Policy- and technical advice on the beneficial uses of marine dredged sediments in Colombia, including nature-based solutions

Information, experiences, and lessons learned in the licensing, operation, monitoring and control of maritime dredging activities in the Netherlands, as well as in the determination of requirements to approve in this country the uses of marine dredged sediments

23rd of January 2026

Foto by Christiaan van Velzen

PARTNERS FOR WATER
CO-CREATING IMPACT

Netherlands Enterprise Agency

Government of the Netherlands

Contact

PARTNERS FOR WATER
info@partnersforwater.nl
www.partnersforwater.nl

Netherlands Enterprise Agency (RVO).
PO Box 93144, 2509 AC
The Hague

The project “Policy and Technical Advice on the Beneficial Uses of Marine Dredged Sediments in Colombia, including Nature-Based Solutions” is part of the collaboration between the Government of the Netherlands, through the Partners for Water program, and the Colombian Ministry of Environment, the National Planning Department (DNP) and the Ministry of Transport. The project was carried out by a consortium consisting of Arcadis, Fundación Herencia Ambiental Caribe, JESyCA, and Netics, together with government entities from both Colombia and the Netherlands.

Contents

1 Introduction

1.1 Background

Within the partnership between the Government of Colombia and the Government of the Netherlands in the field of water and climate change adaptation, beneficial use of (marine) dredged materials is one of the priorities, on the specific request of the Colombian Ministries of Transport (MinTransporte), Environment (MinAmbiente) and the National Planning Department (DNP). Beneficial uses of marine dredged sediments are not yet performed in Colombia, and dredged sediments have been dumped in offshore deposit areas previously approved by the environmental authority. Building on increased attention to beneficial use and to further improve the normative guidelines for dredged materials in Colombia, this assignment focuses on policy and technical advice for the beneficial uses of marine dredged sediments, including nature-based solutions (NbS).

The policy partnership with the Government of Colombia on the topic of dredging and beneficial use of dredged materials has a long history, supported through several projects in the last decade:

- The Plan Nacional de Dragados Marítimos (PNDM, 2017) consisted of a conceptual analysis and main recommendations to achieve, in the short, medium and long term, improvements to: (i) the institutional order, (ii) the technical and environmental regulations, (iii) the financing, (iv) the dredging contracting methodologies in the maritime access channels to the ports and (v) the maintenance dredging strategy by port area and the capital dredging strategy for the two coasts, Atlantic and Pacific, including beneficial use of dredged material. The PNDM also included an international comparison regarding the above aspects, to have a reference that would allow the Colombian Government entities to make qualified decisions, among which the use of materials from dredging occupies a prominent place. Specifically mentioned were the lack of uniformity in the basic criteria for the formulation of designs and works, a lack of clarity regarding the final disposal or beneficial use of dredged material, additional costs for unnecessary transport to dispose of materials offshore that could be used, and imprecision regarding the final values of the projects.
- A webinar series on dredging and use of dredged materials in Colombia, meant to support the stakeholders on the topic of dredging, including key principles such as Building with Nature and use of dredged materials for other purposes (2020/2021)
- In the project Use of dredged materials in the Colombian context, opportunities for enlarging the range of beneficial uses of dredged materials have been analyzed, including examples of legal frameworks and normative requirements in other countries, a case study for opportunities for beneficial uses of dredged materials resulting from capital and maintenance dredging activities in the Buenaventura port zone and an analysis of barriers and enablers for the application of re-use of dredged materials in Colombia (2022).

Following these projects, the National Development Plan 2022-26 indicated in its Article 240 the need to use the dredged material, complying with the environmental regulations issued for this purpose, prioritizing uses in the recovery of areas affected by coastal erosion, and in the recovery of mangrove areas or zones affected by flooding. Besides, in July 2023 the Colombian government issued the CONPES 4118 (National Port Policy), which states that the disposal of dredged materials offshore or onshore may have a negative impact on marine and coastal ecosystems. Given these statements in these normative instruments, it is the responsibility of MinAmbiente to establish a regulatory framework of environmental and technical guidelines for the use of dredged marine sediments in Colombia.

Given this need, the governments of the Netherlands and Colombia agreed to launch the current project “Policy and technical advice on beneficial uses of dredged marine sediments in Colombia, including nature-based solutions”.

1.2 Project objectives and deliverables

The project focuses on further improving the normative guidelines for marine dredged materials in Colombia, proposing a set of rules and parameters in the principal guidance document with respect to dredging (Guía de manejo ambiental de proyectos de infraestructura, modos marítimos y fluvial, INVIAS 2022) and including a case study for the port zone of Barranquilla showing what can be done with the dredged material.

The basis for improving the Colombian guidelines lies in providing technical advice in the form of practical rules and parameters for beneficial use of dredged material, drawn from the experience of The Netherlands and other countries.

Accompanying this technical advice is the capacity building of major stakeholders in Colombia regarding the major technical components of the study.

The project consists of 5 main deliverables:

1. Deliverable 1: Rules and parameters applied in t**he Netherlands** regarding dredging and use of dredged sediments.
2. Deliverable 2: Rules and parameters applied in **other countries: Australia/New Zealand, Japan, Brazil, Peru, Mexico, USA (Florida), Canada, Spain, Costa Rica and Panama.**
3. Deliverable 3: Characteristics of sediments in the port zone of Barranquilla.
4. Deliverable 4: Additions to the INVIAS guidelines.
5. Deliverable 5: Case study port zone of Barranquilla.

1.3 Structure of this deliverable

This report is Deliverable 1, highlighting the rules and parameters applied in the Netherlands regarding the dredging and use of dredged sediments. The structure of this report is as follows:

- Chapter 2: Governance structure of the Netherlands for concessions, planning, environmental licensing and operation of maritime dredging activities.
- Chapter 3: Technical criteria required by environmental institutions in the licensing, monitoring and control of maritime dredging activities.
- Chapter 4: Methodology to determine the background and threshold values of chemical parameters of marine dredged sediments.
- Chapter 5: Threshold values of chemical parameters of marine dredged sediments, for each application.
- Chapter 6: Adaptation strategies to climate variability and other risks.
- Chapter 7: Financing strategies to implement NbS.
- Chapter 8: Discussion and experiences.

Appendices:
- Appendix A - Substance based coefficients
- Appendix B - Detection limits
- Appendix C - Reporting limits
- Appendix D - Standard research packages
- Appendix E - Threshold values for spreading on fresh and saltwater
- Appendix F - Threshold values for application on land
- Appendix G - Threshold values for applying on water
- Appendix H - Threshold values for PFAS/PFOA
- Appendix I – Glossary f technical terms
- Appendix J – Glossary of Acronyms
- Appendix K – Overview of dredging monitoring systems used globally

2 Governance structure of the Netherlands for concessions, planning, environmental licensing and operation of marine dredging activities

Chapter 2 - Executive summary

The governance structure of the Netherlands for maritime dredging activities is characterized by a complex and organized framework that ensures the sustainable use and management of marine resources. This chapter describes the governance structure and framework applied in The Netherlands for the concessions, planning, environmental licensing and operation of maritime dredging activities. The institutions responsible for establishing and enforcing the legal framework are described in Section 2.1. Section 2.2 provides a description of the legislative framework for marine dredging activities.

Key takeaways

- A clear distinction between governing entities, enforcing entities and dredging companies with distinctive responsibilities is important to ensure oversight and enforcement of responsibilities. Ideally, such as in the Netherlands, there is one platform coordinating responsible entities and permits (in the Netherlands this is the omgevingsloket)
- Jurisdiction for licensing and permits can differ for inland and marine waterways and water quality and quantity; these need to be thoroughly assessed prior to proceeding with the development of beneficial use of dredged material activities.
- A multi-layered legal framework from local, national, and international (in the Netherlands, this is e.g., EU regulation) agreements influence regulations and requirements for permits and environmental impact assessments.
- The Netherlands is unique in using a purpose-based framework, which means that final applications of the dredged material determine which regulations are in place and which (beneficial use) applications are applicable. This framework allows for more distinction between use pathways and therefore open possibilities for use.

2.1 Institutions – Responsibilities (processes) – Regulations (legal framework)

In the Netherlands, the regulations from dredging until use applications are well established. There is a clear distinction between governing entities, enforcing entities and dredging companies. Oversight and enforcement responsibilities are distributed across various entities, depending on the activity and location.

The Dutch Ministry of Infrastructure and Water Management is the primary legislating agent for all dredging activities. In marine environments, enforcement is carried out by the Department of Waterways and Public Works (RWS - "Rijkswaterstaat"), except within port areas where port authorities hold jurisdiction. When sediment is applied to land or inland waters, the enforcing entity becomes the responsibility of local entities such as water boards, provinces, or municipalities. An overview of the activities and the entities and regulations involved in The Netherlands is shown in Table 2-1.

Table 2-1: Overview table of activities from dredging to beneficial use, which governing and enforcing entities are involved and the regulations following this.

Governing entity	Enforcing entities	Activity	Regulations
Dutch ministry of infrastructure and water management	Department of Waterways and Public Works (RWS - "Rijkswaterstaat") Port Authorities	Maritime Dredging	- London convention protocol / OSPAR - EU waste framework directive for marine disposal - Water framework directive - Marine strategy framework directive - Nature 2000 and nature conservation act (1998) - Environmental Act - Water act
	Offshore: RWS *Onshore (freshwater):* Waterboards *Onshore (land):* Municipalities and Provinces	Intermediate activities[1]	- Environmental Activities Decree (BAL - "Besluit Activiteiten Leefomgeving")
		Beneficial use	- Soil Quality Decree (Besluit bodemkwaliteit) - Soil Quality Regulation 2022 (Regeling bodemkwaliteit 2022) - Management decree PFAS[2] - Earth removal act - Specific regulations

Since 2024 the "Omgevingswet" (The Environment and Planning Act - EPA) provides the overarching legal basis for all environmental permitting. This law replaces and integrates multiple former laws. If the dredging activity involves disposal in marine waters, use on land or if there is potential for pollution, an environmental permit is required. To receive this permit, the type of activity, scope and location, purpose, timeline and all relevant technical data of the project need to be clearly described. Depending on the scale and impact of the project a "Milieu Effect Rapportage" (MER), comparable to an Environmental Impact Assessment (EIA), and a sediment quality assessment are required. The criteria will be described and explained in more detail in Chapter 3. Some small dredging operations are notifiable under BAL (Besluit leefomgeving) if they meet specific conditions, and they do not require a full permit.

2.2 Legislative framework of maritime dredging activities

Section 2.1 involves the legislative framework of the Netherlands for marine dredging activities. This section starts with an overview of the licensing authorities and permits (Section 2.2.1). In Section 2.2.2 the environmental activities decree ("BAL - Besluit leefomgeving") will be discussed, which describes the regulations and concurrent approach to

[1] Activities that are not final usage such as drying or mixing with other materials
[2] Per- and polyfluoroalkyl substances

follow for environmental activities such as dredging, storing and use. Finally, Section 0.2.4 describes the practical process of applying for permits using the environmental counter.

2.2.1 Licensing / permits

In the Netherlands, inland and marine waterways are maintained by governmental organizations (Table 22). For marine waterways, the Department of Waterways and Public Works or harbor authorities are responsible for water quantity and quality. Depth management and therefore dredging is included in their responsibilities. Surface mineral extraction (sand, oil mining) is not included in the regulations for dredging. This is instead documented in the North Sea policy document 2016-2021

Table 2-2: Overview of the processes from the start to the end of the dredging process and the main responsible entities in The Netherlands

Process	Main Responsible Entity
Area Concessions sand mining / nourishment (EEZ)	RVO / Ministry of Economic Affairs
Planning (national)	RWS / Ministry of Infrastructure and Water management
Planning (regional/local)	Provinces / Municipalities
Environmental Licensing	Environmental counter
Dredging Operations	RWS (for national waterways/coasts)

The above-mentioned managing organizations should submit an environmental permit to be legally allowed to dredge. The environmental permit is closely linked to the Water framework directive (WFD) objectives. The permit encompasses all individual components covered under Dutch legislation:

- Water Act, which requires permits for activities in state waters (e.g., dredge spoil disposal, building in the seabed) and enforces water quality standards;
- The Soil Quality Decree ("Besluit Bodemkwaliteit"), which sets criteria for the use or location of soil and sediment;
- The Earth Removal Act, governing sand and gravel extraction; and
- The Nature Conservation Act, protecting ecological areas and species.

International agreements heavily influence Dutch regulations. The London Convention/Protocol and OSPAR Convention (for the North-East Atlantic) provide the basis for prohibiting unregulated dumping at sea. The Soil Quality Decree independently translates these treaty obligations into Dutch rules. Additionally, the EU directives also frame national requirements: the EU Water Framework Directive imposes chemical and ecological water quality targets that dredging must not compromise. Finally, the Marine Strategy Framework Directive (MSFD) and Habitats/Birds Directives require the maintenance of a good environmental status and biodiversity, this in turn affecting where and how dredging can take place.

In practice, any maritime dredging project in the Netherlands must navigate this multi-layered legal framework, obtaining permits from the appropriate agencies and adhering to conditions that reflect both national standards and international environmental commitments. Depending on the purpose of dredging, other permits and regulations are also put in place such as the MER (comparable to an EIA). Details on the MER are explained in Section 3.3.

2.2.2 Sediment applications on the Environmental Activities Decree (BAL)

The regulations in the Netherlands are mainly purpose-driven. This means that the final application of the dredged materials determines which regulations are in place. The Environmental activities decree (BAL - "Besluit Activiteiten Leefomgeving") is a document stating the different activities that can be conducted in the environment. The BAL gives guidelines and regulations for these activities and redirects them to other required permits and regulations. Generally, the different purposes according to BAL for dredged materials are:

A. Apply and use of soil and dredged materials — see Section 2.2.2.1
B. Redeposit material at original location (no permit needed) — see Section 2.2.2.2
C. Use of/as minestone or use as fertilizer — see Section 2.2.2.3
D. Combining and storing of materials — see Section 2.2.2.4

E. Disposal at disposal sites see Section 2.2.2.5
F. Other applications see Section 2.2.2.6

Storing the dredged materials temporarily involves special regulations but is in most cases required to use the dredged materials beneficially. Reusing minestone or incorporating dredged materials in fertilizers involves different analytical methods and guidelines.

In the scheme in Figure 2-1, the different applications are listed together with the use classes. Use classes are described in more detail in Section 2.2.2.1 to Section 2.2.2.6.

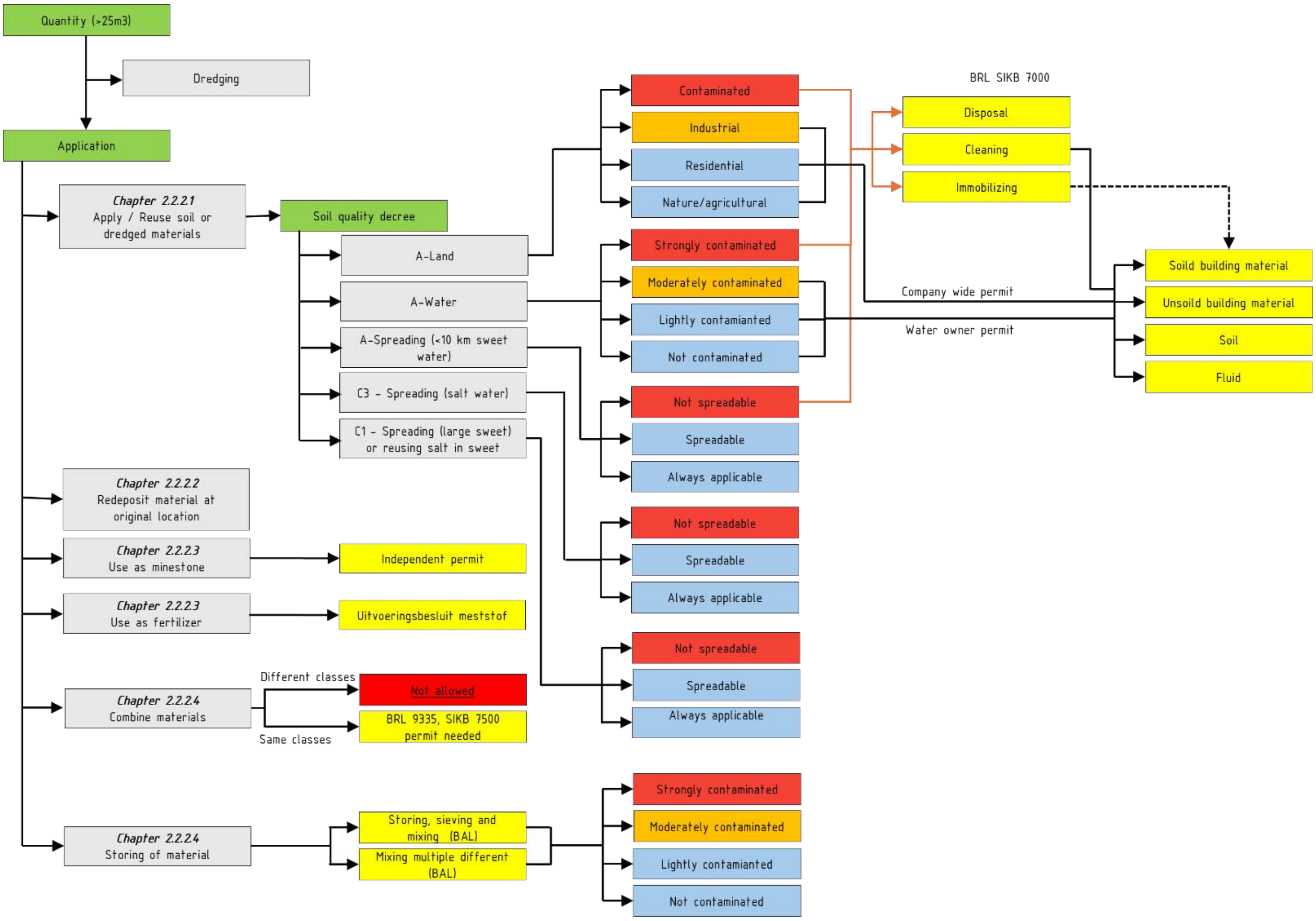


Figure 2-1: Overview of the different environmental activities related to dredged materials according to the environmental activities decree along with the follow up regulations per activity.

2.2.2.1 Apply and use of soil and dredged materials

The Netherlands is one of the few countries in the world that has separate regulations in place for the beneficial use of soil and sediments. 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 location of dredged material must be of beneficial use (i.e., the location has to contribute to a functional and sustainable fulfillment of the morphological and ecological functions of the sediment). Once these general rules in the BAL and the EPA classify the purpose as beneficial use ('a legit application') and do not apply to any other purposes (see Figure 2-2), the Soil Quality Decree applies (Rijksoverheid, 2025a).

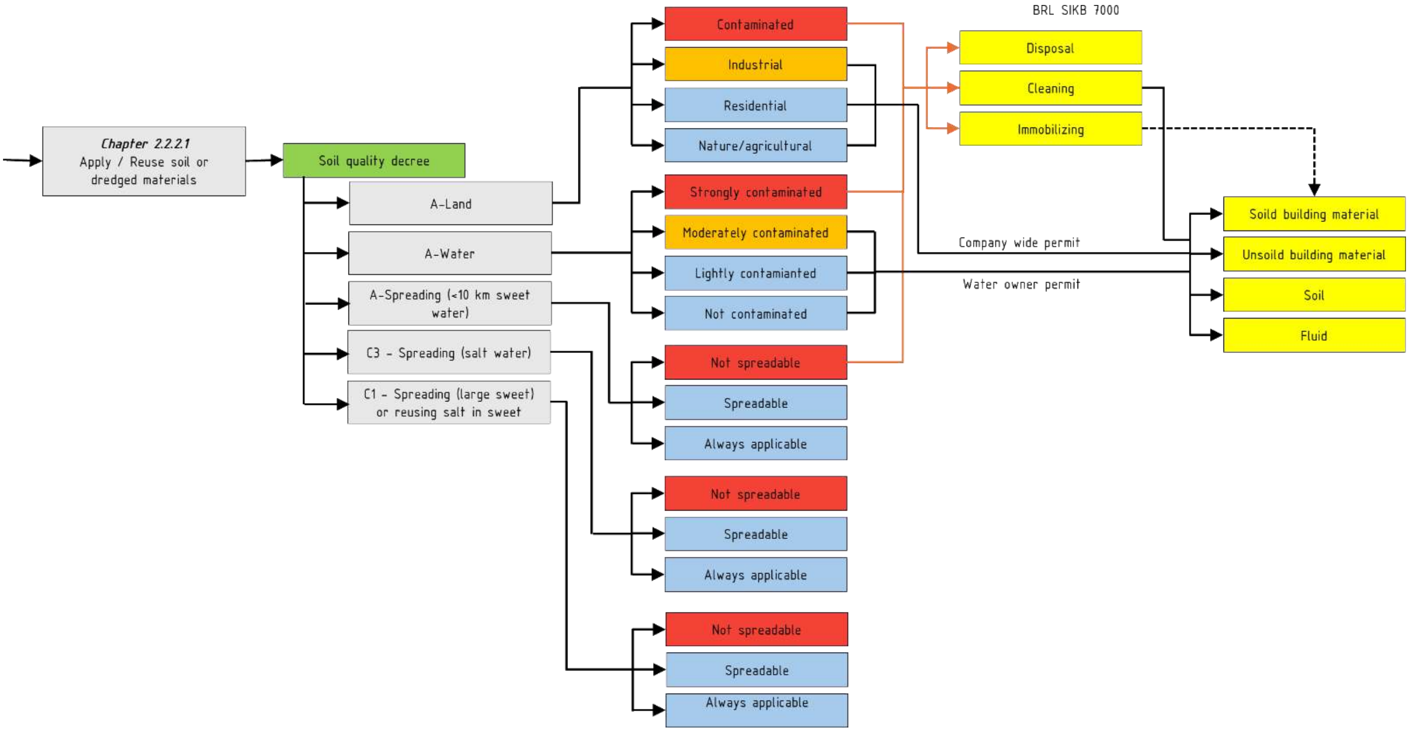


Figure 2-2: Overview of the different environmental activities related to the beneficial use of dredged materials according to the environmental activities decree along with the follow up regulations per activity.

