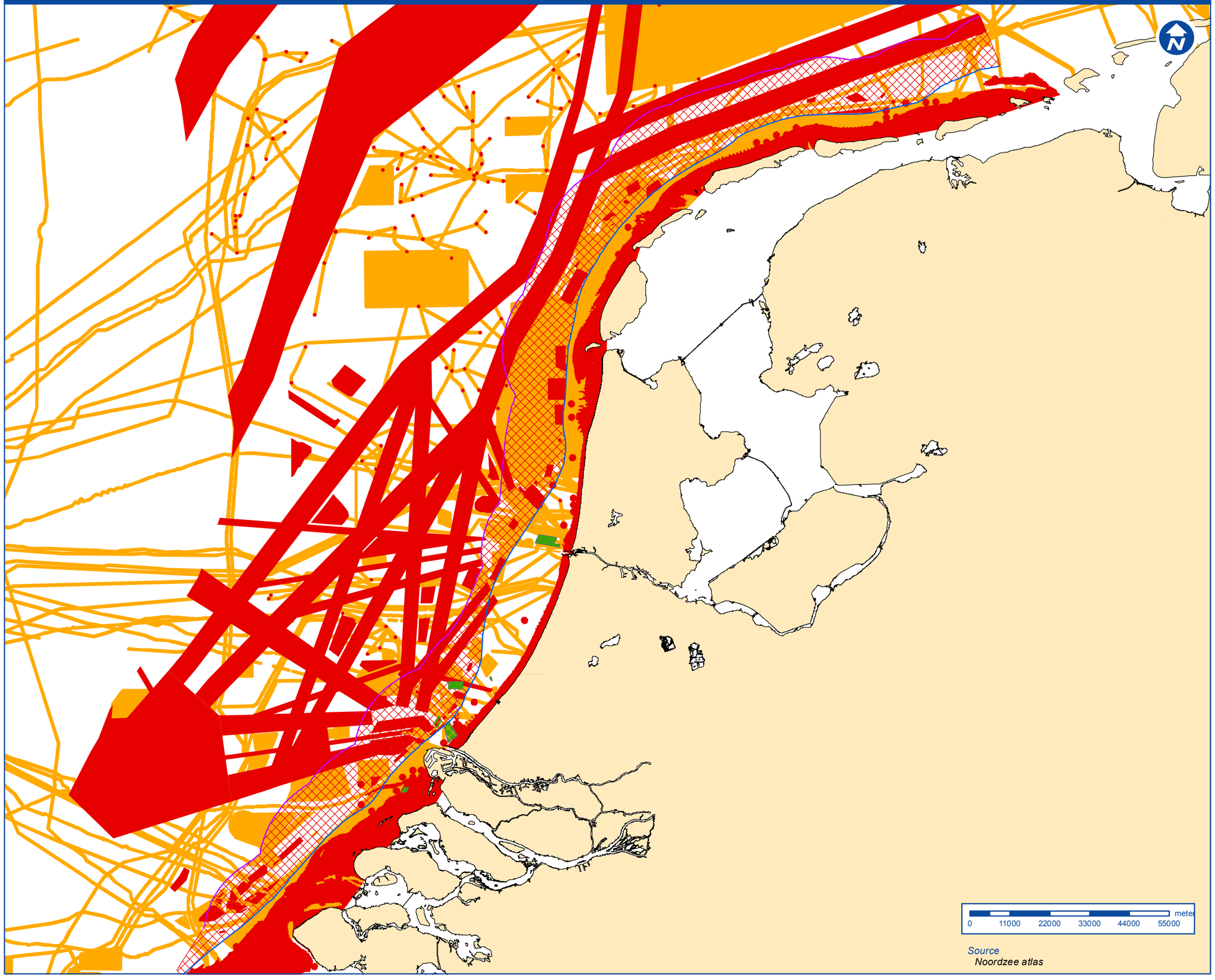
Annex 1 Plan of stages for the decision tree



ANNEX 2 Spatial representation of the assessment framework North Sea

Selection relocation area's: overview North Sea



Source
Noordzee atlas

Overview

Legend

General
- Modified 20 m depth contour
- 12 mile zone
- Netherlands

Preferred relocation area
- Present relocation area
- Relocation area Kf (sandy)

Relocation not possible
- Active sand extraction areas
- Shallow, close to coast
- Shipping lanes
- Living banks of shellfish
- Wind farms
- Oil and gas platforms
- Strategic sand extraction stock

Possible under conditions
- Old sand extraction areas
- Cables
- Pipelines
- Military areas
- Anchor areas
- Natura 2000

Project
Assessment framework dredging North Sea
Client
RWS

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Map number
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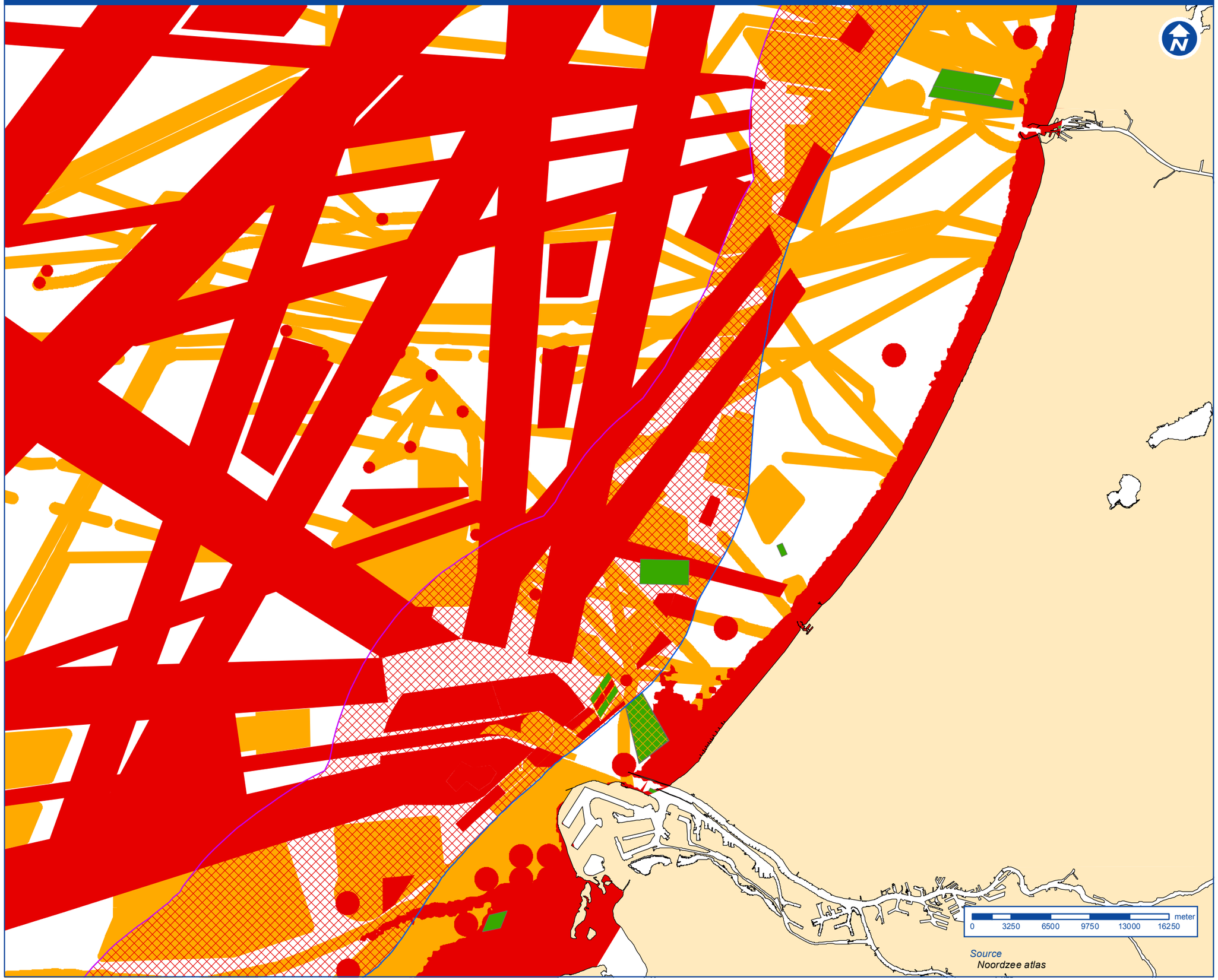
ANNEX 3 Spatial representation of the assessment framework Rotterdam area

Selection relocation area's: Rotterdam area



Overview

Legend

General
- Modified 20 m depth contour
- 12 mile zone
- Netherlands

Preferred relocation area
- Present relocation area
- Relocation area Kf (sandy)