The Soil Quality Decree outlines various purposes for soil and dredged materials, specifying the required testing types and applicable threshold values. The Soil Quality Decree is purpose-driven, meaning the final application determines the regulations in place. This also means that the application of marine sediment in land areas triggers the regulations for land. Unlike its name, the Soil Quality Decree focuses on all types of environments, ranging from sea and surface waters to soil and groundwater. According to the licensing entities, this approach is applied because the impact of potential chemical contamination is long-lasting and is therefore inflicted at the final location instead of its source. Therefore, it is also possible to combine the application of soil, dredged materials, and building materials in one legislation.

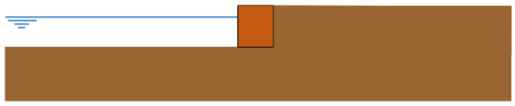
The different types of formal applications in the Soil Quality Decree, directly from soil and dredged materials, include:

- Application on land

All beneficial uses of sediment that is applied only on land. This includes usage in dike structures, filling material, and the use of sediment as replacement for sand or clay on land.

- Application on surface waters

  This includes all applications directly in surface waters, such as revetments or the creation of natural islands.



- Spreading

  This includes spreading the dredged material within 10km of the source on land. Also, a temporary depot on farmland counts as spreading on land.

  This also includes spreading the dredged material in the same freshwater waterway.

- Spreading across or next to salt water

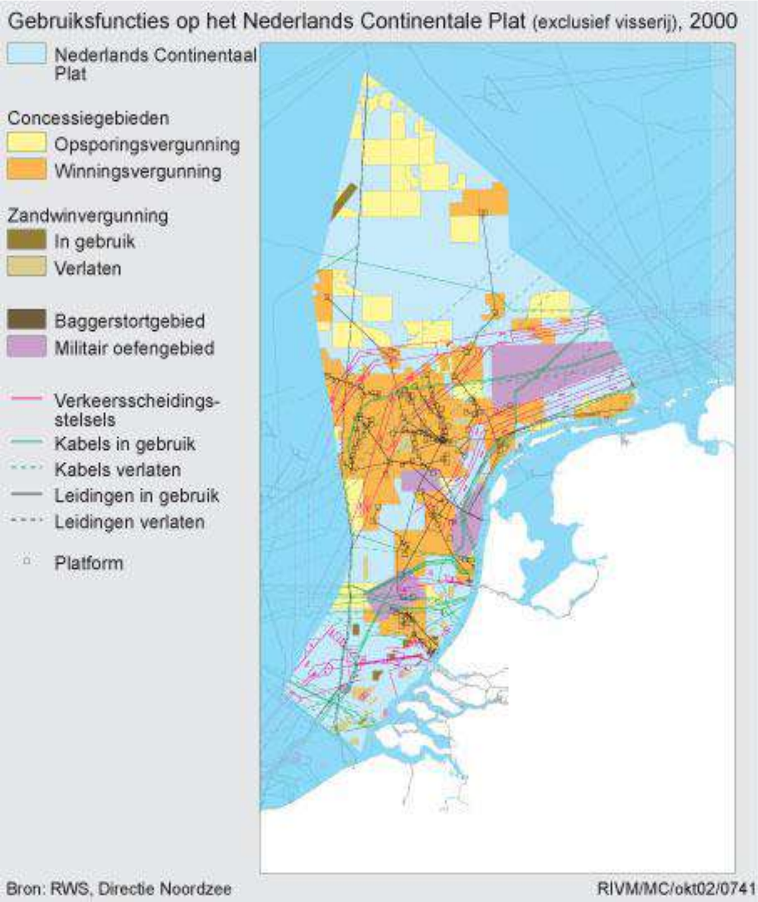
  This includes spreading the dredged material in the same saltwater waterway.

Figure 2-3: Typical methodology for spreading dredged materials at sea. Source: Dutch Department of Waterways and Public Works.

Additionally, clean marine sediments (when below all contamination threshold levels) can be disposed of directly at sea. To do this, an additional permit is needed according to the law spreading in the North Sea (MIW, 2023). This law aims to assign specific areas for disposal and decline other areas to prevent contamination of the North Sea. The following activities apply within this category:

- Facilities in surface water bodies, except deep pools, for the prevention or limitation of flooding or water nuisance, the promotion of the natural or recreational value thereof, the promotion of the passage of shipping, or the restoration or improvement of the location, shape, dimensions, and construction of a water management structure
- Replenishment of dredged material along the coastline for the restoration or improvement of coastal defenses
- Spreading of dredged material in a surface water body, for the restoration or improvement of the ecological and morphological functions of the sediment. Exceptions are floodplains, buntings, mudflats, beaches, or plates.

Disposal at sea also triggers the Responsible Care Act. Here, it is expected that contractors will do everything in their power to reduce environmental effects on the sea surface.



Gebruiksfuncties op het Nederlands Continentale Plat
Usage functions on the Dutch Continental Shelf

Concessiegebieden
Concession areas

Opsporingsvergunning
Exploration permit

Winningsvergunning
Production permit

Zandwinvergunning
Sand extraction permit

In gebruik
In use

Verlaten
Abandoned

Baggerstortgebied
Dredged material disposal area

Militair oefengebied
Military exercise area

Verkeersscheidingsstelsels
Traffic separation schemes

Kabels in gebruik
Cables in use

Kabels verlaten
Abandoned cables

Leidingen in gebruik
Pipelines in use

Leidingen verlaten
Abandoned pipelines

Figure 2-4: Different applications including disposal areas of dredged sediment in the Dutch coastal marine area. Source: Dutch Department of Waterways and Public Works. Translation of terms in the light blue box.

The goal is to maximize the spread at existing locations and old sand winning locations to minimize the areal effects. It is not always clear to the managing and executing parties what the best disposal locations are. So, the Netherlands actively assigned dedicated disposal areas (see Figure 2-4). In addition to that, the Netherlands aims to use sediment from the sea beneficially in sea areas. This means strengthening the coast or coastal foundation is preferred, along with preventing sand from returning (Figure 2-5). To do this, certain conditions apply; for example, fine sludge is not allowed to be used in coastal foundations. If the conditions are met, this application becomes formally beneficial

.

Nuttige toepassingen slib en zand
Beneficial uses of silt and sand

Bijdragen aan kustversterking
Contributing to reinforcement of the coast

Opvullen van erosiekuilen
Filling erosion pits

Bijdragen aan natuurontwikkeling
Contributing to nature development

Afdekken van kabels en leidingen op de bodem
Covering cables and pipelines on the seabed

Figure 2-5: Beneficial applications of sand according to RWS. Translation of terms in the light blue box.

- Exceptions

Some exceptions exist where rules are separately specified and therefore not included in Figure 2-7:

-> Low leaching (below leaching levels) dredged materials for large-scale purposes on land or surface water

This includes all applications that exceed 5000 m^3 and have been proven to have low emission values after a leaching shaking test. Typical applications are road coverage and covering of disposal areas.

-> Filling deep lakes or holes.

Deep lakes or holes are remnants of old commercial (sand) mining practices. Dredged materials can be placed either on top of or in the deep lakes. This category has different regulations.

2.2.2.2 Redeposit material at original location

According to the environmental activities decree, no additional permit is needed when redepositing the dredged materials back, without any additions, to the original location.

2.2.2.3 Use of/as minestone or use as fertilizer

Using dredging material from minestone areas as minestone or mixing dredging materials into a fertilizer product is not included in this report. In the Netherlands, this is not included in the Dutch regulations for applying sediment and falls under different categories. Please note that applying sediment directly to land as a fertilizer is considered spreading on land. Additionally, the salinity of marine sediment precludes its direct use as fertilizer.

2.2.2.4 Combining and storing of materials

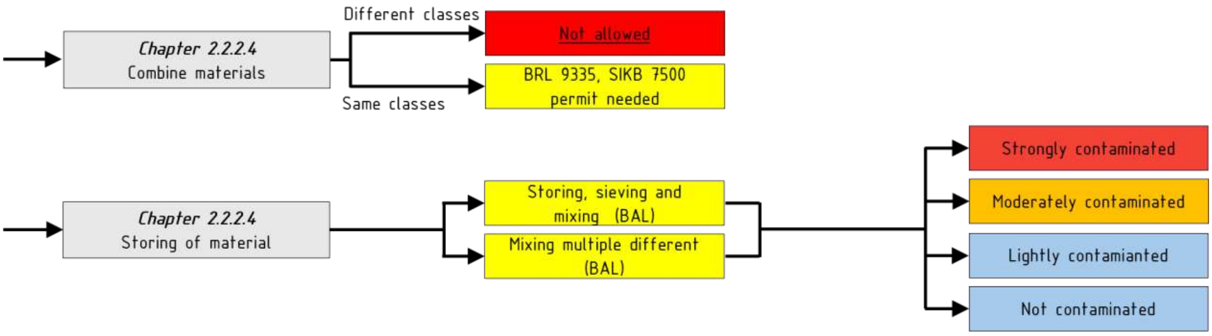


Figure 2-6: Overview of the different environmental activities related to combining and storing dredged materials according to the environmental activities decree along with the follow up regulations per activity.

Storing soil or dredged materials is regarded as a potentially environmentally dangerous activity. The negative consequences are potential contamination of the soil, leaching of wastewater, and unnecessary maintenance of the material. In the BAL law, this activity includes storage on soil, which can be land or a waterbed. This makes a difference because storage on land is driven by company activities and regulated by the company. Storing at a waterbed of a surface water body is regulated by the maintainers of the water body itself and the applicable municipality. Other activities that fall within these regulations are sieving, dewatering, and combining of different dredged materials.

The activities described in this paragraph (regarding storing and mixing) are on top of regulations for dredging or the beneficial use of dredged materials. For this activity, an environmental permit is necessary if the materials are of unknown quality, slightly or strongly contaminated. In any case, all wastewater from these activities that is directed to surface waters is also subject to the environmental permit. The environmental permit should be applied for all the authorities that are in place at the storage location area (municipality, province, water boards, RWS).

In the Netherlands depot locations are very common. This enables effective drying and containment of the material, facilitating collaboration with existing use projects. Lightly contaminated or moderately contaminated dredged materials (see Figure 2.2) are allowed to be stored if the depot is covered with protective foil. If multiple streams of dredged materials are collected independently at the same location, the owner must be a soil storage company or soil cleaning company with a BRL 9335 or BRL 7500 regulation[3]. Also, small volumes (<25 m^3), storage at dedicated agricultural depots, or disposal at disposal locations, are not included in this activity.

Figure 2-7: Typical Dutch sediment drying depot from above. Source: bodembreed.

2.2.2.5 Disposal at disposal sites

Figure 2-8 Waste disposal at waste management company.

If the material is classified as “red” in Figure 2-6 and therefore exceeds intervention values[4], the material is regarded as waste. Waste materials are not part of the Soil Quality Decree. Waste material has to be brought to a waste management company or a dedicated storage area. This falls under the BRL SIKB 7000[5].

Within this perspective, the Netherlands has various options to dispose of contaminated sediments, which are very similar to techniques adopted in other countries such as Canada, the USA, and Australia. The Netherlands has strict sediment quality standards and prohibits dumping heavily contaminated material at sea. Instead, contaminated sediments are either confined underwater or stored in specially designed facilities. For moderately contaminated sediments, they may be placed in underwater depressions and capped with clean material to prevent the spread of pollution. Heavily contaminated material is confined in large engineered depots like *De Slufter* and *IJsseloog*, which are safely isolated from the environment. These depots are closely monitored to ensure contaminants do not leak into the surrounding water. Temporary storage on land is allowed for up to 3 years, and underwater storage for up to 10 years. Short-term storage (under 6 months) is generally permitted with fewer rules, but longer storage requires

[3] BRL stands for “Beoordelingsrichtlijn” (Evalution guideline)
[4] In the Netherlands, the Intervention Value is a generic standard used to classify soils as seriously contaminated, indicating that remediation is required.
[5] SIKB - “Stichting Infrastructuur Kwaliteitsborging Bodembeheer”, is the Infrastructure Quality Assurance Soil Management Foundation. https://www.sikb.nl/bodembeheer/richtlijnen/brl-sikb-7000

notification or permits. These regulations are in place to prevent temporary stockpiles from becoming long-term pollution sources.

The Slufter and IJsseloog are examples of government-owned depots that are practically maintained by Rijkswaterstaat. There are 4 depots in total, of which the Slufter is the largest, with a capacity of 150 million cubic meters of dredged material. Dredged material disposal sites must comply with the so-called IBC criteria to minimize the risk of contaminant spreading (Wijdeveld, A., WL Delft Hydraulics, & Arcadis). (2005).[6] IBC stands for Isolation, Control, and Monitoring. A summary of these criteria is given below:

- **Isolation:** The walls of the disposal facility must provide sufficient protection against the spread of contamination. For this purpose, for example, an impermeable layer (side and bottom sealing) can be installed. The risk of spreading can also be reduced by implementing geo-hydrological measures that influence the direction of groundwater flow. Due to consolidation (settlement) of the dredged material, contaminated water is pressed out. This water must be collected and treated. The location of the disposal site must be chosen so that uncontrolled spreading into surface water is not possible.
- **Control (Management):** Isolation measures must be maintained in good condition and replaced if necessary. It must be possible to take corrective actions if, due to unforeseen circumstances, contaminants nevertheless spread beyond the disposal site. Finally, it must be possible to remove the deposited dredged material from the disposal site if required.
- **Monitoring:** The installed facilities must be monitored for soundness and proper functioning during construction and over the long term. In addition, the surrounding environment must be monitored to determine whether contamination spreads beyond the disposal site.

The requirement is that the (volume of the) area that may be affected by the disposal site must not be greater than the volume of the disposal site itself. This refers to an area within which, after 10,000 years, groundwater quality no longer meets the target values.

If a disposal site does not meet the IBC criteria, additional measures are required, such as impermeable walls, water-level control, top sealing, and sampling programs. For disposal sites located in or under water, these measures are often difficult to implement.

2.2.2.6 Other applications

According to the Soil Quality Decree, other specific regulations exist per application. In this instance, while dredged material is beneficially used, the Dutch regulations can classify the material as not being dredged material anymore. This is the case when creating building materials, using soil as a resource (sand/clay) and some unique applications:

Building materials

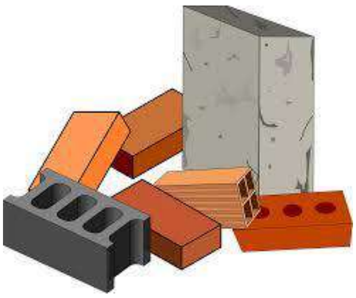


Figure 2-9 Building blocks, available in different sizes and types for different applications.

Building materials fall under a different category in the Soil Quality Decree. Dredged materials are not categorized as building materials since liquid materials are not solid enough to be classified as such. However, dredged materials can

[6] *Uitloging en verspreiding uit depots: Wat weten we meer 10 jaar na het vaststellen van het Beleidsstandpunt Verwijdering baggerspecie?* (Q3771; AKWA report 05.005). Rijkswaterstaat.).

be applied as building materials when dried and potentially solidified. For this, they would comply by having >10% of the total sum of silicium, calcium, and aluminum in dry weight. In Dutch regulations, building materials can be classified as unsolid (<50 cm^3 particles or unstable) or solid (>50 cm^3 particles and stable) after testing them with a diffusion leaching test.

Soil as a resource

If dredged materials do not comply with building material standards, it is classified as soil or dredged materials and is therefore applicable as such. However, to use it as a resource and sell it, it should also comply with the regulations for resources ("Grondstoffenbesluit") and the RAW[7]. This allows sandy dredged materials to be sold such as sand for example.

Miscellaneous applications

Other unique applications, with unique rules in the BAL are:

- Covering contaminated soil or disposal locations with material

These are not described more intensively in this document.

[7] Dutch abbreviation that stands for the standard specification system in the civil engineering sector. https://www.eurofins.nl/media/1663478/2018-04-25-lflt_eurofinsenvironmenttesting_flyer_raw.pdf

2.2.3 Applying for permits

Applying for permits in the Netherlands is done through the environmental service desk / counter (“Omgevingsloket”). The digital counter was founded as part of the Dutch government's digital strategy and developed in collaboration with Rijkwaterstaat and the ministry. The goal of the service desk is to coordinate centrally the permitting efforts prescribed within the Netherland's central environmental laws, thereby streamlining efforts between private parties, central governments, and local governmental parties.

Figure 2-10 Environmental service desk / counter (“Omgevingsloket”).

The steps in this service desk are the following:

- Step A) Select your location
- Step B) Select the environmentally harmful activities (dredging, storing and application)
- Step C) get matched to the regulations in place and upload the required information and documents
- Step D) get matched to the authorities and apply for permits

In the most common situation where permits should be obtained for dredging, storage, and application, one needs an environmental permit, a water permit (for activities in water), and notification of soil quality. In some other cases, it is also necessary to perform a MER proving that there is no environmental harm or a full assessment of ecological effects. The authorities assess each permit individually. In many cases, handmade permits are also possible, where, together with the authorities' specific measures, are selected to decrease environmental harm.

3 Technical criteria required by environmental institutions in the licensing, monitoring and control of maritime dredging activities

Chapter 3 – Executive summary

This chapter focuses on the technical aspects that need to be considered in order to apply for permits and licenses for maritime dredging activities. In the Netherlands, licensing for dredging also depends on the beneficial application and the relocation requirements. This chapter includes, chronologically, the general technical requirements for applying for permits:

- Pre-assessment of the need for dredging (Section 3.1)
- Classification of dredged materials according to the Soil Quality Decree (Section 3.2)
- Dutch Environmental Impact Assessment (MER) (Section 3.3)
- Flora and fauna Law (Section 3.4)
- Socio-economic criteria (Section 3.5)
- Monitoring and control of operations (requirements during contracting within the environmental permit framework) (Section 3.6)

Key takeaways

- The pre-assessment of the need for dredging should consider ecological risks (the threat of contamination of surface water as a result of poor waterbed quality and potential exposure pathways) and economic impact (e.g., navigation routes).
- Analyzing sediment quality typically involves:
  - Determining state and purpose of the material
    - The purpose or assumed application can alter the quality assessment procedure
  - Sampling and preparation scheme for dredged materials and soils:
    - Batch testing should be conducted in the dredged material and receiving soil
  - Preliminary investigation into contaminations
  - Outsourcing chemical testing and reporting:

    - Depending on the application at sea or on land testing requirements could vary depending on their stringency
    - Insights into the content of the material: clay %, organic matter, and foreign materials
  - Evaluating quality according to the baseline values:
    - An Environmental Impact Assessment could be needed to examine the project's impact on water quality, ecosystems and socio-economic aspects, in terms of heavy or lightly contaminated materials
    - In the EU, specific laws exist that protect the environment; this is the Flora and Fauna law. These types of laws may require modifications to the dredging activities (e.g., scheduling and methods) to avoid harming the environment.
  - Evaluating impact according to other factors:
    - Socio-economic criteria assessed with regards to dredging activities are social Cost-Benefit Analysis and stakeholder acceptance and are assessed in the Netherlands using the MER approach
  - Environmental monitoring before, during and after execution:
    - Environmental monitoring plays a central role during dredging projects. Continuous data collection is conducted to track compliance with water quality thresholds, particularly those related to turbidity. Other parameters may include dissolved oxygen levels, chemical contaminants, underwater noise and vibration, etc.
    - Monitoring programs are generally structured in three phases:
      - Pre-construction (baseline) monitoring, to assess initial environmental conditions, such as water clarity, sediment quality, and benthic ecology.
      - Compliance monitoring during operations, to ensure ongoing activities remain within regulatory bounds, such as acceptable sediment plume dispersion or contaminant concentrations.
      - Post-construction monitoring, to evaluate ecological recovery and determine if environmental quality returns to acceptable levels

3.1 Pre-Assessment of the need for dredging

Despite the guidelines for dredging regulations and beneficial use, strict measures are also taken before allowing dredging to take place in the Netherlands. The Dutch assessment of water soils is written as a guideline for determining the need for dredging for water quality standards. This guideline describes the threat of contamination of surface water as a result of poor waterbed quality and the exposure pathways. In the Netherlands, the decision to initiate dredging activities is not only based on ecological criteria but also strongly influenced by transportation requirements. Navigable waterways are vital for logistics and commerce, and sediment accumulation may hinder safe and efficient navigation. Therefore, transportation needs, particularly for shipping channels, can significantly impact whether a waterbody is prioritized for dredging.

For example, suppose a sedimented section of a river reduces its depth below the minimum draft required for cargo vessels. In that case, the functional use of that water body for transportation is compromised. In such cases, preliminary assessments must weigh both ecological risks (e.g., contaminant release during dredging) and economic imperatives (e.g., maintaining shipping routes). These considerations may trigger the need for further investigation using the guideline's assessment framework.

In the Netherlands, water quality targets have been formulated for all surface water bodies. Poor waterbed quality can be a contributing factor to surface water body quality. With the guidelines for assessing waterbeds (Hin et al., 2010), one can determine whether, and to what extent, substances in the waterbed form an obstacle in achieving the quality objectives for a water body. The guideline is not intended as a testing framework for granting permits for interventions. The guideline can be used to estimate the influence of the waterbed on the failure of achieving the objectives for each quality objective (including environmental values) and each application function.

The guideline waterbed quality also includes a calculation assistant (SEDImentASsistent (SEDIAS)). Most of the calculations prescribed in the guideline can be performed with SEDIAS. An example of this is calculating the effect of resuspension of the waterbed by shipping on the water quality and calculating msPAF values for macrofauna. A separate calculation assistant has been developed for bank areas: SEDIAS bank areas. SEDIAS bank areas are based on the web application 'Sanscrit' for the land soil.

3.2 Classification of dredged materials according to the Soil Quality Decree

The Soil Quality Decree regulates the threshold and analytical methods for determining sediment quality. The decree proposes a detailed step by step approach:

- Determining state and purpose of the material (Section 3.2.1)
- Sampling and preparation scheme for dredged materials and soil (Section 3.2.4)
- Preliminary investigation (Section 3.2.3)
- Outsourcing chemical testing and reporting according to NEN (Section 3.2.2)
- Evaluating quality according to the baseline values (Section 3.2.5)

Each of the steps is described below in more detail.

3.2.1 Determining state of the material / purpose

The Soil Quality Decree divides the required analytical methods according to the purpose/type of application. The first essential check is whether the dredged materials can be regarded as building material. If the material is classified as building material, sampling, preparation, and analytical methods differ from the standard described in this document. Based on a predetermined sampling strategy, ASTM-norm D 3682-13 describes testing for aluminum, calcium and, silicium. For use as a building material, it should exceed 10% of these components in total.

Also, the Soil Quality Decree describes whether dredged materials are classified as dredged materials or as soil. This is described in NEN-5104.

3.2.2 Sampling and preparation scheme for dredged materials and soil

Proving the environmental quality of soil and dredged materials can be done in several ways. Firstly, if an already proven or a supplier declaration is available, this is sufficient. Furthermore, if a soil investigation has already been performed or a map is available stating the necessary parameters, it is sufficient. In most cases, however, batch testing is required. Testing should be conducted on the dredged materials as well as the receiving soil.

Samples shall be taken from the batch of soil or dredging spoil to be examined in accordance with the applicable procedures described in SIKB Protocol 1001. This means under normal circumstances, 100 grabs, divided over 2 mixed samples of 50 grabs.

3.2.3 Preliminary investigation

Prior to a batch inspection, a preliminary investigation is mandatory. This must comply with NEN 5725 for soil and NEN 5717 for dredged material[8]. This is necessary to determine the (possible) presence of contaminants or other parameters, check the origin of the material, investigate possible stratification in the batch, and determine the expected environmental quality of the batch to be inspected. A good preliminary investigation is essential to ensure that detailed inspections are carried out correctly.

3.2.4 Outsourcing chemical testing and reporting according to NEN

Chemical testing and analytical methods required for dredged materials and soil are bundled into an environmental declaration. NEN 5720 describes the requirements for a soil investigation. If the preliminary soil investigation can prove that there is no suspicion of chemical contamination present, no soil investigation is needed.

The origin and the purpose of the dredged materials determine which analytical package has to be chosen. Marine dredged materials require package C3, which does not include barium (Ba), cobalt (Co), and molybdenum (Mo), as well as several pesticides (since they are not present in the sea). However, if marine dredged materials are applied on land, package C1 is required, which includes all components but tributyltin (Appendix D)

[8] NEN stands for" Nederlands Normalisatie-Instituut" (Dutch Standards Institutes)

These decisions are made based on the following assumptions:

- Tributyltin is dangerous for marine animals due to its high bioavailability in salt water, in contrast to fresh water.
- Barium precipitates in seawater and therefore poses little threat compared to freshwater.
- Cobalt interacts with carbonates and organic matter in a high salinity environment and is therefore less toxic.
- Molybdenum is highly soluble in seawater and remains dissolved in contrast to freshwater.

For applications of any type of dredged material on land, the required package is reduced even further because many of the chemicals listed only become toxic when in contact with water.

Besides testing the chemical parameters listed, the environmental declaration report should also contain text on clay percentage, organic matter, and foreign materials. If the purpose is to apply dredged material (low leaching) on a large scale, a leaching test should also be performed.

In recent years, PFAS (per- and polyfluoroalkyl substances) have received increased regulatory attention due to their persistence, bioaccumulation, and potential toxic effects. In the Netherlands, PFAS analysis is now mandatory for most soil and dredged material applications, especially when used on land. The Dutch government has issued specific temporary threshold values for PFOS, PFOA, PFHxS, and other PFAS substances. These values depend on whether the material is to be used, applied as a building material, or deposited. For any use, PFAS levels must be reported and compared against the application-specific threshold values. Testing must be performed using validated analytical methods, such as LC-MS/MS, with detection limits of around 0.1 µg/kg dry matter or lower, in line with the RIVM guideline and Wvl-rapport 2019-0126.

The analytical methods associated with the chemical parameters stated above are described in the AP04 / SIKB 3000 guidelines of the Netherlands for assessing soil and material quality. This is in line with EN ISO/IEC 17025 international guidelines and is, in all cases, prevailing. Importantly, the required detection limit is described in appendix B of the Soil Quality Regulation 2022 (Regeling bodemkwaliteit 2022).

3.2.5 Evaluating quality according to the baseline values

The measured chemical characteristics are stated in a standard format for environmental declaration. Two steps need to be taken in order to normalize the measured values.

Step 1 Is correcting values that are measured as smaller than the detection limit. Important here is that the wrong detection limits are used if the detection limits are higher than the first threshold value. If this is the case, the value should be multiplied by 0.7.

Step 2 Is correcting the values for standard soil with 10% organic matter and 25% clay. In the case of spreading in salt water, this is not applicable, as standard soil conditions do not apply.

The conversion or standardization of measured concentrations with the soil type correction to standard soil takes place for each individual measured concentration, before other calculations are performed, such as determining the average concentration of two or more measurements in the same soil or batch. The measured percentages of organic matter and clay are used for the conversion. The percentage of organic matter is determined in accordance with NEN 5754, and the percentage of clay is equal to the weight percentage of mineral components with a diameter of less than 2 µm, related to the dry weight. The conversion of measured concentrations of substances to concentrations of substances in a standard soil is done using the following formula for all categories of beneficial use of sediment. Additionally, for maritime dredging activities, an environmental declaration of soil quality is required (Chapter 2.1) to prove the validity of any of these applications.

This formula uses a minimum value of organic matter and clay for several of the components. Correction of the quality values according to the above is regarded as complex. Therefore, analytical methods are bundled in the Netherlands in automation software called botova or other in-house tools.

$$G_s = G_m * \left((A + B * 25 + C * 10)/(A + B * \%clay + C * \%OM)\right)$$

G_s = Standardized concentration of a substance

G_m	=	Measured concentration of a substance
A	=	Substance-specific based constant
B	=	Substance-specific based constant for clay
C	=	Substance-specific based constant for organic matter

The values for the substance-based coefficients A,B and C are included in appendix A.

Generally, if the soil falls under the ‘blue’ categories in Figure 2-1, the application is permitted in terms of soil quality. Here, one should also consider the soil quality of the receiving land or waterbed. The application is not permitted if the receiving soil is category “blue” and the dredged material is category “orange” or “red”.

If the material is classified as “red” and therefore exceeds intervention values, the material is regarded as waste. To use this, one can prove its validity by performing a sediment leaching test (additional testing). Waste materials are not part of the Soil Quality Decree.

3.3 Dutch Environmental Impact Assessment (MER)

The MER is the Dutch equivalent of the environmental impact assessment procedures commonly used internationally. Conducting a full MER-assessment is commonly not required. Instead, the Dutch legislative enforcement will determine which aspects of the MER are relevant for the considered activity and location.

The MER process in the Netherlands is a critical tool for evaluating both environmental and socioeconomic impacts of dredging proposals. It systematically examines how the project might affect water quality, ecosystems, and surrounding communities, and it requires a comparison of alternatives (including a “no action” scenario) with their respective impacts. Dutch law (aligned with EU EIA Directives) mandates that dredging projects which could significantly affect the environment, such as large port expansions, navigation channel deepening, or disposal of dredged spoil, prepare an MER report. The MER report should be submitted for independent review by the Netherlands Commission for Environmental Assessment (Commissie m.e.r.). Within the MER report, all environmental effects, both adverse impacts and potential benefits, should be evaluated. This includes:

- water turbidity increases,
- sediment dispersion,
- habitat loss or creation,
- noise from dredging,
- any effect on fisheries or recreation,
- public health and safety (e.g., flood security improvements from dredging rivers)

The MER often involves modeling studies (for sediment plumes, contaminant release, etc.), field surveys (e.g., baseline ecology), and stakeholder consultations.

Plan
Plan (the proposed project or activity)

Initiatiefnemer
Initiator (the project proponent or developer)

Is een milieueffectrapport nodig?
Is an Environmental Impact Assessment (EIA) required?

Bevoegd gezag
Competent authority (the government body responsible for decision-making)

Publicatie van het plan in de krant
Publication of the plan in the newspaper

Opstellen notitie over gewenste inhoud milieueffectrapport
Drafting a note on the desired content of the Environmental Impact Report

Commissie kan adviseren over gewenste inhoud milieueffectrapport
The commission can advise on the desired content of the Environmental Impact Report

Iedereen kan zienswijzen indienen
Everyone can submit views/comments (public consultation)

Notitie over gewenste inhoud milieueffectrapport definitief maken
Finalizing the note on the desired content of the Environmental Impact Report

Milieueffectrapport opstellen
Preparing the Environmental Impact Report

Milieueffectrapport ter inzage
Environmental Impact Report available for public inspection

Commissie toetst milieueffectrapport
The commission reviews the Environmental Impact Report

Bevoegd gezag besluit over plan en maakt dit bekend
The competent authority decides on the plan and announces the decision

Start uitvoering
Start of implementation

Monitoring en evaluatie van effecten
Monitoring and evaluation of effects

Commissie kan adviseren over monitorings- en evaluatierapport
The commission can advise on the monitoring and evaluation report

Figure 3-1 The Netherlands Commission for Environmental Assessment (Commissie m.e.r.) procedure. Translation of terms in the light blue box

3.4 Flora and Fauna Law

Projects must also consider impacts on aquatic fauna and flora, both to comply with the WFD's (EC, 2018) ecological status goals and the Nature Conservation Act within the latest environmental laws (Rijksoverheid, 1979; Rijksoverheid, 2016) which implements EU Natura 2000 directives. In sensitive or protected areas, dredging schedules and methods are adjusted to minimize disturbance. For example, RWS's species protection code of practice specifies that the preferred dredging period is in the fall (Sept–Oct) to avoid breeding seasons, with the exact operation date set by an ecologist. It also requires leaving at least 25% of underwater vegetation and the bottom undisturbed during maintenance dredging, so that the habitat is partly preserved. Such measures protect fish spawning grounds, water birds, and aquatic plants. Furthermore, if dredging occurs near Natura 2000 sites or involves protected species, a nature permit is needed and will include conditions like buffer zones around animal burrows or seasonal work stoppages. Additionally, a protected species indicator (BeSI) check is required to be performed during the submission of the environmental permit.

Once an environmental permit is received for the delving of surface minerals, such as sand, in marine and riverine areas, there is typically a maximum amount or area of material specified. The party that gathers the material is the owner of the material once it is removed from the water body.

The benefit-sharing model for the initial owners of the sediment (mostly governmental parties) depends on the situation and type of application for the material under consideration. This could be any of the following:

1) Improvement of the natural situation by the removal of material, e.g., when deepening channels for economic purposes.
2) Direct usage of material in relevant applications for governmental parties, such as reuse as sand supplements and
3) Cost savings on dredging costs when avoiding costs that should be paid by the owner of the channel for disposal of dredging materials
4) In case of full authorization of the economic removal of raw resources, it is common to ask a monthly fee for using the site or a fixed fee for the permit.

First of all, permits for gathering material will be granted only under strict conditions, including that the material be clean, continuously monitored, gathered using proper techniques, and not sold commercially. All these prerequisites must be continuously reported to the governmental body granting the permit. Moreover, the commercial party must comply with the dredging material guidelines in place, which means any contaminated material cannot be used for purposes such as direct sale or spreading across the sea.

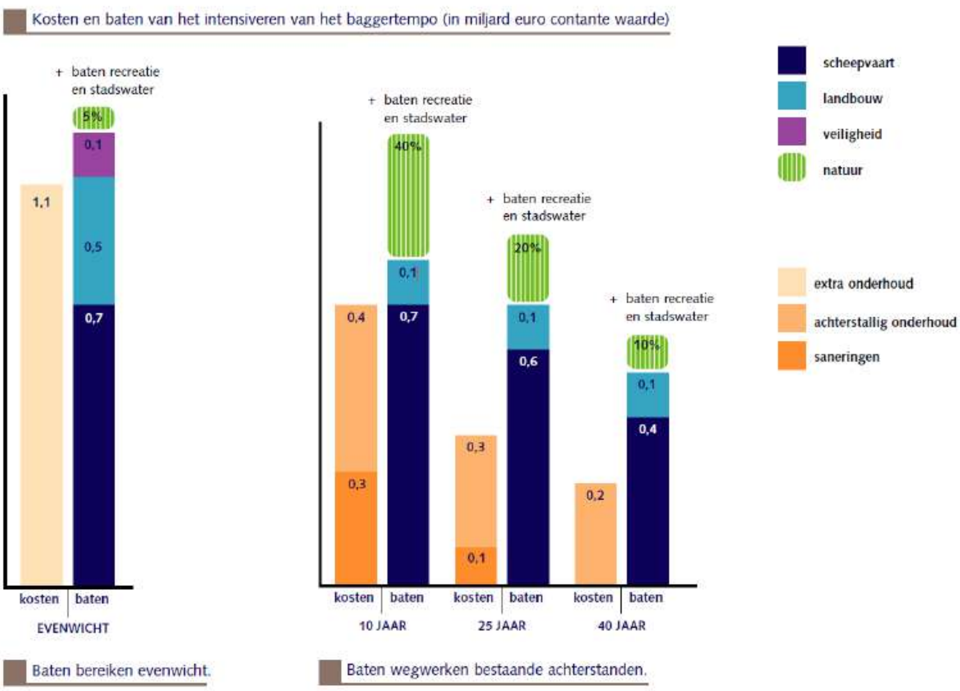
3.5 Socio-Economic Criteria

When assessing the environmental impacts of dredging, Dutch authorities require that the proposals demonstrate societal justification, balancing economic development with environmental protection. This involves using:

- Socioeconomic criteria, such as cost-effectiveness of mitigation. Dutch policy requires compensatory measures, which are essentially investments to ensure no net loss of ecological or environmental value
- Cost-benefit analyses, including environmental costs (in Dutch: MilieuKostenIndicator - MKI)
- Stakeholder acceptance
- Distribution of impacts

A hallmark of Dutch project evaluation is the Social Cost-Benefit Analysis (MKBA - “Maatschappelijke Kosten-Baten Analyse”). For large dredging and maritime infrastructure projects, an MKBA is usually performed to quantify in monetary terms the expected benefits (e.g., improved shipping access, reduced flood risk, economic development) versus the costs (both direct costs and environmental/social costs). Environmental organizations and government agencies use these analyses to inform decisions by illustrating trade-offs in common units.

Often this is also demonstrated through a multi-criteria analysis where environmental impacts are given a monetary proxy or score alongside economic criteria, as displayed below.



Kosten	Costs
Extra onderhoud	Extra maintenance
Achterstallig onderhoud	Deferred maintenance
Saneringen	Remediation
Baten	Benefits
Baten recreatie en stadswater	Benefits for recreation and urban water
Baten bereiken evenwicht	Benefits from achieving equilibrium
Baten wegwerken bestaande achterstanden	Benefits from eliminating existing backlogs
Scheepvaart	Shipping/navigation
Landbouw	Agriculture
Veiligheid	Safety
Natuur	Nature/environment
Evenwicht	Equilibrium

Figure 3-2 Social Cost-Benefit Analysis of the intensification of the dredging speed. Translation of terms in the light blue box.

Additionally, Dutch policy emphasizes “preventive investment”: investing early in environmental protection to save larger costs later.

A dredging activity that, for example, prevents larger future costs (like environmental restoration or flood damage) can be viewed favorably as a prudent investment. Conversely, if the environmental risk is high and the economic benefit low, the project may be deemed unsustainable.

By embedding these criteria, the Netherlands aligns dredging governance with the broader goals of sustainable development: ensuring that economic gains from maritime infrastructure do not come at the expense of ecosystem services and social well-being. This comprehensive approach, combining rigorous environmental standards with socioeconomic evaluation, helps Dutch regulators and environmental organizations make balanced decisions about if, where, and how dredging activities should proceed.

3.6 Monitoring and Control of Operations

Marine dredging in Dutch waters is commonly carried out using large trailing suction hopper dredgers operated by major international contractors, including firms such as Boskalis, Van Oord, and DEME. The Netherlands took part in the multiple international environmental agreements, such as the OSPAR Convention, a convention whose aim is to protect marine ecosystems in the North-East Atlantic region. As a result, dredging operations must align with both international obligations and national environmental regulations. The Dutch Marine Strategy under the Marine Strategy Framework Directive (MSFD) now includes descriptors like seafloor integrity and food web condition that dredging must consider as part of achieving “Good Environmental Status”.

Figure 3-3: Typical methods for spreading marine sediments on sea and coastal areas. Source: Dutch Department of Waterways and Public Works

Contractors undertaking dredging works are required to follow the conditions set out in their environmental permits. These include provisions related to the proper management of dredged sediments, the scheduling of activities to avoid ecologically sensitive periods, and the implementation of ongoing monitoring. All responsibilities and environmental safeguards are clearly specified in the permit documents, including adherence to the "duty of care" principle, which ensures responsible environmental stewardship throughout the project.

Environmental monitoring plays a central role during dredging projects. Continuous data collection is conducted to track compliance with water quality thresholds, particularly those related to turbidity. Limits for suspended sediments, often expressed as maximum allowable increases in NTU or mg/L units, relative to background levels, are typically specified at particular distances from the activity or at ecologically important areas. If thresholds are breached, contractors are required to modify or suspend operations to prevent further impact.

Monitoring programs are generally structured in three phases:

- Pre-construction (baseline) monitoring, to assess initial environmental conditions, such as water clarity, sediment quality, and benthic ecology.
- Compliance monitoring during operations, to ensure ongoing activities remain within regulatory bounds, such as acceptable sediment plume dispersion or contaminant concentrations.
- Post-construction monitoring, is used to evaluate ecological recovery and determine if environmental quality returns to acceptable levels.

In addition to turbidity, other monitored parameters may include dissolved oxygen levels, chemical contaminants (particularly when dealing with polluted sediments), and sometimes underwater noise or vibration, especially when marine species such as mammals or sensitive fish populations are present.

While multiple indicators are tracked, turbidity is often the primary focus due to its direct connection to dredging and its measurable influence on light penetration and aquatic health. Modern dredging projects frequently incorporate adaptive monitoring systems, where data is assessed in near real-time. This allows immediate operational adjustments, such as reducing dredging intensity or deploying control measures like silt curtains when elevated turbidity is detected.