Relocation not possible
- Active sand extraction areas
- Shallow, close to coast
- Shipping lanes
- Living banks of shellfish
- Wind farms
- Oil and gas platforms
- Strategic sand extraction stock

Possible under conditions
- Old sand extraction areas
- Cables
- Pipelines
- Military areas
- Anchor areas
- Natura 2000

DHV

Project
Assessment framework dredging North Sea
Client
RWS

Author
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Date
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V1.1
Map number
BA7222-S001-N01
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A3 (Landscape)

Annex 4 Standards and materials package

Soil Quality Decree: No difference in salt content
Interpretation of salt-fresh made by assigning areas
Salt: Wadden Sea, Zeeland Delta, North Sea along the coast
Fresh: 'The rest'

Where exactly is the boundary?
The boundary between fresh and salt waters is set down in the Soil Quality Decree.

Standard framework for freshwater and salt water
Application & temporary circulation
General ('the basis'):

- The same rules and standards for use and storage from an environmental hygienic perspective
- The same standard framework for freshwater and salt water (class A and class B)
- Match with or better quality than receiving ground
- No applications > Intervention values
- Soil Quality Decree acknowledges an exemption for short term storage (< 6 months)

Relocation

- No applications > Intervention values
- Relocation in salt waters; the maximum values for relocation in salt waters
- Relocation in fresh waters; the maximum values for relocation in fresh waters

Material packages

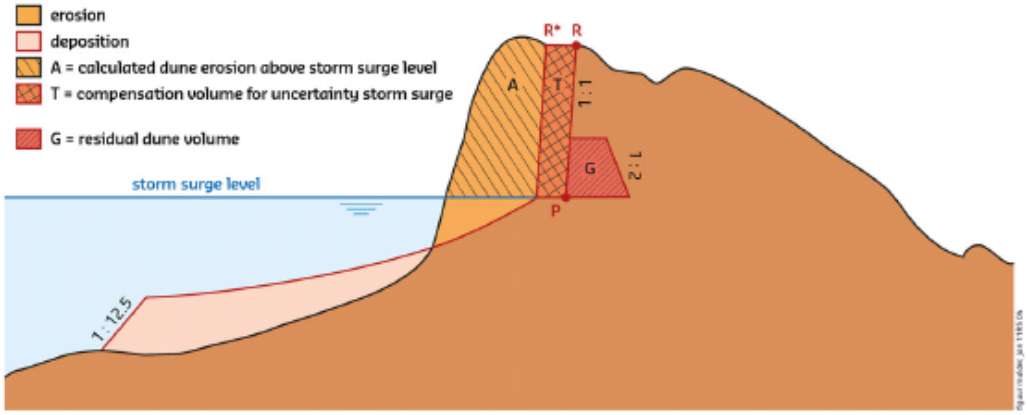
- Minimum packages set down within the NEN framework
- Based on regular prevention in the area of origin
- Use (incl. storage) and relocation of freshwater dredged material in fresh surface water: C1
- Use (incl. storage) and relocation of salt dredged material in salt surface water: C3
- Differences:
  - C1 (freshwater): Pesticides extra
  - C3 (salt): TBT extra
- Conclusion with regard to the transition areas (through tide): combination of C1 and C3 due to the assumption that materials are present

Annex 5 Dutch coastal erosion management

The Netherlands is located at the south-eastern part of the North Sea and has a coastline of more than 400 km. The Dutch coastline can be divided into three different parts: the Delta coast in the south, the Holland coast in the centre and the Wadden Sea area in the north. The Delta coast consists of tidal inlets and estuaries that, except for the Western Scheldt, have been closed by dams and storm surge barriers since the beginning of the 1960s. The Dutch coast is a typical storm dominated sandy coast with aeolian sand dunes and some minor stretches being reinforced with hard defence structures.
Barrier islands are characteristic features of the Wadden coastal area. Currently, 75% of the total coast is protected by sandy dune areas varying in width from less than 100 m up to several kilometres. Next, 15% of the coast consists of hard constructions such as sea-walls, dykes and other barriers and 10% of the coast is formed by beach flats that are present at the tips of the Wadden islands.