All field measurements and laboratory analyses must comply with established quality assurance protocols. Water quality is typically checked with in situ sensors (turbidity meters, OBS, optical backscatter sensors, and sometimes ADCPs[9] for sediment flux). The collected data is submitted to relevant authorities, such as RWS, or regional water boards, or review. This comprehensive monitoring and regulatory oversight framework ensure that dredging activities

[9] ADCP = Acoustic Doppler Current Profiler

are conducted within environmentally acceptable limits and that marine ecosystems are effectively protected. For more information about global monitoring methodology, equipment, and applicability in Colombia, please find more details in Appendix K.

The Netherlands was among the first to adopt the “Adaptive Monitoring” approach for dredging – where initial tight monitoring can be relaxed if impacts are consistently below thresholds, or conversely, operations are modified if unexpected effects occur. This risk-based, adaptive management style has been incorporated into guidance and permit conditions gradually since the early 2010s, reflecting a more dynamic use of technical criteria rather than fixed rules alone.

Also, in the Netherlands, the Responsible Care Act is in place. The responsible care act involves that:

- The current legislation involves detailed descriptions of constraints according to the dredging locations
- Disposal is not allowed at locations with another purpose (collection of sand, cables, and pipes, ship freighting)
- Disposal is not allowed in the above areas with shellfish.
- Disposal is not allowed within 1500 meters from quiet or breeding areas for seals, 1000m from living shellfish banks and 500m from other functional uses.
- Sailing through areas dedicated to wind parks, oil/gas platforms, anchor areas, and military areas is not allowed
- Disposal within 100m of shipwrecks is not allowed

4 Methodology to determine the background and threshold values of chemical quality of marine dredged sediments

Chapter 4 – Executive summary

This chapter describes the steps the Netherlands has undertaken to determine its threshold values for sediment quality. These threshold values mainly rely on natural background values. Threshold values are used to evaluate the specific sediment quality class depending on the purpose of the sediment. Section 4.1 will give a general overview of the vision on threshold values according to the Dutch ministry. Section 4.2 give a technical overview on the analytical methods for determining the threshold values. Each of the subsections will zoom in on the detailed analytical methods for deriving these values.

The key takeaways

- Threshold values are used to evaluate the specific sediment quality class depending on the purpose of the sediment, e.g., application on land and sea and can as such also vary depending on their purpose.
- Lower threshold values in the Netherlands mainly rely on natural background values (healthy environment). The principle is that any substance/material added should not result in further harming/polluting the environment it is applied to.
- Upper threshold values in the Netherlands are mostly determined by modeling using dose-response relationships

4.1 Analytical framework applied in the Netherlands to determine sediment quality guidelines

Threshold values for applying dredged materials in The Netherlands are based on a general assessment standard. This means the starting point is a healthy environment. Anything that is added to the environment ('the beneficial application') cannot further pollute the environment. Much research is done in The Netherlands and the EU on what is perceived as a healthy environment or "baseline". The Dutch environmental ministry gives the justification for the threshold values in each category of beneficial use as shown in Table 4-1.

Table 4-1: Justification for threshold values in each category of beneficial use (source: informatiepunt leefomgeving)

Standard	Location	Designation in old laws and regulations	Related environmentally harmful activities or other regulations	Justification
Quality requirement Agriculture or nature	Appendix B, Table 1, Soil Quality Regulation 2022	Background values (AW2000) (Soil Quality Regulation 2022)	- Dredged material with concentrations above intervention value - Dredged material with concentrations equal to or below intervention value - Applying soil or dredged material to land - Application of mine stone or mixed mine stone - Soil remediation - Large-scale soil application (industry quality requirement) - Storing soil - Included as a standard in the dowry for allowing construction on a soil-sensitive location	Existing quality in 'clean' areas. The soil is and remains suitable for every soil function.
Quality requirement for housing	Appendix B, Table 1, Soil Quality Regulation 2022	Maximum value Residential (Soil Quality Regulation 2022)	The same activities as for quality requirements for agriculture or nature	Ensuring the sustainable suitable condition of the soil for residential purposes, based on risks to people and the environment.
Quality Requirement Industry	Appendix B, Table 1, Soil Quality Regulation 2022	Maximum value Industry (Soil Quality Regulation 2022)	The same activities as for quality requirements for agriculture or nature	Ensuring sustainable suitable soil condition for industrial function, based on risks to people and the environment
Intervention value soil quality or quality requirement moderately polluted	Annex IIA of the Bal and Annex B, Table 1, Soil Quality Regulation 2022	Intervention value of land soil (Circular soil remediation) (, 1 July 2013)	The same activities as for quality requirements for agriculture or nature	Presence of possible unacceptable risks to humans or the environment with a standard soil use or ecological value
MTR human and TCL or odor thresholds	Annex VB and Annex XIIIB, Bk1	MTR human and TCL/odor thresholds (Appendix 2, (Circular on soil remediation), 1 July 2013)	**- Condition for determining value for allowing construction on soil-sensitive location- Chance find**	Presence of possible unacceptable risks to humans based on lifelong exposure
Quality requirement for low-emission soil (emission test value and maximum emission value)	Appendix B, Table 3a, Soil Quality Regulation 2022	Emission test values and maximum emission values (Soil Quality Regulation 2022)	Large-scale soil application	Protecting soil, groundwater and surface water quality
Testing framework for applying suitable soil in deep pools	Appendix B, Table 3d, Soil Quality Regulation 2022	Assessment framework from Circular redevelopment of deep pools and associated Guidelines for deep pools	**Apply soil in a deep puddle** or in a covering layer of a deep puddle	Protection of surface water quality, soil quality, groundwater quality and other environmental impacts
Quality requirement not contaminated (water bottom) / Generally applicable (dredging spoil)	Appendix B, Table 2, Soil Quality Regulation 2022	Background value (AW 2000) (Soil Quality Regulation 2022)	**- Storing dredged material- Applying soil or dredged material in surface water**	Existing quality in 'clean' areas

Standard	Location	Designation in old laws and regulations	Related environmentally harmful activities or other regulations	Justification
Quality requirement slightly contaminated	Appendix B, Table 2, Soil Quality Regulation 2022	Maximum value class A (Soil Quality Regulation 2022)	- **Storing dredged material- Applying soil or dredged material in surface water**	Re-pollution level of the Rhine branches and ecosystem protection
Quality requirement moderately polluted or Intervention value waterbed	Appendix B, Table 2, Soil Quality Regulation 2022	Maximum value class B / Intervention value waterbed (Soil Quality Regulation 2022)	- **Storing dredged material- Applying soil or dredged material in surface water**	Presence of possible significant risks to humans, plants or animals
Quality requirement for spreading dredged material on land	Appendix B, Table 3b, Soil Quality Regulation 2022	Maximum value for spreading dredged material over adjacent plot (Soil Quality Regulation 2022)	**Spreading dredged material on land**	Protecting ecosystem and human health and aligning quality with agricultural use
Quality requirement for spreading dredged material in fresh surface water	Appendix B, Table 3c, Soil Quality Regulation 2022	Maximum values for spreading dredged material in a fresh surface water body (Soil Quality Regulation 2022)	**Spreading dredged material in fresh surface water**	Re-pollution level of the Rhine branches and ecosystem protection
Quality requirement for spreading dredged material in salt surface water	Appendix B, Table 3c, Soil Quality Regulation 2022	Maximum values for spreading dredged material in a saline surface water body (Soil Quality Regulation 2022)	**Spreading dredged material in salt surface water**	Significant risks to aquatic organisms
Assessment framework for applying suitable dredged material in deep pools	Appendix B, Table 3e, Soil Quality Regulation 2022	Assessment framework from Circular redevelopment of deep pools and associated Guidelines for deep pools	**Applying dredged material in a deep pool** or in a cover layer of a deep pool	Protection of surface water quality, soil quality, groundwater quality and other environmental impacts
Quality requirement for low-emission dredged material (emission test value and maximum emission value)	Appendix B, Table 3a, Soil Quality Regulation 2022	Emission test values and maximum emission values (Soil Quality Regulation 2022)	Large-scale soil application	Protecting soil, groundwater and surface water quality

In the following paragraphs, the threshold value categories and the assumptions that are made per environment are stated.

4.2 Determination of threshold values

As explained in Chapter 2, the Dutch norms for soil and dredging are purpose-driven. These norms are all based on different sources and different analytical methods. Table 4-2 includes an overview of the sources that make up the Dutch norms for soil and dredged materials along with the analytical method that is used to derive it.

Table 4-2: Overview of the sources that make up the Dutch norms for soil and dredged materials along with the analytical method that is used to derive it

Norm	Last revision	First content source	Analytical method	Section in the report
Applying to Soil				
Intervention value soil	2013	Lijzen et al, 2001	Empirical	4.2.1
Background value soil	2013	Lame and Nieuwenhuis, 2007	Empirical	4.2.1
Soil living and industry	2013	Dirven et al, 2007	Theoretical	4.2.1
Applying in Water				

Intervention value waterbed (class B)	2013	Van de berg and Roels, 1991 with adjustments	Theoretical, Equilibrium Partitioning (EP) (CSOIL)	4.2.2
Class A waterbed	2013	CSO, 2005, Lamé et al., 2007	Empirical: SLC/SBA	4.2.3
Spreading in sea	2013	ERM/PEL	Empirical: ERM/PEL	4.2.4

The derivation of the norms for sediment quality (Table 4-2) uses the EU Technical Guidance for deriving Environmental Quality Standards (EC, 2018) as the main guideline. Additionally, it is based on the following general choices:

1) The European standard norm for water is the first norm. After this, also bioavailability and background concentration are assessed.
2) The norms for sediment are ideally based on sediment tests, but if only water tests are available an equilibrium partition approach is used.
3) Societal choices are used for choosing the best determination method:
   a) Lab tests instead of field tests
   b) Use chronic exposure NOEC (no observed effect concentration) as endpoint instead of EC50 (effect for 50% of the population), that is more used for acute dosage.
   c) One norm is used which has to be the strictest one
   d) Preference for ecotoxicological testing instead of aquatic assays.
   e) No use of combination toxicities
   f) Safety factors are used when data is absent or scarce.

The analytical methods described in Table 4-2 are explained in more detail in Sections 4.2.1 to 4.2.4. All other norms that are not included in Table 4-2 are covered in Section 4.2.5.

4.2.1 Applying on land

Applying sediment on land is regulated by the Soil Quality Regulation 2022. It takes into account the various purposes of land and the contamination values that are sufficient for this soil function.

The threshold values for these classes are estimated based on the average degree of chemical contamination of these soil classes in the Netherlands (background value/AW). This is adjusted according to estimated toxicity compared to the soil's function:

Risk scenarios have been worked out for 7 different soil functions (including subfunctions) on the basis of:

- amount of human contact with the soil: considerable or little contact;
- amount of crop consumption: none, limited, average, considerable;
- protection of agricultural production: exists or does not exist;
- protection of ecosystems (generic): little, average, high;
- protection of ecosystems taking into account biomagnification: little, average, high.

The 7 functions of the soil have ultimately been clustered into three soil function classes. A generic standard has been worked out for each soil function class for sustainable suitability based on the most susceptible scenario in the soil function class. The classification of soil functions into soil function classes is shown in Table 4-3. The name of the generic standard for sustainable suitability is also shown. The most susceptible function was determining for establishing the threshold values in the guidelines (background value, housing and industry as described in chapter 5)

Table 4-3: Classification into soil function classes and name of soil standard according to Lijzen et al. (2001)[19]

Soil Standard	Soil Functions
Soil standard derived for sustainable suitability	Soil functions that form a single soil function class
Background Values	Agriculture, Nature conservation and Vegetable gardens/allotments
Maximum Housing Value	Residential with garden, Places where children play and Green areas with ecological values
Maximum Industrial Value	Other green area, development, infrastructure and industry

The intervention values in the Soil Quality Regulation 2022 are directly in line with the guidelines for soil and groundwater remediation (Ministry of Housing, Spatial Planning and the Environment & Ministry of Transport, Public Works and Water Management, 2009) (intervention value or maximum industrial value). These in fact are derived using serious risk assessment on humans and life forms. This is based on both species and human toxicological tests (dose-response relationships), both for aquatic sediments (left) as well as soil and groundwater (right).

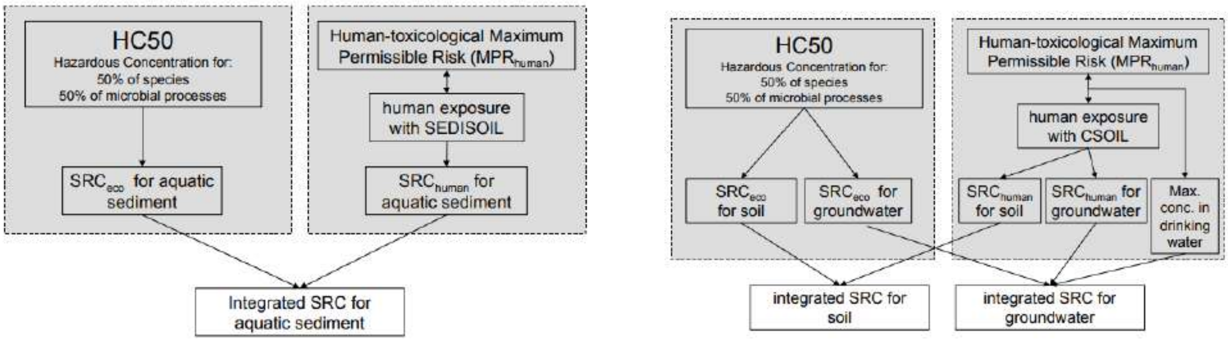


Figure 4-1: Overview of the procedure for determining intervention values (sediment remediation criteria (SRC)) for aquatic sediment, soil and groundwater in The Netherlands (Lijzen et al., 2001)

Background values are derived using the AW-2000 (background value of Dutch soils). The AW-2000 project group has chosen to determine background values based on a 95th percentile of a sample consisting of 100 top-soil samples from agriculture (80% of the locations) and nature reserves (20% of the locations). Background values of all different types of contaminations are determined using these measured concentrations in combination with existing data.

Recently new backgrounds values were derived and proposed to the Ministry, which hasn't been implemented yet. These backgrounds values were derived using two national datasets:

- AW-2000 database
- Geochemical Atlas of The Netherlands.

All samples that formed the basis of the AW-2000 values were re-analyzed in 2018 with a different solvent (Aqua nitrosa). In addition, the national database of the Geochemical Atlas was used. The samples were sampled throughout The Netherlands at unsuspected locations. The 95th percentile (P-95) was used to determine the final values per element. This is a common value that is used to maintain a high level of protection while recognizing extreme values.

4.2.2 Applying in fresh surface water – Class B

In general, for metals, metalloids and other trace elements aerobic transfer functions have been developed to assess their impact on surface water protection. These functions are based on the maximum allowable dissolved concentrations in surface water, following the European Water Framework Directive (WFD) standards. The Dutch rules ensure that applying soil or dredged sediments will not compromise water quality goals set by the Water Framework Directive. They describe chemical behavior in oxygen-rich environments, ensuring that oxygen does not act as a limiting factor. The transfer functions rely on chemical partitioning relationships (Equilibrium partitioning), which describe how substances distribute between solid and dissolved (mobile) phases. This approach provides a reliable estimate of how metals will be released from soil or dredged material once applied.

The Intervention values or maximum values class B are based on human and ecological risks. The lower value of the two is considered an Intervention value for both soil and sediment (Figure 4-2).

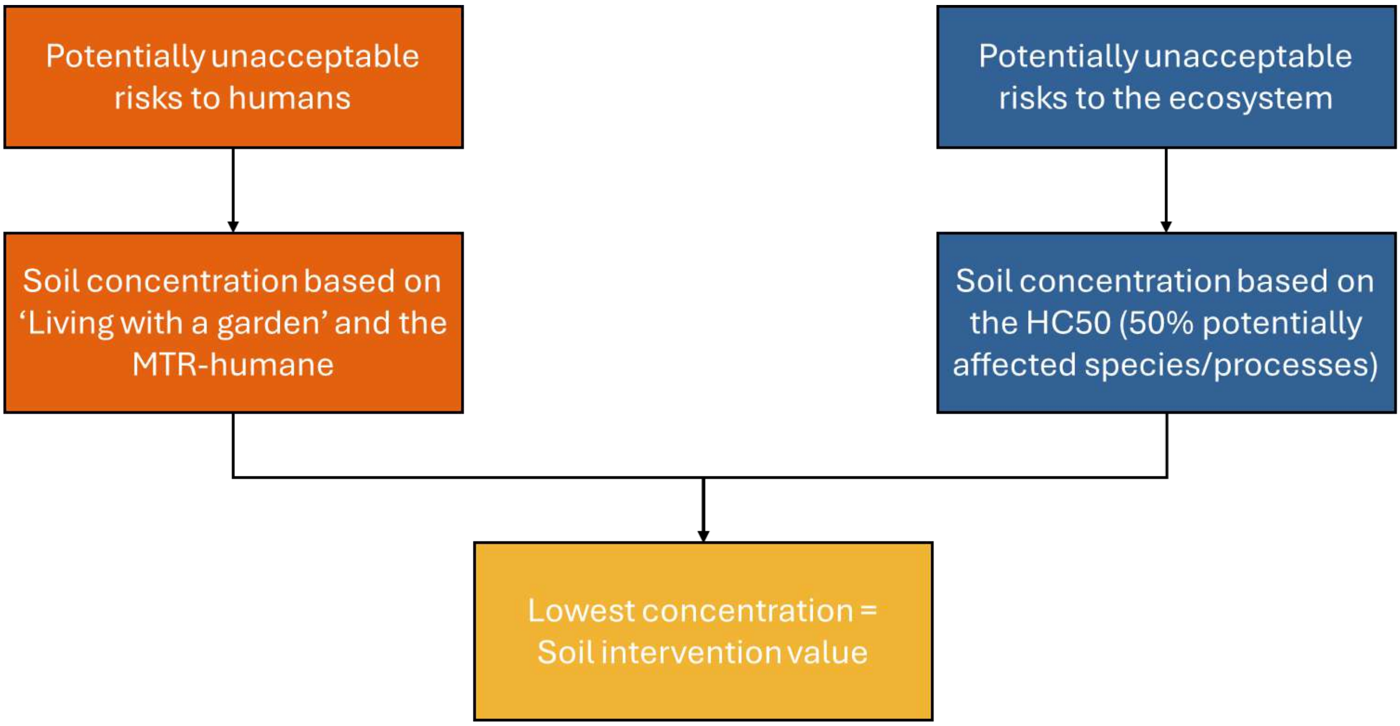


Figure 4-2 Schematic overview of the procedure for deriving risk thresholds for humans and for the ecosystem. The lowest value is the proposal for intervention values soil quality

The intervention values for water sediments from AW-2000 have been maintained as an environmental basis (Lijzen et al., 2001). The substantiation of this can be found in several publications (Van den Berg, 1994; Kreule, 1995; Kreule & Swartjes 1997), respectively. These researchers use the CSOIL model. The CSOIL exposure model calculates the extent to which people are exposed to substances in the soil throughout their lives. By testing against a health-based limit value (the MTRhuman[10]) it can be assessed to what extent the exposure can lead to unacceptable risks. The CSOIL model can also be used to determine the ultimate risk limit value in the soil for humans. This is possible for various soil functions and uses.

Compared to the original AW-2000 guidelines, small changes have been made afterwards. For metals, the 5% quantile was determined on the basis of a database of class 3 & 4 (contaminated) water bottoms in the Rhine River

[10] MTRhuman = Maximum Tolerable Risk for humans

branches. The P95 was compared with the intervention values from AW-2000 and the higher of these two values has become the new intervention value.

4.2.3 Applying in fresh surface water – Class A

The generic maximum value class A is based on the level of contamination (HVN) of the Rhine River[11] and its branches [12]. This HVN is based on the Lobith measured contents in suspended solids converted to standard soil (25% clay and 10% organic matter). However, the HVN Rhine branches turned out to encounter practical problems for some substances. Adjustments have been made to the HVN for various reasons:

- Because the maximum value class A applies to both application and spreading in fresh water, a comparison has been made with the standards for spreading in salt water (Salt Dredging Test; ZBT - "Zoute Baggertoets"). Internationally, it was not acceptable for The Netherlands to be stricter for fresh waters than for spreading at sea. This would suggest dumping' at sea.
- Three additional substances have been standardized that are included in the substance package for land soil and regional waters: Ba, Co and Mo. These substances were not included in the HVN database. The maximum value class A is the P95 of a database (in which only a few water boards were included) for regional waters. There are three other substances in the table of the Soil Quality Regulation 2022, namely V, Sb and Sn, which were not in the HVN database. No maximum value class A has been set for this. For these substances, an exceedance of the Background Value automatically to the judgment class B.
- Six standards have been raised because the Background Value is higher than the P95 HVN: sum DDD/DDE/DDT, endrin, dieldrin, sum drins, Hexachlorocyclohexane (-HCH) and sum HCH. For these substances, the maximum value class A is equal to the Background value.