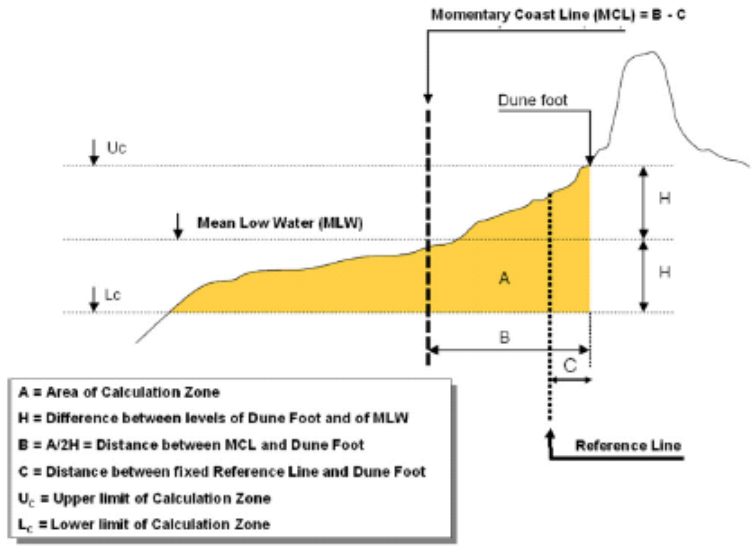
To ensure safety against flooding, safety standards for all flood defences in the Netherlands, including the dunes have been established through legislation. In 1990, the policy of “Dynamic Preservation” was adopted by the government in order to stop the structural erosion of the coast. Since 1990, coastal erosion management in the Netherlands has been translated into an ongoing coastal nourishment policy.

Traditionally, coastal policy in the Netherlands primarily focused on flood protection. The strategic objective to preserve safety against flooding has been arranged through legislation. This safety policy is translated into the tactical objective to maintain a safety standard, related to the probability of a certain storm surge level being exceeded. E.g., coastal dunes at the Holland coast must be able to withstand a storm event with a probability of exceedance of 1 in 10,000 years; for the Delta coast and the isle of Texel, the standard is 1 in 4000 years and for the remaining Wadden islands, 1 in 2000 years. The safety standards have been made operational by defining a residual strength of the dunes: a minimum dune volume needed to be able to withstand the design storm conditions. This minimum dune volume and its associated erosion line represent the quantitative state concepts specifying the safety standard. The position of the erosion line and the presence of the residual dune volume behind this line are being tested in a procedure using a dune erosion model every 5 years. If the residual dune volume appears to exceed the landward boundary of the coastal profile, interventions are needed to restore coastal safety.