4.2.4 Spreading in surface water

In general, most test values of the surface water threshold values appear to correspond reasonably well with the ERM (Effect Range Median) used internationally, which indicates the level above which negative biological effects are considered likely (ER level) (Stronkhorst & Hattum, 2003). The risk level of the ZBT standards is not entirely clear: for metals, the MTR sediment is higher than the standard for spreading in saltwater, for Polychlorinated Biphenyls (PCBs) and Hexachlobenzene (HCB) the current level in sediment is lower.

Some substances deviate from the original threshold list. The standard of Polycyclic Aromatic Hydrocarbons - PAHs (som10) is based on North American research from the late 90s (8 mg/kg). The sum 7-PCB is based on an ERM of 90 ug/kg d.s. (the ZBT standard is 100) (Stronkhorst et al., 2003). Individual PAHs and PCBs have similar effects on organisms. Therefore, the assessment system has been simplified by using criteria for the parameters 'sum 10-PAH' and 'sum 7-PCB'.

The most recent is the tributyltin (TBT) standard. Based on laboratory experiments of Stronkhorst on the survival of marine benthic organisms (including amphipods and burdock) exposed to TBT-contaminated sediments, an average threshold of 90 ug Sn/kg d.s. was derived (the ZBT standard varies from 100-250).

For spreading in salt water no soil-type correction is being done because the mixing of sludge and contaminations is very different in sea bottoms. Equilibrium partitioning is not applicable here.

The chemical substances aldrin, endrin, dieldrin, lindane and heptachlor-epoxide are no longer tested because these organopesticides are no longer or hardly present in marine dredged material.

4.2.5 Threshold values for other applications

Spreading on land is a specific application that is the standard application for dredged materials coming from rivers/canals and streams. This is not applicable to marine sediments and therefore its analytical methods not described further.

[11] HVN stands for" Herverontreinigingsniveau" (recontamination level)
[12] https://open.rijkswaterstaat.nl/open-overheid/onderzoeksrapporten/@162282/hvn-saneringsdoelstelling-maas/

Deep ponds are another application that is common on land but can also be used as an application for marine sediments. When shallow filling is applied to deep ponds, the local hydrological conditions can change significantly. In an isolated deep pond, the water inside is in direct contact with groundwater if it intersects an aquifer. However, when the pond is filled to a shallower depth, the hydrological resistance typically increases significantly once the water column is no longer in direct contact with the aquifer. The soil or dredged material placed in the pond then forms a relatively impermeable layer within a more permeable environment.

As a result of this new geohydrological situation, the amount of water flowing through the applied soil or dredged material is much smaller than the amount of water moving past it in the aquifer. This leads to hydrological dilution of the pore water within the applied material.

For substances that naturally occur in groundwater, such as metals, the background concentrations in groundwater must be accounted for in the test concentration. This also results in a lower dilution factor compared to the hydrological dilution factor.

The test concentration (the maximum pore water concentration at which the protective goal is still achieved) is calculated using the following formula:

$$C1=w(C2-AW)+AWC1 = w\,(C2 - AW) + AWC1=w(C2-AW)+AW$$

where:

- C1 : test concentration (in pore water)
- C2 : concentration in equilibrium with the solid phase
- AW : background concentration in groundwater
- w : dilution factor

5 Threshold values of chemical substances in marine dredged sediments, for each application

Chapter 5 – Executive summary

This chapter focuses on the threshold values in The Netherlands for the qualification marine dredged sediments. According to the Soil Quality Regulation 2022, threshold values are dependent on the purpose of dredged materials. In this chapter the threshold values of The Netherlands are presented for spreading in fresh and salt surface waters (Section 5.3), applying on land (Section 5.1) and applying on water (Section 5.2). Additionally, The Netherlands has recently, as an exception, started evaluating PFAS/PFOA, an additional criterion for sediment quality assessment on top of the Soil Quality Regulation 2022 (Section 5.4). Other applications are summarized in Section 5.5.

The key takeaways

- Threshold values in the Netherlands are relatively mild due to the distinction into different categories (so one can be more specific), cold climate effects and detailed modeling
- Exceptions do exist, such as for PFAS, PFOA, and PFOS; these have resulted in problems in the Netherlands and as a countering measure the EU has banned all sources of PFAS; however, they are still present in sediments.

5.1 For applying on land

For applying on land 5 classes exist. Every measured concentration in the soil or sediment, first needs to be converted to 'standard soil', as explained in Chapter 3 before comparing the values to the threshold values in Appendix F.

An important exception to the table presented in Appendix F, is that sand or sediment from the sea cannot exceed chloride concentration above 200 mg/kg dry matter. Any other exceptions can be read in the table notes in the Soil Quality Regulation 2022.

5.2 For applying on water

For applying on water four (4) classes exist. Every measured concentration in the soil or sediment first needs to be converted to 'standard soil', as explained in chapter 3 before comparing the values to the threshold values presented Appendix G.

An important exception to the table presented in Appendix F, is that sand or sediment from the sea cannot exceed chloride concentration above 200 mg/kg dry matter. Any other exceptions can be read in the table notes in the Soil Quality Regulation 2022.

5.3 For spreading in surface waters (fresh & salt)

The threshold values for spreading sediments in fresh and salt surface water and bundled in one overview table presented in appendix E. These regulations include a lower threshold value and a higher threshold value, similar to other international regulations.

To check if dredged material is clean enough to be spread in fresh or saltwater, two conditions must be met:

1. All tested substances must meet the strictest quality limit (see Column 3 (higher threshold) in appendix E).
2. Most tested substances must meet a slightly less strict limit (see Column 2 (lower threshold) in appendix E), with some room for exceptions:
   a. If 2–6 substances were tested: max. 1 may exceed the limit.
   b. If 7–15 were tested: max. 2 may exceed.
   c. If 16–26: max. 3 may exceed.
   d. If 27–36: max. 4 may exceed.
   e. If 37 or more: max. 5 may exceed.

If a substance does exceed the limit, the excess must be less than double the allowed amount, and for all substances (except nickel), the level must also stay below the residential soil quality limit as stated in Appendix F.

Additionally, to decide whether the dredged material is clean enough to be spread in salt surface water, the following two conditions must be met:

1. All tested substances must meet the limit in Column 4 in Appendix E, using the measured concentrations.
   a. Exception: For up to two non-priority substances (as defined by the Water Framework Directive), the concentration may be up to 1.5 times the limit shown in Column 4.
   b. These non-priority substances are marked *in italics* in Column 4.
2. No tested substance may exceed the stricter limit of Appendix E.

5.4 Exceptions – PFAS/PFOA

PFAS (per- and polyfluoroalkyl substances), PFOA (perfluoro octanoic acid) and PFOS (Perfluorooctane sulfonate), are traditionally not included in the Soil Quality Regulation 2022. As a result of the release or large amount of PFAS and PFOA due to high emission sources, The Netherlands decided to introduce an emergency act for toxic levels of these substances in the Dutch soils (MIW, 2022).

The values determined here a solely used for stand-still purposes, since the problems are very problematic. This means that the contamination of these substances cannot exceed current levels measured nationally. Locally if cleaning is intended, other evaluation levels are used.

Since February 2023, all sources of PFAS in Europe are banned. Only irreplaceable sources or sources that are essential to society may be allowed.

5.5 Exceptions – Other applications

The threshold values for spreading on land, applying in deep lakes and applying non-leaching sediment on a large scale are not included in this report and can be found online in the Soil Quality Regulation 2022 (Rijksoverheid, 2025b). The values that apply for leaching of building material are not specific to sediment. These are not included in this report but can also be found in the soil Quality Regulation 2022.

6 Adaptation strategies to climate variability and other risks

Chapter 6 – Executive Summary

The key takeaway

- An integrated adaptation strategy has been adopted to enhance resilience and environmental protection in the face of increasing climatic uncertainty. Central to this approach is the adoption of risk-based sediment quality assessments. Rather than applying uniform thresholds, the strategy emphasizes context-sensitive evaluations that account for local conditions and future scenarios.
- Another core strategy is the integration of sediment quality into broader water safety and spatial planning policies, for inland and coastal zones.
- Both these factors allow the Netherlands to act flexibly on climate change consequences which is reflected in the frequent updates on the regulations in the Netherlands and the addition of new contaminants to the regulations

The Netherlands, with its intricate system of waterways, is uniquely vulnerable to the impacts of climate change. Rising sea levels, increased rainfall, extreme weather events, and shifting sedimentation patterns pose significant challenges to maintaining sediment quality and managing dredging activities. In response, Dutch regulatory frameworks for sediment quality have evolved to integrate adaptation strategies that enhance resilience and environmental protection in the face of increasing climatic uncertainty.

Central to this approach is the adoption of risk-based sediment quality assessments. Rather than applying uniform thresholds, the Dutch system emphasizes context-sensitive evaluations that account for local conditions and future scenarios. For example, regulators consider how climate-induced changes such as acidification, higher flow velocities, or prolonged droughts could alter the mobility and bioavailability of contaminants in sediments. This foresight ensures that risk assessments remain relevant even as environmental baselines shift due to climate stress. The *Soil Quality Regulation 2022 (Regeling bodemkwaliteit 2022)*, a cornerstone of sediment policy, supports this flexibility by allowing site-specific standards for sediment use and location, provided human health and ecological risks are managed acceptably.

Another core strategy is the integration of sediment quality into broader water safety and spatial planning policies, particularly those outlined in the national Delta Programme. Recognizing that climate change is increasing sedimentation pressures in both inland and coastal zones, sediment management is now directly linked with flood protection efforts. Initiatives such as *Room for the River* exemplify how sediment control, water retention, and ecological restoration can be aligned. Clean or remediated sediments are often used in dike reinforcement, wetland restoration, or the elevation of floodplains, turning a potential waste product into a climate adaptation asset.

7 Financing strategies to implement NbS

Chapter 7 – Executive Summary

The key takeaways

- Nature-based Solutions offer cost-effective and multifunctional benefits. It is important in funding arrangements to be able to point these benefits out.
- Government incentives can be key in upscaling and implementation of NbS
- NBS is heavily stimulated as a result of the purpose-based but also flexible approach that is adopted in the Netherlands. Multiple type of NBS (e.g. beach nourishment, agricultural enhancement, island building) are strongly encouraged and described specifically within the framework as beneficial solutions allowing for clear assessments.

The Netherlands, with its centuries-long experience in water management and land reclamation, is at the forefront of adopting Nature-based Solutions (NbS) to address climate resilience, biodiversity loss, and sustainable development. NbS — such as restoring wetlands, creating living shorelines, and using natural vegetation for flood defence — offer cost-effective, multifunctional benefits. However, financing their implementation remains a critical challenge. The Dutch approach employs a blend of public funding, private investment, innovative financial mechanisms, and integrated policy frameworks to support NbS deployment at scale.

The Dutch government fosters an enabling environment through regulatory incentives. Policy instruments like the Environmental Planning Act (“Omgevingswet”) simplify permitting for projects that integrate NbS and offer additional points or funding eligibility under spatial and climate adaptation grants. Tax benefits for green infrastructure investment are also increasingly under consideration, particularly for private landowners and corporations willing to incorporate NbS into their operations.

European funding programs also play a major role. The Netherlands actively leverages EU mechanisms such as the European Regional Development Fund (ERDF), LIFE Programme, and the Natural Capital Financing Facility (NCFF) to support innovative NbS pilots and scale-up efforts. Accessing EU funding typically requires co-financing from Dutch partners, further encouraging collaboration across sectors.

Other financing strategies include:

- PES (payment for ecosystem services) by monetizing environmentally beneficial applications
- Public private partnerships

8 Discussion and experiences

Chapter 8 – Executive summary

This chapter includes the experiences of the contracting parties with the Dutch regulatory standards for maritime dredging and beneficial use. These experiences can be used to evaluate the best strategy for implementing sediment quality guidelines in Colombia, based on the Dutch regulations.

8.1 Dredging

Marine dredging projects in The Netherlands consist for the primarily of maintenance dredging routines. Most of the dredging is done by the port authorities (for example Port of Rotterdam). These organizations have the responsibility to perform dredging and have automatic testing and compliance in place. Besides them, RWS coordinates maintenance and occasional dredging of maritime waterways.

Most dredging activities in the Netherlands are limited to navigational channels. These channels are far from natural locations and are dredged frequently throughout history (ranging from multiple dredging operations per year to one every few year) and need to maintained by international and national laws for shipment activities. Due to these factors, dredging is accepted by society and therefore discussion on RWS dredging activities is very rare. If any discussion exists RWS asks for a so-called MER (environmental effect report). This report, compared to an EIA, is very intensive and focuses also on social factors. The MER-system is something that other countries could adopt to show dredging is environmentally safe.

Most discussions regarding dredging originate from the disposal locations at sea and rivers. When disposal locations do rarely harm natural communities, the disposed material is released back into the dredged areas. RWS is investing a lot of resources in the prevention of dredging by choosing effectively their disposal locations.

8.2 Beneficial uses including Nature-based Solutions (NbS)

The Dutch regulations for beneficial use of sediment are mainly represented in the Soil Quality Decree. The Soil quality Decree is originally designed with beneficial use as 'normal situation'. In fact, spreading on the sea and sand nourishment in beach **are the standard application of marine sediments.** Therefore, the success of NbS in the Netherlands is measured on what is the most useful or most circular use pathway. In fact, the Dutch ministry has set the goal for the Dutch governmental institutions (local and national) to be 50% circular in 2030 and 100% circular in 2050. NETICS together with research institution Deltares came up with an innovative effort to quantify the success ('circularity' level) of beneficial solutions in the Netherlands for local fluvial sediments[13]

The Dutch system for quantifying suitability for beneficial use of sediments, is essentially different from other regulations due to the purpose-driven approach. One can evaluate the reason for the Dutch-distinction of international approaches. The main reason is that traditionally the Netherlands is an international forerunner on flood protection and civil engineering. The fact the majority of the Netherlands consists of waterways and water bodies and 60% of the country if flood-prone, dredging is treated as a national safety issue. Traditionally innovating on this topic and making use of what is locally available is a priority. For application of dredged sediment in beneficial applications, including NbS, the Dutch system has the following advantages:

- The purpose driven approach gives multiple regulatory pathways for use. Sometimes when spreading at sea is not allowed, the system allows for other possibilities
- The Dutch threshold values are loose compared to international values. The threshold values are mainly theoretically determined in combination with intensive site data. This gives confidence to use loose values and allows for many beneficial applications
- The system allows for a custom procedure. Here despite crossing threshold values, permits might still be allowed with adequate prevention measures.

Despite the advantages the system has some major drawbacks:

- The system is very complex due to the many use pathways and overlapping with other laws.
- The loose threshold values are prone to exploitation. As an example, many contaminated dredged materials have been imported to The Netherlands from elsewhere in the past
- The Dutch norms for marine sediment are screened initially with the Rhine River background values to prevent promoting dumping at sea, which might not be representable for marine dose-response relations. Actual background values at sea are not used at all.
- The derivation of the Dutch threshold values is fairly dated as it uses old Rhine background values and the spreading at sea norms miss some contaminants. The system is not updated because applications that are now

[13] https://www.nplg.stowa.nl/toolbox/circsed

very common might be formally excluded. This has happened due to the introduction of PFAS and nitrogen ruling and has had a large impact on the Dutch economy.

Looking at the use of NbS on land, marine dredged sediment is mainly suitable for coastal construction measures. Recently the Dutch organization for the protection against floods (HWBP) has introduced an important program to include dredged materials in dikes as filling and cover material. Clayey dredged materials are very suitable for this from a technical point of view, but the Dutch regulations for dike clay do not allow it due to the fact they are designed for assessing soil material and do not allow imperfections such as additional sand or organic material.

To make NbS and high-class use possible, The Netherlands has positive experiences with so-called dredging depots. These are mainly utilized for drying freshwater sediments across agricultural lands. Dredging depots are also upcoming in coastal areas. The ports in The Netherlands are doing a lot of experiments with drying of dredged materials, are reusing them as soil, resources for bricks and dike clay. Depending on what definition of nature based solutions is utilized, which is still under debate, most beneficial use of dredging materials fall under NBS. For more information about the Dutch experiences with NBS one can utilize the Dutch EcoShape consortium references: https://www.ecoshape.org/en/pilots/.

8.3 Future of Dutch marine sediment laws

The Dutch government's NL2120 consortium, backed by €110 million, aims to accelerate NbS adoption in dredging through research, collaboration, and updated frameworks. Projects like the Marker Wadden and Sand Motor exemplify hybrid NbS approaches that combine traditional engineering with ecological restoration. This project is also pushing towards making the Dutch regulations more fitting to NbS measures. NL2120's focus on knowledge-sharing and pilot testing aims to resolve implementation hurdles, positioning The Netherlands as a global leader in sustainable dredging. Success hinges on continued government funding, cross-sector collaboration, and adaptive policies that value ecological resilience alongside economic growth

Traditional procurement models and cost-based assessments hinder NbS adoption, which often requires long-term ecological evaluations. Therefore, Dutch local and national governments are working towards circular procurement (circular buyer group) which is setting up procurements systems for promoting circular use with additional assessment factors. This means electrical vessels and NbS measures are getting more important compared to purely cost-based procurement. In fact, the growing scarcity of primary resources will make NbS and use of dredged materials even more beneficial.

9 References

1. CSO Adviesbureau. (2005). *HVN en saneringsdoelstelling Maas en Rijntakken*. CSO Adviesbureau. Geraadpleegd op 13 mei 2025, van https://open.rijkswaterstaat.nl/open-overheid/onderzoeksrapporten/@162282/hvn-saneringsdoelstelling-maas/
2. Dirven-van Breemen, E. M., Lijzen, J. P. A., Otte, P. F., van Vlaardingen, P., Spijker, J., Verbruggen, E. M. J., Swartjes, F. A., Groenenberg, J. E., & Rutgers, M. (2007). *National land use specific reference values: A basis for maximum values in Dutch soil policy* (RIVM Report 711701053). National Institute for Public Health and the Environment (RIVM). https://www.rivm.nl/bibliotheek/rapporten/711701053.html
3. European Commission. (2018). *Technical guidance for deriving environmental quality standards* (Guidance Document No. 27, Updated version 2018). Common Implementation Strategy for the Water Framework Directive (2000/60/EC). https://rvs.rivm.nl/sites/default/files/2019-04/Guidance%20No%2027%20-%20Deriving%20Environmental%20Quality%20Standards%20-%20version%202018.pdf
4. Hin, J. A., Osté, L. A., & Schmidt, C. A. (2010). *Handreiking beoordelen waterbodems: Methoden ter bepaling van de mate waarin het realiseren van kwaliteitsdoelen van een watersysteem wordt belemmerd door verontreinigde waterbodems* (Definitieve versie 4 november 2010). Ministerie van Infrastructuur en Milieu, Rijkswaterstaat Waterdienst & Deltares. https://iplo.nl/publish/pages/177612/handreiking_waterbodems_4-11-10_definitief_1.pdf
5. Kreule, P., & Swartjes, F. A. (1997). *Proposals for intervention values for soil and groundwater, including the calculation of the human-toxicological serious soil contamination concentrations. Fourth series of compounds*. RIVM Rapport 711701 005. Rijksinstituut voor de Volksgezondheid en Milieu (RIVM), Bilthoven, Nederland.
6. Kreule, P., Van den Berg, R., Waitz, M. F. W., & Swartjes, F. A. (1995). *Calculation of human-toxicological serious soil contamination concentrations and proposals for intervention values for clean-up of soil and groundwater. Third series of compounds*. RIVM Briefrapport 320002004. Rijksinstituut voor de Volksgezondheid en Milieu (RIVM), Bilthoven, Nederland.
7. Lamé, F. P. J., Brus, D. J., & Nieuwenhuis, R. H. (2007). *Background values of heavy metals in Dutch soils*.
8. Lijzen, J. P. A., Baars, A. J., Otte, P. F., Rikken, M. G. J., Swartjes, F. A., Verbruggen, E. M. J., & van Wezel, A. P. (2001). *Technical evaluation of the Intervention Values for soil/sediment and groundwater: Human and ecotoxicological risk assessment and derivation of risk limits for soil, aquatic sediment and groundwater* (RIVM Report 711701023). National Institute of Public Health and the Environment (RIVM). https://www.rivm.nl/bibliotheek/rapporten/711701023.pdf
9. Ministerie van Infrastructuur en Waterstaat. (2022). *Landelijk toetsingskader hergebruik van licht verontreinigde baggerspecie* (Versie 4.0). https://open.overheid.nl/documenten/dpc-dee421ec8377efafeaf463e5d632d30a7c38b567/pdf
10. Ministerie van Infrastructuur en Waterstaat. (2023). *Beleidsregel Toepassen en verspreiden baggerspecie op de Noordzee* (Besluit van 28 november 2023, kenmerk RWS-2023/47216; geldend van 23-12-2023 t/m heden). https://wetten.overheid.nl/BWBR0049093/2023-12-23/
11. Ministry of Housing, Spatial Planning and the Environment & Ministry of Transport, Public Works and Water Management. (2009). *Soil Remediation Circular 2009* (English version). https://support.esdat.net/Environmental%20Standards/dutch/engelse%20versie%20circulaire%20bodemsanering%202009.pdf
12. Rijksoverheid. (1979). *Wet milieubeheer [Environmental Management Act]*. https://wetten.overheid.nl/BWBR0003245/2025-01-01
13. Rijksoverheid. (2016). *Omgevingswet (Wet van 23 maart 2016, houdende regels over het beschermen en benutten van de fysieke leefomgeving; geldend van 01-01-2024 t/m heden)*. https://wetten.overheid.nl/BWBR0037885/2024-01-01
14. Rijksoverheid. (2025a, January 1). *Besluit bodemkwaliteit.* Wettenbank Overheid.nl. wetten.nl - Regeling - Besluit bodemkwaliteit - BWBR0022929
15. Rijksoverheid. (2025b, January 1). *Regeling bodemkwaliteit 2022 – Bijlage B*. Wettenbank Overheid.nl. https://wetten.overheid.nl/BWBR0047808/2025-01-01/#BijlageB
16. Stronkhorst, J., & Van Hattum, B. (2003). Contaminants of concern in Dutch marine harbor sediments. *Archives of Environmental Contamination and Toxicology, 45*, 306–316.
17. Stronkhorst, J., Ariese, F., Van Hattum, B., Postma, J. F., de Kluijver, M., Den Besten, P. J., ... & Vethaak, A. D. (2003). Environmental impact and recovery at two dumping sites for dredged material in the North Sea. *Environmental Pollution, 124*(1), 17–31.
18. Van den Berg, R. (1994). *Human exposure to soil contamination: A qualitative and quantitative analysis towards proposals for human toxicological intervention values* (partly revised edition).

19. Van den Berg, R., & Roels, J. M. (1991). *Intervention values and target values: Soil quality standards for soil and groundwater in the Netherlands*. National Institute of Public Health and the Environment (RIVM).

Appendices

Appendix A – Substance based coefficients

The following substance-based coefficients are used to convert measured contaminant values to standard soils according to the Soil Quality Regulation 2022.

Substance	Substance dependent base constant A	Substance dependent constant for the clay correction B	Material dependent constant for the organic matter correction C
Antimony	1	0	0
Arsenic	15	0.4	0.4
Barium	30	5	0
Beryllium	8	0.9	0
Cadmium	0.4	0.007	0.021
Chrome	50	2	0
Cobalt	2	0.28	0
Copper	15	0.6	0.6
Mercury	0.2	0.0034	0.0017
Lead	50	1	1
Molybdenum	1	0	0
Nickel	10	1	0
Thallium	1	0	0
Tin	4	0.6	0
Vanadium	12	1,2	0
Zinc	50	3	1.5
Organic compounds	0	0	1
Other connections	1	0	0

Appendix B - Detection limits

The Dutch soil quality decree uses the following analytical detection limits for components included in the norms. The analytical lab methods utilized in laboratories assessing soil quality need to comply with the detection limit as listed below (source: Soil Quality Regulation 2022) More information about typical analytical lab methods and the corresponding contaminants can be found in the report of Element 2, Chapter 4.4.

Component	Limit of determination in mg/kg dry matter
Inorganic substances	
1. Metals	
antimony (Sb)	3.9
arsenic (As)	5.9
barium (Ba)	59
cadmium (Cd)	0.45
chromium (Cr)	23
cobalt (Co)	3.2
copper (Cu)	7.7
(Non-volatile) mercury (Hg)	0.05
lead (Pb)	19.4
molybdenum (Mo)	1.5
nickel (Ni)	4.5
tin (Sn)	4.5
vanadium (V)	9
zinc (Zn)	32
2. Other inorganic substances	
chloride	36
cyanide (free)	0.45
cyanide complex (pH < 5)	0.36
cyanide complex (pH ≥ 5)	0.36
thiocyanates (sum)	0.9
Organic substances	
3. Aromatic substances	
benzene	0.16
toluene	0.20
ethylbenzene	0.20
xylenes (sum)	0.41

styrene (vinylbenzene)	0.23
phenol	0.09
cresols (sum o-, m-, p-)	0.29
dodecylbenzene	0.34
aromatic solvents	0.42
4. Polycyclic aromatic hydrocarbons (PAHs)	
naphthalene	0.009
phenanthrene	0.014
anthracene	0.014
fluoranthene	0.014
chrysene	0.014
benzo(a)anthracene	0.014
benzo(a)pyrene	0.014
benzo(k)fluoran-thene	0.014
indeno(1,2,3cd)-pyrene	0.014
benzo(ghi)pery-lene	0.014
pack total (sum 10)	0.09
5. Chlorinated hydrocarbons	
a. (volatile) chlorinated hydrocarbons	
monochloroethene (vinyl chloride)	0.23
dichloromethane	0.059
1,1-dichloroethane	0.16
1,2-dichloroethane	0.18
1,1-dichloroethylene	0.27
1,2-dichloroethylene (sum cis and trans)	0.27
dichloropropanes (sum)	0.77
trichloromethane (chloroform)	0.23
1,1,1-trichloroethane	0.25

1,1,2-trichloroethane	0.27
trichloroethylene (tri)	0.25
tetrachloromethane (tetra)	0.29
tetrachloroethylene (per)	0.045
b. chlorobenzenes	
monochlorobenzene	0.18
dichlorobenzenes (sum)	1.6
trichlorobenzenes (sum)	0.014
tetrachlorobenzenes (sum)	0.009
pentachlorobenzene	0.00045
hexachlorobenzene	0.00045
chlorobenzenes (sum)	0.63
c. chlorophenols	
monochlorophenols (sum)	0.023
dichlorophenols (sum)	0.18
trichlorophenols (sum)	0.0027
tetrachlorophenols (sum)	0.01
pentachlorophenol	0.0027
chlorophenols (sum)	0.027
d. polychlorinated biphenyls (PCBs)	
PCB 28	0.0009
PCB 52	0.00045
PCB 101	0.0009
PCB 118	0.0009
PCB 138	0.0009
PCB 153	0.0009
PCB 180	0.0009
PCBs (sum 7)	0.0039

e. other chlorinated hydrocarbons	
monochloroanilines (sum)	0.20
pentachloroaniline	0.14
chloronaphthalene (sum α, β)	0.07
dioxin	0.000054
6. Pesticides	
a. organochlorine pesticides	
chlordane	0.0006
DDT (sum)	0.0014
DDE (sum)	0.0014
DDD (sum)	0.0014
DDT/DDE/DDD (sum)	0.0016
aldrin	0.0003
dieldrin	0.0003
endrin	0.0003
isodrine	0.0009
telodrin	0.0003
drink (sum)	0.0006
endosulfan sulfate	0.0009
α-endosulfan	0.00014
α-HCH	0.0009
β-HCH	0.0003
γ-HCH (lindane)	0.0001
δ-HCH	0.0007
HCH compounds (sum)	0.0008
heptachlor	0.0005
heptachlor epoxide (sum)	0.0003
hexachlorobutadiene	0.003

organochlorine pesticides (sum)	0.008
b. organophosphorus pesticides	
azinphos-methyl	0.007
c. organotin pesticides	
organotin (sum)	0.0045
tributyltin	0.0045
d. chlorophenoxyacetic acid herbicides	
MCPA	0.54
e. other pesticides	
atrazine	0.03
carbofuran	0.14
carbaryl	0.14
4-chloromethylphenols	0.59
organonitrogen and organophosphorus pesticides (sum)	0.09
7. Other substances	
tetrahydrothiophene	1,1
tribromomethane	0.20
cyclohexanone	1.8
Methyl-Tert-Butyl-Ether (MTBE)	0.18
tetrahydrofuran	0.23
acrylonitril	2
ethylene glycol	2
diethylene glycol	2
isopropanol	2
methanol	2
butanol	2
1,2-butyl acetate	2

ethyl acetate	2
methyl ethyl ketone	2
dimethyl phthalate	0.045
diethyl phthalate	0.045
di-isobutyl phthalate	0.045
dibutyl phthalate	0.07
butyl benzyl phthalate	0.07
dihexyl phthalate	0.07
di(2-ethylhexyl)phthalate	0.045
phthalates (sum)	0.22
mineral oil	77
formaldehyde	2,3
pyridine	0.15

Appendix C - Reporting limits

While detection limits are related to the required analytical lab methods. Reporting limits are also stated in the Soil Quality Regulation 2022. If not reported precisely enough, certificates stating soil quality classification are not valid.

	Soil, soil and dredged material		Groundwater	
Substance	**unit in mg/kg dry matter (unless otherwise stated)**	**reporting limit**	**unit in µg/l (unless otherwise stated)**	**reporting limit**
1. Metals				
Antimony		1.5		3
Arsenic		4		5
barium		20		20
beryllium		1		1
cadmium		0.2		0.2
chrome		10		1
cobalt		3		2
copper		5		2
mercury		0.05		0.05
lead		10		2
molybdenum		1.5		2
nickel		4		3
selenium		1.5		
tellurium		2		15
thallium		1		5
tin		1.5		2.5
vanadium		10		2
silver		1		5
zinc		20		10
2. Other inorganic substances				
chloride		150	mg/l	50
CN free		2		3
CN total		3		5
nitrate			mg N/l	3
ortho-phosphate			mg P/l	1
sulphate			mg/l	30
3. Aromatic substances				
benzene		0.05		0.2
ethylbenzene		0.05		0.2
toluene		0.05		0.2
o-xylene		0.05		0.1
m-xylene p-xylene		sum 0.1		sum 0.2
styrene		0.05		0.2
1,2,3-trimethylbenzene		0.1		
1,2,4-trimethylbenzene		0.1		
1,3,5-trimethylbenzene		0.1		
2-ethyltoluene		0.1		
3-ethyltoluene		0.1		
4-ethyltoluene		0.1		
isopropylbenzene		0.1		
propylbenzene		0.1		
4. Polycyclic aromatic hydrocarbons (PAHs)				
naphthalene		0.05		0.02
phenanthrene		0.05		0.01
anthracene		0.05		0.01
fluoranthene		0.05		0.01
chrysene		0.05		0.01
benz(a)anthracene		0.05		0.01
benz(a)pyrene		0.05		0.01
benz(k)fluoranthene		0.05		0.01
indeno(123cd)pyrene		0.05		0.01
benz(ghi)perylene		0.05		0.01
5. Chlorinated hydrocarbons				
a.(volatile) chlorinated hydrocarbons				
monochloroethylene (vinyl chloride)		0.05		0.2
dichloromethane		0.05		0.2
1,1-dichloroethane		0.1		0.2
1,2-dichloroethane		0.1		0.2
1,1-dichloroethylene		0.1		0.1
cis 1,2-dichloroethylene		0.1		0.1

trans 1,2-dichloroethylene		0.1		0.1
1,1-dichloropropane		0.05		0.2
1,2-dichloropropane		0.05		0.2
1,3-dichloropropane		0.05		0.2
trichloromethane(chloroform)		0.05		0.2
1,1,1-trichloroethane		0.05		0.1
1,1,2-trichloroethane		0.05		0.1
trichloroethylene(Tri)		0.05		0.2
tetrachloromethane(Tetra)		0.05		0.1
tetrachloroethylene (Per)		0.05		0.1
b. chlorobenzenes				
monochlorobenzene		0.04		0.2
1,2-dichlorobenzene		0.1		0.2
1,3-dichlorobenzene		0.1		0.2
1,4-dichlorobenzene		0.1		0.2
1,2,3-trichlorobenzene	µg/kg dry matter	1		0.01
1,2,4-trichlorobenzene	µg/kg dry matter	1		0.01
1,3,5-trichlorobenzene	µg/kg dry matter	1		0.01
1,2,3,4-tetrachlorobenzene	µg/kg dry matter	1		0.01
1,2,3,5-tetrachlorobenzene 1,2,4,5-tetrachlorobenzene	µg/kg dry matter	sum 2		sum 0.02
pentachlorobenzene	µg/kg dry matter	1	ng/l	5
hexachlorobenzene	µg/kg dry matter	1	ng/l	5
c. chlorophenols				
pentachlorophenol	µg/kg dry matter	3		
d. polychlorinated biphenyls (PCBs)				
PCB 28	µg/kg dry matter	1	ng/l	6
PCB 52	µg/kg dry matter	1	ng/l	6
PCB 101	µg/kg dry matter	1	ng/l	6
PCB 118	µg/kg dry matter	1	ng/l	6
PCB 138	µg/kg dry matter	1	ng/l	6
PCB 153	µg/kg dry matter	1	ng/l	6
PCB 180	µg/kg dry matter	1	ng/l	6
6. Pesticides				
a. oranochlorine pesticides				
cis-chlordane	µg/kg dry matter	1		0.01
trans-chlordane	µg/kg dry matter	1		0.01
onDDT	µg/kg dry matter	1		0.01
ppDDT	µg/kg dry matter	1		0.01
onDDE	µg/kg dry matter	1		0.01
ppDDE	µg/kg dry matter	1		0.01
onDDD	µg/kg dry matter	1		0.01
ppDDD	µg/kg dry matter	1		0.01
aldrin	µg/kg dry matter	1		0.01
dieldrin	µg/kg dry matter	1		0.01
endrin	µg/kg dry matter	1		0.01
isodrine	µg/kg dry matter	1		
telodrin	µg/kg dry matter	1		
endosulfan sulfate	µg/kg dry matter	2		
α-endosulfan	µg/kg dry matter	1		0.01
α-HCH	µg/kg dry matter	1		0.01
β-HCH	µg/kg dry matter	1	ng/l	8
γ-HCH	µg/kg dry matter	1	ng/l	9
δ-HCH	µg/kg dry matter	1	ng/l	8
heptachlor	µg/kg dry matter	1		0.01
cis-heptachloroepoxide	µg/kg dry matter	1		0.01
trans-heptachloroepoxide	µg/kg dry matter	1		0.01
hexachlorobutadiene	µg/kg dry matter	1		
c. organotin pesticides				
tributyltin	µg Sn/kg dry matter	4		
triphenyltin	µg Sn/kg dry matter	4		

Appendix D - Standard research packages and grouping parameters

The Dutch ministry has stated the requirements for testing according to the purpose of the dredged materials. Dutch laboratories work according to the packages and grouping parameters as listed below. Source: Soil Quality Regulation 2022.

Overview of substances that belong to the standard research package [1]

	Standard research package, **Variant A**	**Standard research package,** **Variant C1**	**Standard research package,** **Variant C3**
The material or soil to which the investigation relates	**1. land surface** **2. waterbed in regional waters** **3. ground** **4. dredged material from regional waters**	**1. waterbed in fresh surface water managed by the government** **2. dredged material from surface water managed by the government**	**1. waterbed in salt surface water managed by the government** **2. dredged material from salt surface water managed by the government [2]**
organic matter and clay	Yes	Yes	Yes
cadmium,copper, mercury, lead, nickel, zinc	Yes	Yes	Yes
barium, cobalt, molybdenum	Yes	Yes	
arsenic, chrome		Yes	Yes
PCBs (sum 7)	Yes	Yes	Yes
PAHs-Total (sum 10)	Yes	Yes	Yes
mineral oil	Yes	Yes	Yes
pentachlorobenzene, pentachlorophenol, chlordane (sum), aldrin, dieldrin, endrin, isodrine, telodrin,		Yes	

pentachlorobenzene, pentachlorophenol, chlordane (sum), aldrin, dieldrin, endrin, isodrine, telodrin, drink (sum), a-endosulfan, endosulfan sulfate, a-HCH, b-HCH, g-HCH, d-HCH, HCH compounds (sum), heptachlor, heptachlor epoxide(sum), hexachlorobutadiene, organochlorine containing pesticides (sum) [3]	Yes	
hexachlorobenzene, DDT, DDE, DDD, sum-DDT/DDD/DDE	Yes	Yes
tributyltin		Yes

Definition of normalized sum parameters

Sum parameter	List of individual substances to be summed	CAS number
xylenes	ortho-xylene	95-47-6
	meta-xylene	108-38-3
	para-xylene	106-42-3
cresols	ortho-cresol	95-48-7
	meta-cresol	108-39-4
	para-cresol	106-44-5
1,2-dichloroethylene	cis-1,2-dichloroethylene	156-59-2
	trans-1,2-dichloroethylene	156-60-5
dichloropropanes	1,1-dichloropropane	78-99-9
	1,2-dichloropropane	78-87-5
	1,3-dichloropropane	142-28-9
dichlorobenzenes	1,2-dichlorobenzene	95-50-1
	1,3-dichlorobenzene	541-73-1
	1,4-dichlorobenzene	106-46-7
trichlorobenzenes	1,2,3-trichlorobenzene	87-61-6
	1,2,4-trichlorobenzene	120-82-1
	1,3,5-trichlorobenzene	108-70-3
tetrachlorobenzenes	1,2,3,4-tetrachlorobenzene	634-66-2
	1,2,3,5-tetrachlorobenzene	634-90-2
	1,2,4,5-tetrachlorobenzene	95-94-3
chlorobenzenes	monochlorobenzene	108-90-7
	1,2-dichlorobenzene	95-50-1
	1,3-dichlorobenzene	541-73-1
	1,4-dichlorobenzene	106-46-7
	1,2,3-trichlorobenzene	87-61-6
	1,2,4-trichlorobenzene	120-82-1
	1,3,5-trichlorobenzene	108-70-3
	1,2,3,4-tetrachlorobenzene	634-66-2
	1,2,3,5-tetrachlorobenzene	634-90-2
	1,2,4,5-tetrachlorobenzene	95-94-3
	pentachlorobenzene	608-93-5
	hexachlorobenzene	118-74-1
aromatic solvents	benzene	71-43-2
	toluene	108-88-3
	ethylbenzene	100-41-4
	ortho-xylene	95-47-6
	meta-xylene	108-38-3
	para-xylene	106-42-3
	styrene	100-42-5
	1, 2, 3-trimethylbenzene	526-73-8
	1, 2, 4-trimethylbenzene	95-63-6
	1, 3, 5-trimethylbenzene	108-67-8
	2-ethyltoluene	611-14-3
	3-ethyltoluene	620-14-4
	4-ethyltoluene	622-96-8
	isopropylbenzene	98-82-8
	propylbenzene	103-65-1
	n-dodecylbenzene	123-01-3
sum-PAK	naphthalene	91-20-3
	phenanthrene	85-01-8
	anthracene	120-12-7
	fluoranthene	206-44-0
	chrysene	218-01-9
	benzo(a)anthracene	56-55-3
	benzo(a)pyrene	50-32-8
	benzo(k)fluoranthene	207-08-9
	indeno(1,2,3cd)pyrene	193-39-5
	benzo(ghi)perylene	191-24-2
4-chloromethylphenols	4-chloro-3-methylphenol	59-50-7
	4-chloro-2-methylphenol	1570-64-5
monochlorophenols	2-chlorophenol	95-57-8
	3-chlorophenol	108-43-0
	4-chlorophenol	106-48-9
dichlorophenols	2,3-dichlorophenol	576-24-9
	2,4-dichlorophenol	120-83-2
	2,5-dichlorophenol	583-78-8
	2,6-dichlorophenol	87-65-0
	3,4-dichlorophenol	95-77-2
	3,5-dichlorophenol	591-35-5
trichlorophenols	2,3,4-trichlorophenol	15950-66-0
	2,3,5-trichlorophenol	933-78-8
	2,3,6-trichlorophenol	933-75-5
	2,4,5-trichlorophenol	95-95-4
	2,4,6-trichlorophenol	88-06-2
	3,4,5-trichlorophenol	609-19-8
tetrachlorophenols	2,3,4,5-tetrachlorophenol	4901-51-3
	2,3,4,6-tetrachlorophenol	58-90-2
	2,3,5,6-tetrachlorophenol	935-95-5
chlorophenols	2-chlorophenol	95-57-8
	3-chlorophenol	108-43-0
	4-chlorophenol	106-48-9
	2,3-dichlorophenol	576-24-9
	2,4-dichlorophenol	120-83-2
	2,5-dichlorophenol	583-78-8
	2,6-dichlorophenol	87-65-0
	3,4-dichlorophenol	95-77-2
	3,5-dichlorophenol	591-35-5
	2,3,4-trichlorophenol	15950-66-0
	2,3,5-trichlorophenol	933-78-8
	2,3,6-trichlorophenol	933-75-5
	2,4,5-trichlorophenol	95-95-4
	2,4,6-trichlorophenol	88-06-2
	3,4,5-trichlorophenol	609-19-8
	2,3,4,5-tetrachlorophenol	4901-51-3
	2,3,4,6-tetrachlorophenol	58-90-2
	2,3,5,6-tetrachlorophenol	935-95-5
	pentachlorophenol	87-86-5
chlordane	cis-chlordane	5103-71-9
	trans-chlordane	5103-74-2
DDT	2,4-DDT	789-02-6
	4,4-DDT	50-29-3
DDE	2,4-DDE	3424-82-6
	4,4-DDE	72-55-9