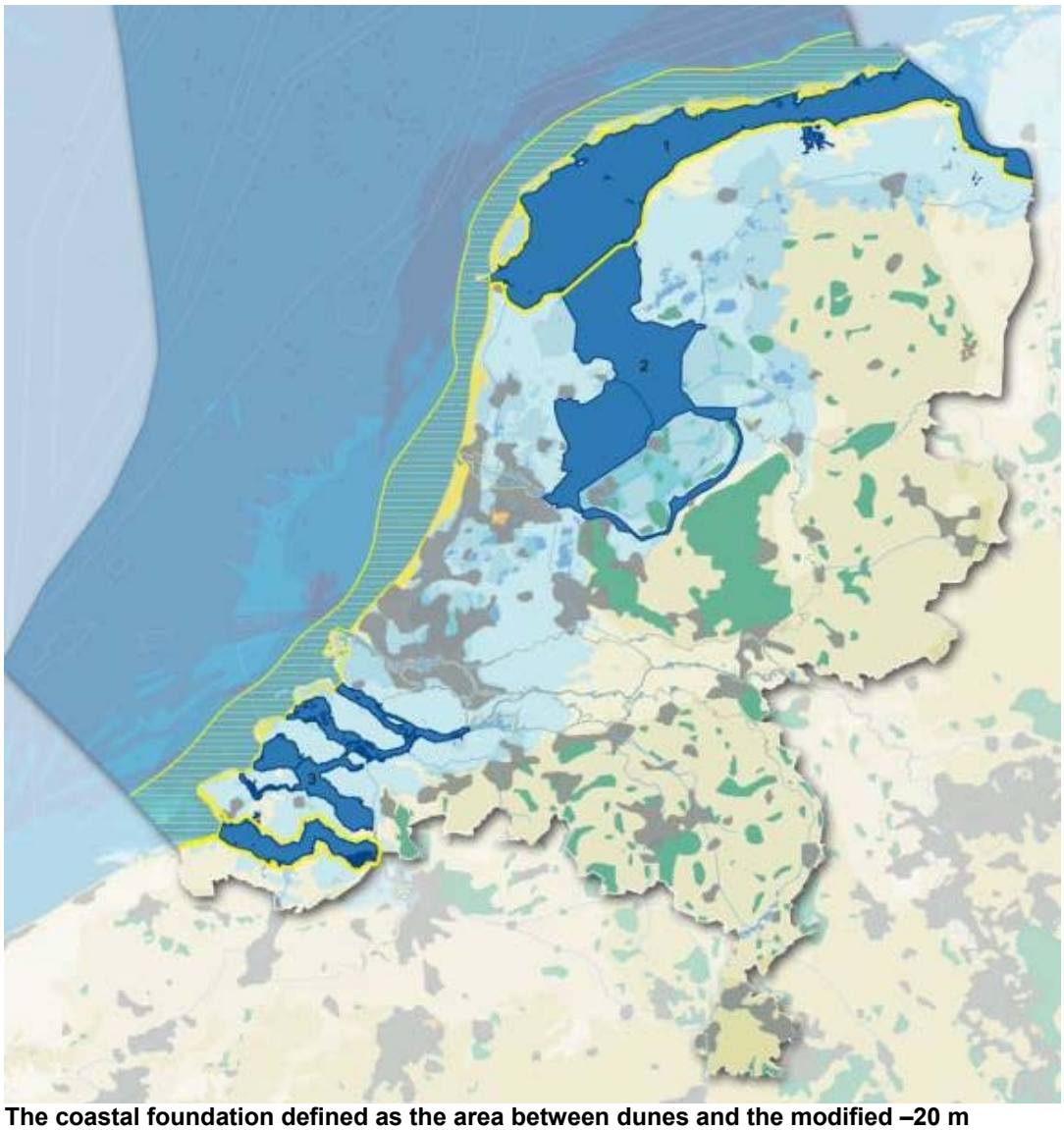
Cross section of a coastal profile defining erosion and deposition during design conditions, the resulting position of the erosion line (R) and the position of the residual dune volume

Once the safety standards of the primary defences had been established in the second half of the 20th century, structural coastal erosion problems along the Dutch coast received increasing attention. In 1990, the Dutch government adopted the national coastal policy of 'Dynamic Preservation' formulating as an additional strategic objective: sustainable preservation of safety against flooding and of values and functions in the dune area. Subsequently, implementation of the Dynamic Preservation policy was guided by the definition of the tactical objective to maintain the coastline at its 1990 position. In 1996, this objective was included in legislation. In order to do so, the concept of a coastline has been made operational by defining a Momentary Coastline (MCL) - as a quantitative state concept for each 250 m wide section along the dune protected coast. The MCL relates the coastline position to ten-year trends in sand volume in the upper part of the cross-shore profile, i.e. between the dune foot and approximately -5 m MSL (mean sea level) and is determined annually (Fig. x). The 1990 position of the MCL, which has been defined as the Basal Coast Line (BCL), represents the desired state. Whenever the actual position of the MCL (current state) shifts landwards of the BCL, a decision on intervention may be necessary. In line with the philosophy of the Dynamic Preservation policy to respect natural dynamics as much as possible, the preferred method of intervention is sand nourishment, either on the beach or at the shore face.



Definition of the Momentary Coastline (MCL) in a dune cross section

Successive evaluations of the policy in 1995 and 2000 pointed out that the BCL was successfully being maintained. Thus the tactical objective was complied with. However, morphological developments at larger scales, e.g. sand losses at larger depths and the impacts of sea level rise were neglected by the BCL approach. As a result, the Dutch government decided on an extended large-scale approach: additional compensation of sand losses at deeper water. This resulted in an additional large-scale tactical objective being defined: the preservation and improvement of the coastal foundation. The coastal foundation consists of the area between dunes and the modified -20 m depth contour and is a quantitative state concept additional to the MCL.



The coastal foundation defined as the area between dunes and the modified –20 m depth contour

The text above is a summery from an article about coastal erosion management in the Netherlands in Ocean & Coastal management:

Jan P.M. Mulder, Saskia Hommes, Erik M. Horstman; Implementation of coastal erosion management in the Netherlands. Ocean & Coastal Management 54 (2011) 888 – 897.