DDD	2,4-DDD	53-19-0
	4,4-DDD	72-54-8
DDT/DDE/DDD	2,4-DDT	789-02-6
	4,4-DDT	50-29-3
	2,4-DDE	3424-82-6
	4,4-DDE	72-55-9
	2,4-DDD	53-19-0
	4,4-DDD	72-54-8
drink	aldrin	390-00-2
	dieldrin	60-57-1
	endrin	72-20-8
HCH connections	α-hexachlorocyclohexane (α-HCH)	319-84-6
	β-hexachlorocyclohexane (β-HCH)	319-85-7
	γ-hexachlorocyclohexane (γ-HCH)	58-89-9
	δ-hexachlorocyclohexane (δ-HCH)	319-86-8
heptachlor epoxide	cis-heptachlor epoxide	1024-57-3
	trans-heptachlor epoxide	280044-83-9
polychlorinated biphenyls	PCB 28	7012-37-5
	PCB 52	35693-99-3
	PCB 101	37680-73-2
	PCB 118	31508-00-6
	PCB 138	35065-28-2
	PCB 153	35065-27-1
	PCB 180	35065-29-3
chloroanilines		
monochloroanilines	2-chloroaniline	95-51-2
	3-chloroaniline	108-42-9
	4-chloroaniline	106-47-8

chloroanilines		
monochloroanilines	2-chloroaniline	95-51-2
	3-chloroaniline	108-42-9
	4-chloroaniline	106-47-8
dichloroanilines	2,3-dichloroaniline	608-27-5
	2,4-dichloroaniline	554-00-7
	2,5-dichloroaniline	95-82-9
	2,6-dichloroaniline	608-31-1
	3,4-dichloroaniline	95-76-1
	3,5-dichloroaniline	626-43-7
trichloroanilines	2,3,4-trichloroaniline	634-67-3
	2,3,5-trichloroaniline	18487-39-3
	2,4,5-trichloroaniline	636-30-6
	2,4,6-trichloroaniline	634-93-5
	3,4,5-trichloroaniline	634-91-3
tetrachloroanilines	2,3,4,5-tetrachloroaniline	634-83-3
	2,3,5,6-tetrachloroaniline	3481-20-7
chloronaphthalene	α-chloronaphthalene	90-13-1
	β-chloronaphthalene	91-58-7
dioxins (sum quantified as TEQ, see Appendix B, Table 4)	2,3,7,8-TCDD	1746-01-6
	1,2,3,7,8-PeCDD	40321-76-4
	1,2,3,6,7,8-HxCDD	57653-85-7
	1,2,3,7,8,9-HxCDD	19408-74-3
	1,2,3,4,7,8-HxCDD	39227-28-6
	1,2,3,4,6,7,8-HpCDD	35822-46-9
	1,2,3,4,6,7,8,9-OCDD	3268-87-9
	2,3,7,8-TCDF	51207-31-9
	1,2,3,7,8-PeCDF	57117-41-6

	1,2,3,6,7,8-HxCDF	57117-44-9
	1,2,3,7,8,9-HxCDF	72918-21-9
	1,2,3,4,7,8-HxCDF	70648-26-9
	2,3,4,6,7,8-HxCDF	60851-34-5
	1,2,3,4,6,7,8-HpCDF	67562-39-4
	1,2,3,4,7,8,9-HpCDF	55673-89-7
	1,2,3,4,6,7,8,9-OCDF	39001-02-0
	PCB77	32598-13-3
	PCB81	70362-50-4
	PCB105	32598-14-4
	PCB114	74472-37-0
	PCB118	31508-00-6
	PCB123	65510-44-3
	PCB126	57465-28-8
	PCB156	38380-08-4
	PCB157	69782-90-7
	PCB167	52663-72-6
	PCB169	32774-16-6
	PCB189	39635-31-9
organochlorine pesticides (OCPs) (land soil)	hexachlorobenzene (HCB)	118-74-1
	α-hexachlorocyclohexane (α-HCH)	319-84-6
	β-hexachlorocyclohexane (β-HCH)	319-85-7
	γ-hexachlorocyclohexane (γ-HCH)	58-89-9
	aldrin	390-00-2
	dieldrin	60-57-1
	endrin	72-20-8

	endrin	72-20-8
	2,4-DDT	789-02-6
	4,4-DDT	50-29-3
	2,4-DDE	3424-82-6
	4,4-DDE	72-55-9
	2,4-DDD	53-19-0
	4,4-DDD	72-54-8
	heptachlor	76-44-8
	α-endosulfan	959-98-8
	endosulfan sulfate	1031-07-8
	cis-heptachlor epoxide	1024-57-3
	trans-heptachlor epoxide	28044-83-9
	telodrin	465-73-6
	isodrin	297-78-9
	cis-chlordane	5103-71-9
	trans-chlordane	5103-74-2
	hexachlorobutadiene	87-68-3
organonitrogen and organophosphorus pesticides (sum)	atrazine	1912-24-9
	propazine	139-40-2
	simazine	122-34-9
	terbutryn	886-50-0
	azinphos-methyl	86-50-0
	bromophos-ethyl	4824-78-6
	bromophos-methyl	2104-96-3
	chlorpyrifos-ethyl	2921-88-2
	dichlorvos	62-73-7

	[illegible]	[illegible]
	disulfoton	298-04-4
	fenthion	55-38-9
	malathion	121-75-5
	parathion-ethyl	56-38-2
	parathion-methyl	298-00-0
organotin compounds	tributyltin	688-73-3
	triphenyltin	892-20-6
phthalates	dimethyl phthalate	131-11-3
	diethyl phthalate	84-66-2
	di-isobutyl phthalate	84-69-5
	dibutyl phthalate	84-74-2
	butyl benzyl phthalate	85-68-7
	dihexyl phthalate	84-75-3
	di(2-ethylhexyl)phthalate	117-81-7
asbestos		
serpentine	chrysotile - white asbestos	12001-29-5
amphibole	actinolite – green asbestos	77536-66-4
	amosite / grunerite - brown asbestos	12172-73-5
	anthophyllite - yellow asbestos	77536-67-5
	crocidolite - blue asbestos	12001-28-4
	tremolite - gray asbestos	77536-68-6

Appendix E - Threshold values for spreading on fresh and saltwater

This appendix shows the threshold values for spreading sediment in fresh and salt water. Source: Table 3c of Appendix B of the Soil Quality Regulation 2022.

Component	quality requirement for 'dredged material suitable for spreading in fresh surface water'		quality requirement for 'dredged material suitable for spreading in salt surface water'	
column number	2	3	4	5
	The distinction between the quality requirements in column 2 and 3 respectively has been made with a view to the assessment rules included in table note 1		The distinction between the quality requirements in column 4 and 5 respectively has been made with a view to the assessment rules included in table note 2	
	for standard soil, in mg kg/dry matter			
inorganic substances				
1. Metals				
antimony (Sb)	4	[1]	[2]	15
arsenic (As)	[1]	29	*29*	85
barium (Ba)	[1]	[1]	[2]	[2]
cadmium (Cd)	[1]	4	4	14
chromium (Cr)	[1]	120	*120*	380
cobalt (Co)	[1]	25	[2]	240
copper (Cu)	[1]	96	*60*	190
mercury (Hg)	[1]	1,2	1,2	10
lead (Pb)	[1]	138	110	580
molybdenum (Mo)	[1]	5	[2]	200
nickel (Ni)	[1]	50	45	210
tin (Sn)	6.5	[1]	[2]	[2]
vanadium (V)	80	[1]	[2]	[2]
zinc (Zn)	[1]	563	*365*	2000
2. Other inorganic substances				
chloride	[1]	[1]	[2]	[2]
cyanide (free)	3	[1]	[2]	20
cyanide (complex) [3]	5.5	[1]	[2]	50
thiocyanates	6	[1]	[2]	20
organic substances				
3. Aromatic substances				
benzene	0.2	[1]	[2]	1
ethylbenzene	0.2	[1]	[2]	50
toluene	0.2	[1]	[2]	130
xylenes (sum)	0.45	[1]	[2]	25
styrene (vinylbenzene)	0.25	[1]	[2]	100
phenol	0.25	[1]	[2]	40
cresols (sum)	0.3	[1]	[2]	5
dodecylbenzene	0.35	[1]	[2]	[2]
1, 2, 3-trimethylbenzene	0.45	[1]	[2]	[2]
1, 2, 4-trimethylbenzene	0.45	[1]	[2]	[2]
1, 3, 5-trimethylbenzene	0.45	[1]	[2]	[2]
2-ethyltoluene	0.45	[1]	[2]	[2]
3-ethyltoluene	0.45	[1]	[2]	[2]
4-ethyltoluene	0.45	[1]	[2]	[2]
isopropylbenzene	0.45	[1]	[2]	[2]
propylbenzene	0.45	[1]	[2]	[2]
aromatic solvents (sum)	2.5	[1]	[2]	[2]
4. Polycyclic aromatic hydrocarbons (PAHs)				
naphthalene	[1]	[1]	[2]	[2]
phenanthrene	[1]	[1]	[2]	[2]
anthracene	[1]	[1]	[2]	[2]
fluoranthene	[1]	[1]	[2]	[2]
chrysene	[1]	[1]	[2]	[2]
benzo(a)anthracene	[1]	[1]	[2]	[2]
benzo(a)pyrene	[1]	[1]	[2]	[2]
benzo(k)fluoranthene	[1]	[1]	[2]	[2]
indeno(1,2,3cd)pyrene	[1]	[1]	[2]	[2]
benzo(ghi)perylene	[1]	[1]	[2]	[2]
PAKs total (sum 10)	[1]	9	8	40
5. Chlorinated hydrocarbons				
a. (volatile) chlorinated hydrocarbons				
monochloroethylene (vinyl chloride)	0.1	[1]	[2]	0.1

dichloromethane	0.1	1	2	10
1,1-dichloroethane	0.2	1	2	15
1,2-dichloroethane	0.2	1	2	4
1,1-dichloroethylene	0.3	1	2	0.3
1,2-dichloroethylene (sum)	0.3	1	2	1
dichloropropanes (sum)	0.8	1	2	2
trichloromethane (chloroform)	0.25	1	2	10
1,1,1-trichloroethane	0.25	1	2	15
1,1,2-trichloroethane	0.3	1	2	10
trichloroethylene (Tri)	0.25	1	2	60
tetrachloromethane (Tetra)	0.3	1	2	1
tetrachloroethylene (Per)	0.15	1	2	4
b. chlorobenzenes				
monochlorobenzene	0.2	1	2	2
dichlorobenzenes (sum)	2	1	2	2
trichlorobenzenes (sum)	0.015	1	2	2
tetrachlorobenzenes (sum)	0.009	1	2	2
pentachlorobenzene	1	0.007	2	2
hexachlorobenzene	1	0.044	0.02	2
chlorobenzenes (sum)	2	1	2	30
c. chlorophenols				
monochlorophenols (sum)	0.045	1	2	2
dichlorophenols (sum)	0.2	1	2	2
trichlorophenols (sum)	0.003	1	2	2
tetrachlorophenols (sum)	0.015	1	2	2
pentachlorophenol	1	0.016	2	5
chlorophenols (sum)	0.2	1	2	10
d. polychlorinated biphenyls (PCBs)				
PCB 28	1	0.014	2	2
PCB 52	1	0.015	2	2
PCB 101	1	0.023	2	2
PCB 118	1	0.016	2	2
PCB 138	1	0.027	2	2
PCB 153	1	0.033	2	2
PCB 180	1	0.018	2	2
PCBs (sum 7)	1	0.139	*0.1*	1
e. other chlorinated hydrocarbons				
monochloroanilines (sum)	0.2	1	2	50
pentachloroaniline	0.15	1	2	2
dioxin (sum TEQ) [4]	0.000055	1	2	2
chloronaphthalene (sum)	0.07	1	2	10
6. Pesticides				
a. organochlorine pesticides				
chlordane (sum)	0.002	1	2	4
DDT (sum)	1	1	2	2
DDE (sum)	1	1	2	2
DDD (sum)	1	1	2	2
DDT/DDE/DDD (sum)	1	0.3	0.02	4
aldrin	1	0.0013	2	2
dieldrin	1	0.008	2	2
endrin	1	0.0035	2	2
isodrine	0.001	1	2	2
telodrin	0.0005	1	2	2
drink (sum)	1	0.015	2	4
endosulfan sulfate	1	1	2	2
α-endosulfan	1	0.0021	2	4
α-HCH	1	0.0012	2	2
β-HCH	1	0.0065	2	2
γ-HCH (lindane)	1	0.003	2	2
δ-HCH	1	1	2	2

Table note 1 covers various situations, the only thing which has in common is that for a particular substance, at least one of columns 2 to 6 refers to Table note 1.

This means that no quality requirement has been included for the substance in question for classifying the soil or a batch of soil or dredged material in the quality class to which the relevant column relates.

The following describes how the relevant substance should be dealt with in various situations when classifying soil or a batch of soil or dredged material into a quality class.

Only one situation description can apply to each substance at a time.

The following applies to a substance for which reference is made to table note 1 in one of columns 2 to 6.

– If reference is made in all columns 2 to 6 to table note 1, the substance is not included in the classification if:

• it concerns a substance that is not part of a sum parameter as described in Annex E ; or

• it concerns a sum parameter as described in Appendix E.

– If one of columns 2 to 6 refers to table note 1 and it concerns a substance that is part of a sum parameter as described in Annex E, then the substance is only included in the classification.

Appendix F - Threshold values for application on land

This appendix shows the threshold values for applying sediment in an application on land. Source: Soil Quality Regulation 2022.

Substance	**quality requirement for quality class 'agriculture/nature'**	**quality requirement for quality class 'residential'**	**quality requirement for quality class 'industry'**	**quality requirement for quality class 'moderately contaminated'**	**quality requirement for quality class 'heavily contaminated'**
quality class limitation	**the concentration of the substance is less than or equal to the value stated in this column**	**the concentration of the substance is greater than the value stated in the agriculture/nature column and less than or equal to the value stated in this column**	**the concentration of the substance is greater than the value stated in the living column and less than or equal to the value stated in this column**	**the concentration of the substance is greater than the value stated in the industry column and less than or equal to the value stated in this column**	**the concentration of the substance is greater than the value stated in this column**
Column number	**2**	**3**	**4**	**5**	**6**
	for standard soil, expressed in mg/kg dry matter				
Inorganic substances					
1. Metals					
antimony (Sb)	4	15	22	22	22
arsenic (As)	20	27	76	76	76
barium (Ba)	[1]	[1]	[1]	[1]	[1]
cadmium (Cd)	0.6	1,2	4.3	13	13
chromium (Cr)	55 [11]	62	180	180	180
cobalt (Co)	15	35	190	190	190
copper (Cu)	40	54	190	190	190
mercury (Hg)	0.15	0.83	4.8	36	36
lead (Pb)	50	210	530	530	530
molybdenum (Mo)	1,5 [11]	88	190	190	190
nickel (Ni)	35	39	100	100	100
tin (Sn)	6.5	180	900	[1]	[1]
vanadium (V)	80	97	250	[1]	[1]
zinc (Zn)	140	200	720	720	720
2. Other inorganic substances					
chloride [2]	[1]	[1]	[1]	[1]	[1]
cyanide (free)	3	3	20	20	20
cyanide (complex) [3]	5.5	5.5	50	50	50
thiocyanates	6	6	20	20	20
Organic substances					
3. Aromatic substances					
benzene	0.2	0.2	1	1,1	1,1
ethylbenzene	0.2	0.2	1.25	110	110

toluene [4]	0.2	0.2	1.25	32	32
xylenes (sum)	0.45	0.45	1.25	17	17
styrene (vinylbenzene)	0.25	0.25	2.5	86	86
phenol [4]	0.25	0.25	1.25	14	14
cresols (sum) [4]	0.3	0.3	5	13	13
dodecylbenzene	0.35	0.35	0.35	[1]	[1]
1, 2, 3-trimethylbenzene	0.45	0.45	0.45	[1]	[1]
1, 2, 4-trimethylbenzene	0.45	0.45	0.45	[1]	[1]
1, 3, 5-trimethylbenzene	0.45	0.45	0.45	[1]	[1]
2-ethyltoluene	0.45	0.45	0.45	[1]	[1]
3-ethyltoluene	0.45	0.45	0.45	[1]	[1]
4-ethyltoluene	0.45	0.45	0.45	[1]	[1]
isopropylbenzene	0.45	0.45	0.45	[1]	[1]
propylbenzene	0.45	0.45	0.45	[1]	[1]
aromatic solvents (sum)	2.5	2.5	2.5	[1]	[1]
4. Polycyclic aromatic hydrocarbons (PAHs)					
naphthalene	[1]	[1]	[1]	[1]	[1]
phenanthrene	[1]	[1]	[1]	[1]	[1]
anthracene	[1]	[1]	[1]	[1]	[1]
fluoranthene	[1]	[1]	[1]	[1]	[1]
chrysene	[1]	[1]	[1]	[1]	[1]
benzo(a)anthracene	[1]	[1]	[1]	[1]	[1]
benzo(a)pyrene	[1]	[1]	[1]	[1]	[1]
benzo(k)fluoranthene	[1]	[1]	[1]	[1]	[1]
indeno(1,2,3cd)pyrene	[1]	[1]	[1]	[1]	[1]
benzo(ghi)perylene	[1]	[1]	[1]	[1]	[1]
PAKs total (sum 10)	1.5	6.8	40	40	40
5. Chlorinated hydrocarbons					
a. (volatile) chlorinated hydrocarbons					
monochloroethene (vinyl chloride)	0.1	0.1	0.1	0.1	0.1
dichloromethane	0.1	0.1	3.9	3.9	3.9
1,1-dichloroethane	0.2	0.2	0.2	15	15
1,2-dichloroethane	0.2	0.2	4	6.4	6.4

1,1-dichloroethylene	0.3	0.3	0.3	0.3	0.3
1,2-dichloroethylene (sum)	0.3	0.3	0.3	1	1
dichloropropanes (sum)	0.8	0.8	0.8	2	2
trichloromethane (chloroform)	0.25	0.25	3	5.6	5.6
1,1,1-trichloroethane	0.25	0.25	0.25	15	15
1,1,2-trichloroethane	0.3	0.3	0.3	10	10
trichloroethylene (Tri)	0.25	0.25	2.5	2.5	2.5
tetrachloromethane (Tetra)	0.3	0.3	0.7	0.7	0.7
tetrachloroethylene (Per)	0.15	0.15	4	8.8	8.8
b. chlorobenzenes					
monochlorobenzene	0.2	0.2	5	15	15
dichlorobenzenes (sum)	2	2	5	19	19
trichlorobenzenes (sum)	0.015	0.015	5	11	11
tetrachlorobenzenes (sum)	0.009	0.009	2,2	2,2	2,2
pentachlorobenzene	0.0025	0.0025	5	6.7	6.7
hexachlorobenzene	0.0085	0.027	1,4	2	2
chlorobenzenes (sum)	[1]	[1]	[1]	[1]	[1]
c. chlorophenols					
monochlorophenols (sum)	0.045	0.045	5.4	5.4	5.4
dichlorophenols (sum)	0.2	0.2	6	22	22
trichlorophenols (sum)	0.003	0.003	6	22	22
tetrachlorophenols (sum)	0.015	1	6	21	21
pentachlorophenol	0.003	1,4	5	12	12
chlorophenols (sum)	[1]	[1]	[1]	[1]	[1]
d. polychlorinated biphenyls (PCBs)					
PCB 28	[1]	[1]	[1]	[1]	[1]
PCB 52	[1]	[1]	[1]	[1]	[1]
PCB 101	[1]	[1]	[1]	[1]	[1]
PCB 118	[1]	[1]	[1]	[1]	[1]
PCB 138	[1]	[1]	[1]	[1]	[1]

PCB 153	[1]	[1]	[1]	[1]	[1]
PCB 180	[1]	[1]	[1]	[1]	[1]
PCBs (sum 7)	0.02	0.04	0.5	1	1
e. other chlorinated hydrocarbons					
monochloroanilines (sum) [5]	0.2	0.2	0.2	50	50
pentachloroaniline	0.15	0.15	0.15	[1]	[1]
dioxin (sum TEQ) [6]	0.000055	0.000055	0.000055	0.00018	0.00018
chloronaphthalene (sum)	0.07	0.07	10	23	23
6. Pesticides					
a. organochlorine pesticides					
chlordane (sum)	0.002	0.002	0.1	4	4
DDT (sum)	0.2	0.2	1	1,7	1,7
DDE (sum)	0.1	0.13	1,3	2,3	2,3
DDD (sum)	0.02	0.84	34	34	34
DDT/DDE/DDD (sum)	[1]	[1]	[1]	[1]	[1]
aldrin [7]	[1]	[1]	[1]	0.32	0.32
dieldrin	[1]	[1]	[1]	[1]	[1]
endrin	[1]	[1]	[1]	[1]	[1]
isodrine	[1]	[1]	[1]	[1]	[1]
telodrin	[1]	[1]	[1]	[1]	[1]
drink (sum)	0.015	0.04	0.14	4	4
endosulfan sulfate	[1]	[1]	[1]	[1]	[1]
α-endosulfan	0.0009	0.0009	0.1	4	4
α-HCH	0.001	0.001	0.5	17	17
β-HCH	0.002	0.002	0.5	1.6	1.6
γ-HCH (lindane)	0.003	0.04	0.5	1,2	1,2
δ-HCH	[1]	[1]	[1]	[1]	[1]
HCH compounds (sum)	[1]	[1]	[1]	[1]	[1]
heptachlor	0.0007	0.0007	0.1	4	4
heptachlor epoxide (sum)	0.002	0.002	0.1	4	4
hexachlorobutadiene	0.003	[1]	[1]	[1]	[1]
organochlorine pesticides (sum soil)	0.4	[1]	[1]	[1]	[1]
b. organophosphorus pesticides					

azinphos-methyl	0.0075	0.0075	0.0075	[1]	[1]
c. organotin pesticides					
organotin compounds (sum) [8]	0.15	0.5	2.5	2.5	2.5
tributyltin (TBT) [8]	0.065	0.065	0.065	[1]	[1]
d. chlorophenoxyacetic acid herbicides					
MCPA	0.55	0.55	0.55	4	4
e. other pesticides					
atrazine	0.035	0.035	0.5	0.71	0.71
carbaryl	0.15	0.15	0.45	0.45	0.45
carbofuran	0.017	0.017	0.017	0.017	0.017
4-chloromethylphenols (sum)	0.6	0.6	0.6	[1]	[1]
organonitrogen and organophosphorus pesticides (sum)	0.09	0.09	0.5	[1]	[1]
7. Other substances					
asbestos [9]	[9]	100	100	100	100
cyclohexanone	2	2	150	150	150
dimethyl phthalate	0.045	9.2	60	82	82
diethyl phthalate	0.045	5.3	53	53	53
di-isobutyl phthalate	0.045	1,3	17	17	17
dibutyl phthalate	0.07	5	36	36	36
butyl benzyl phthalate	0.07	2.6	48	48	48
dihexyl phthalate	0.07	18	60	220	220
di(2-ethylhexyl)phthalate	0.045	8.3	60	60	60
mineral oil [10, 4]	190	190	500	5000	5000
pyridine	0.15	0.15	1	11	11
tetrahydrofuran	0.45	0.45	2	7	7
tetrahydrothiophene	1.5	1.5	8.8	8.8	8.8
tribromomethane (bromoform)	0.2	0.2	0.2	75	75
ethylene glycol	5	5	5	[1]	[1]
diethylene glycol	8	8	8	[1]	[1]
acrylonitril	0.1	0.1	0.1	[1]	[1]
formaldehyde	0.1	0.1	0.1	[1]	[1]
isopropanol (2-	0.75	0.75	0.75	[1]	[1]

isopropanol (2-propanol)	0.75	0.75	0.75	'	'
methanol	3	3	3	'	'
butanol (1-butanol)	2	2	2	'	'
butyl acetate	2	2	2	'	'
ethyl acetate	2	2	2	'	'
methyl tert-butyl ether (MTBE)	0.2	0.2	0.2	'	'
methyl ethyl ketone	2	2	2	'	'

1 Table note 1 covers various situations, the only thing which has in common is that for a particular substance, at least one of columns 2 to 6 refers to Table note 1.

This means that no quality requirement has been included for the substance in question for classifying the soil or a batch of soil or dredged material in the quality class to which the relevant column relates.

The following describes how the relevant substance should be dealt with in various situations when classifying soil or a batch of soil or dredged material into a quality class.

Only one situation description can apply to each substance at a time.

The following applies to a substance for which reference is made to table note 1 in one of columns 2 to 6.

– If reference is made in all columns 2 to 6 to table note 1, the substance is not included in the classification if:

• it concerns a substance that is not part of a sum parameter as described in Annex E ; or

• it concerns a sum parameter as described in Appendix E.

– If one of columns 2 to 6 refers to table note 1 and it concerns a substance that is part of a sum parameter as described in Annex E , then the substance is only included in the classification:

• as part of the relevant sum parameter when the substance is required to be included in determining the sum parameter according to Annex E; and

• as a substance also to the extent that a quality requirement is included for the substance in one of columns 2 to 6.

– If only columns 5 and 6 refer to table note 1 and the concentration of the substance converted according to Annex G is greater than the quality requirement for the quality class 'industry', then the quality class 'moderately contaminated' is used for the classification of that substance.

– If only columns 3 to 6 refer to table note 1 and the concentration converted according to Annex G is greater than the quality requirement for the quality class 'agriculture/nature', then the quality class 'industry' is used for the classification of that substance.

Appendix G - Threshold values for applying on water

This appendix shows the threshold values for using sediment in an application in a water body. Source: Soil Quality Regulation 2022.

Substance	**quality requirement for quality class 'not contaminated' or quality class 'generally applicable'**	**quality requirement for quality class 'slightly contaminated'**	**quality requirement for quality class 'moderately contaminated'**	**quality requirement for quality class 'heavily contaminated'**
quality class limitation	**the concentration of the substance is less than or equal to the value stated in this column**	**the concentration of the substance is greater than that in the 'not contaminated' column or 'generally applicable' value stated and less than or equal to the value stated in this column**	**the concentration of the substance is greater than the value stated in the 'slightly contaminated' column and less than or equal to the value stated in this column**	**the concentration of the substance is greater than the value stated in this column**
Column number	**2**	**3**	**4**	**5**
	for standard soil, in mg kg/dry matter			
Inorganic substances				
1. Metals				
antimony (Sb)	4	[1]	15	15
arsenic (As)	20	29	85	85
barium (Ba)	[1]	[1]	[1]	[1]
cadmium (Cd)	0.6	4	14	14
chromium (Cr)	55	120	380	380
cobalt (Co)	15	25	240	240
copper (Cu)	40	96	190	190
mercury (Hg)	0.15	1,2	10	10
lead (Pb)	50	138	580	580
molybdenum (Mo)	1.5	5	200	200
nickel (Ni)	35	50	210	210
tin (Sn)	6.5	[1]	[1]	[1]
vanadium (V)	80	[1]	[1]	[1]
zinc (Zn)	140	563	2000	2000
2. Other inorganic substances				
chloride [2]	[1]	[1]	[1]	[1]
cyanide (free)	3	[1]	20	20
cyanide (complex) [3]	5.5	[1]	50	50
thiocyanates	6	[1]	20	20
Organic substances				
3. Aromatic substances				

benzene	0.2	[1]	1	1
ethylbenzene	0.2	[1]	50	50
toluene	0.2	[1]	130	130
xylenes (sum)	0.45	[1]	25	25
styrene (vinylbenzene)	0.25	[1]	100	100
phenol	0.25	[1]	40	40
cresols (sum)	0.3	[1]	5	5
dodecylbenzene	0.35	[1]	[1]	[1]
1, 2, 3-trimethylbenzene	0.45	[1]	[1]	[1]
1, 2, 4-trimethylbenzene	0.45	[1]	[1]	[1]
1, 3, 5-trimethylbenzene	0.45	[1]	[1]	[1]
2-ethyltoluene	0.45	[1]	[1]	[1]
3-ethyltoluene	0.45	[1]	[1]	[1]
4-ethyltoluene	0.45	[1]	[1]	[1]
isopropylbenzene	0.45	[1]	[1]	[1]
propylbenzene	0.45	[1]	[1]	[1]
aromatic solvents (sum)	2.5	[1]	[1]	[1]
4. Polycyclic aromatic hydrocarbons (PAHs)				
naphthalene	[1]	[1]	[1]	[1]
phenanthrene	[1]	[1]	[1]	[1]
anthracene	[1]	[1]	[1]	[1]
fluoranthene	[1]	[1]	[1]	[1]
chrysene	[1]	[1]	[1]	[1]
benzo(a)anthracene	[1]	[1]	[1]	[1]
benzo(a)pyrene	[1]	[1]	[1]	[1]
benzo(k)fluoranthene	[1]	[1]	[1]	[1]
indeno(1,2,3cd)pyrene	[1]	[1]	[1]	[1]
benzo(ghi)perylene	[1]	[1]	[1]	[1]
PAKs total (sum 10)	1.5	9	40	40
5. Chlorinated hydrocarbons				
a. (volatile) chlorinated hydrocarbons				
monochloroethene (vinyl chloride)	0.1	[1]	0.1	0.1
dichloromethane	0.1	[1]	10	10
1,1-dichloroethane	0.2	[1]	15	15
1,2-dichloroethane	0.2	[1]	4	4

1,1-dichloroethylene	0.3	[1]	0.3	0.3
1,2-dichloroethylene (sum)	0.3	[1]	1	1
dichloropropanes (sum)	0.8	[1]	2	2
trichloromethane (chloroform)	0.25	[1]	10	10
1,1,1-trichloroethane	0.25	[1]	15	15
1,1,2-trichloroethane	0.3	[1]	10	10
trichloroethylene (Tri)	0.25	[1]	60	60
tetrachloromethane (Tetra)	0.3	[1]	1	1
tetrachloroethylene (Per)	0.15	[1]	4	4
b. chlorobenzenes				
monochlorobenzene	0.2	[1]	[1]	[1]
dichlorobenzenes (sum)	2	[1]	[1]	[1]
trichlorobenzenes (sum)	0.015	[1]	[1]	[1]
tetrachlorobenzenes (sum)	0.009	[1]	[1]	[1]
pentachlorobenzene	0.0025	0.007	[1]	[1]
hexachlorobenzene	0.0085	0.044	[1]	[1]
chlorobenzenes (sum)	2	[1]	30	30
c. chlorophenols				
monochlorophenols (sum)	0.045	[1]	[1]	[1]
dichlorophenols (sum)	0.2	[1]	[1]	[1]
trichlorophenols (sum)	0.003	[1]	[1]	[1]
tetrachlorophenols (sum)	0.015	[1]	[1]	[1]
pentachlorophenol	0.003	0.016	5	5
chlorophenols (sum)	0.2	[1]	10	10
d. polychlorinated biphenyls (PCBs)				
PCB 28	0.0015	0.014	[1]	[1]
PCB 52	0.002	0.015	[1]	[1]
PCB 101	0.0015	0.023	[1]	[1]
PCB 118	0.0045	0.016	[1]	[1]
PCB 138	0.004	0.027	[1]	[1]
PCB 153	0.0035	0.033	[1]	[1]
PCB 180	0.0025	0.018	[1]	[1]
PCBs (sum 7)	0.02	0.139	1	1
e. other chlorinated hydrocarbons				
monochloroanilines (sum)	0.2	[1]	50	50
pentachloroaniline	0.15	[1]	[1]	[1]

dioxin (sum TEQ) [4]	0.000055	[1]	[1]	[1]
chloronaphthalene (sum)	0.07	[1]	10	10
6. Pesticides				
a. organochlorine pesticides				
chlordane (sum)	0.002	[1]	4	4
DDT (sum)	[1]	[1]	[1]	[1]
DDE (sum)	[1]	[1]	[1]	[1]
DDD (sum)	[1]	[1]	[1]	[1]
DDT/DDE/DDD (sum)	0.3	0.3	4	4
aldrin	0.0008	0.0013	[1]	[1]
dieldrin	0.008	0.008	[1]	[1]
endrin	0.0035	0.0035	[1]	[1]
isodrine	0.001	[1]	[1]	[1]
telodrin	0.0005	[1]	[1]	[1]
drink (sum)	0.015	0.015	4	4
endosulfan sulfate	[1]	[1]	[1]	[1]
α-endosulfan	0.0009	0.0021	4	4
α-HCH	0.001	0.0012	[1]	[1]
β-HCH	0.002	0.0065	[1]	[1]
γ-HCH (lindane)	0.003	0.003	[1]	[1]
δ-HCH	[1]	[1]	[1]	[1]
HCH compounds (sum)	0.01	0.01	2	2
heptachlor	0.0007	0.004	4	4
heptachlor epoxide (sum)	0.002	0.004	4	4
hexachlorobutadiene	0.003	0.0075	[1]	[1]
organochlorine pesticides (sum water bottom)	0.4	[1]	[1]	[1]
b. organophosphorus pesticides				
azinphos-methyl	0.0075	[1]	[1]	[1]
c. organotin pesticides				
organotin compounds (sum) [5]	0.15	[1]	2.5	2.5
tributyltin (TBT) [5]	0.065	0.25	[1]	[1]
d. chlorophenoxyacetic acid herbicides				
MCPA	0.55	[1]	4	4
e. other pesticides				
atrazine	0.035	[1]	6	6

carbaryl	0.15	[1]	5	5
carbofuran	0.017	[1]	2	2
4-chloromethylphenols (sum)	0.6	[1]	[1]	[1]
organonitrogen and organophosphorus pesticides (sum)	0.09	[1]	[1]	[1]
7. Other substances				
asbestos [6]	[6]	100	100	100
cyclohexanone	2	[1]	45	45
dimethyl phthalate	[1]	[1]	[1]	[1]
diethyl phthalate	[1]	[1]	[1]	[1]
di-isobutyl phthalate	[1]	[1]	[1]	[1]
dibutyl phthalate	[1]	[1]	[1]	[1]
butyl benzyl phthalate	[1]	[1]	[1]	[1]
dihexyl phthalate	[1]	[1]	[1]	[1]
di(2-ethylhexyl)phthalate	[1]	[1]	[1]	[1]
phthalates (sum)	0.25	[1]	60	60
mineral oil	190	1250	5000	5000
pyridine	0.15	[1]	0.5	0.5
tetrahydrofuran	0.45	[1]	2	2
tetrahydrothiophene	1.5	[1]	90	90
tribromomethane (bromoform)	0.2	[1]	75	75
ethylene glycol	5	[1]	[1]	[1]
diethylene glycol	8	[1]	[1]	[1]
acrylonitril	0.1	[1]	[1]	[1]
formaldehyde	0.1	[1]	[1]	[1]
isopropanol (2-propanol)	0.75	[1]	[1]	[1]
methanol	3	[1]	[1]	[1]
butanol (1-butanol)	2	[1]	[1]	[1]
butyl acetate	2	[1]	[1]	[1]
ethyl acetate	2	[1]	[1]	[1]
methyl tert-butyl ether (MTBE)	0.2	[1]	[1]	[1]
methyl ethyl ketone	2	[1]	[1]	[1]

Appendix H - Threshold values for PFAS/PFOA

This appendix shows the threshold values for PFAS/PFOA for the beneficial use of sediment. Source: Emergency act for toxic levels of PFAS/PFOA, version December 2023.

Categorie	**Toepassingssituatie**		**Toepassingswaarde (µg/kg d.s.)** [2][3][4][5][7]
		Op de landbodem	
4.1	Grond en baggerspecie toepassen		
	Bodemkwaliteitsklasse	**Bodemfunctieklasse**	
	wonen of industrie	wonen of industrie	PFOS = 3 PFOA = 7 Overige PFAS = 3
	landbouw/natuur	wonen of industrie	PFOS = 1,4 PFOA = 1,9 Overige PFAS = 1,4
	Landbouw/natuur, wonen of industrie	landbouw/natuur	PFOS = 1,4 PFOA = 1,9 Overige PFAS = 1,4
4.2	Baggerspecie verspreiden, als bedoeld in artikel 4.1269, derde lid onder a van het Bal (verspreiden inclusief verspreiden in weilanddepots van baggerspecie afkomstig uit regionale wateren op aangrenzende percelen of op landbouwgronden gelegen tot 10 km afstand van de plaats van vrijkomen)		PFOS = 3 PFOA = 7 Overige PFAS = 3
4.3	Grond en baggerspecie grootschalig toepassen		PFOS = 3 PFOA = 7 Overige PFAS = 3
4.4	Grond en baggerspecie toepassen in grondwaterbeschermingsgebieden		Gebiedskwaliteit, indien niet bekend 0,1
4.5, vervallen	Grond en baggerspecie toepassen onder grondwaterniveau, met inbegrip van grootschalige toepassing.		Vervalt, zie categorie 4.1, 4.2 en 4.3
		In een oppervlaktewaterlichaam[9]	
4.6, vervallen	Grond toepassen		Vervalt, zie categorie 4.8.2, 4.9.1 en 4.9.2
4.7	Baggerspecie verspreiden in hetzelfde oppervlaktewaterlichaam of aansluitende (sedimentdelende)[10] stroomafwaarts gelegen oppervlaktewaterlichamen (als bedoeld in artikel 4.1269, derde lid onder b en c van het Bal)		Toepasbaar, wel meten en toetsen op uitschieters[8].
4.8.1	Baggerspecie toepassen in hetzelfde oppervlaktewaterlichaam in toepassingen, als bedoeld in artikel 4.1269, tweede lid onder f, g en h van het Bal		Toepasbaar, wel meten en toetsen op uitschieters[8].
4.8.2	Het in een ander oppervlaktewaterlichaam : • verspreiden van baggerspecie (bij niet-sedimentdelende oppervlaktewaterlichamen) als bedoeld in artikel 4.1269, derde lid onder b van het Bal en • het toepassen van baggerspecie en grond in toepassingen als bedoeld in artikel 4.1269, tweede lid onder f, g en h van het Bal.		Rijkswater: PFOS = 3,7 PFOA = 0,8 Overige PFAS = 0,8 Anders: PFOS = 1,1 PFOA = 0,8 Overige PFAS = 0,8
4.9.1	Baggerspecie en grond toepassen in niet-vrijliggende diepe plassen die in open verbinding staan met een rijkswater [1][6]		PFOS = 3,7 PFOA = 0,8 Overige PFAS = 0,8

Appendix I - Glossary of technical terms

Term	Definition
Beneficial use (of dredged material)	Productive reuse of dredged sediment for functional or ecological purposes, such as flood defense, construction fill, or ecosystem restoration.
Building with Nature (BwN)	Design approach integrating natural processes into engineering projects to enhance sustainability and resilience.
Disposal	Final placement of dredged material at a dedicated site, typically due to contamination or lack of reuse potential.
Environmental Impact Assessment (EIA)	International process to evaluate environmental effects of a project. In the Netherlands, this is implemented as MER.
Environmental permit	Legal authorization required for activities with potential environmental impacts (e.g., dredging, reuse, storage).
Natura 2000	European network of protected natural areas under Birds and Habitats Directives.
Nature-based Solutions (NbS)	Use of natural systems or processes for addressing societal challenges like climate adaptation and biodiversity loss.
North Sea Spreading Law	Dutch law specifying designated zones for safe disposal or reuse of marine sediments in the North Sea.
Pre-assessment (of dredging need)	Dutch guideline to determine if dredging is required to meet water quality goals.
Soil Quality Decree (Besluit Bodemkwaliteit)	Dutch decree setting threshold values and protocols for reuse of soil and dredged sediments based on intended application.
Spreading	Reuse method involving placing dredged sediment on land or water, typically near its origin, under regulatory thresholds.
Temporary storage	Interim holding of dredged material before final application or disposal, subject to permit rules.
Threshold values	Regulatory limits for contaminants, used to determine if dredged material can be reused or requires disposal.

Appendix J - Glossary of Acronyms

Acronym	Full Name	Description
AW-2000	Achtergrondwaarden 2000	Dutch baseline soil contamination dataset used to derive background values.
BAL	Besluit Activiteiten Leefomgeving	Dutch Environmental Activities Decree listing environmentally relevant activities and required permits.
BeSI	Beschermde Soorten Indicator	Tool to check for presence of protected species and determine need for nature permits.
BRL	Beoordelingsrichtlijn	Certification guideline for quality control in soil and sediment management (e.g., BRL 9335, BRL SIKB 7000).
C1 / C3	–	Standardized analytical lab packages used in the Netherlands for assessing soil and dredged material quality.
CONPES 4118	Consejo Nacional de Política Económica y Social 4118	Colombian policy directive emphasizing beneficial sediment reuse in port management.
CSOIL	–	Dutch exposure model to calculate human health risks from contaminated soil.
DNP	Departamento Nacional de Planeación	Colombian agency for long-term national planning and development strategy.
EIA	Environmental Impact Assessment	International assessment process for identifying environmental risks of major projects.
EPA	Environment and Planning Act (Omgevingswet)	Dutch law integrating environmental and spatial planning regulations into a single framework.
ERM/PEL	Effect Range Median / Probable Effect Level	International toxicity thresholds used to assess sediment impact on aquatic life.
EU WFD	European Union Water Framework Directive	EU directive that sets water quality goals and prohibits activities (like dredging) that degrade water bodies.
HVN	Hoogst Verantwoorde Norm	Maximum acceptable value for sediment quality based on environmental and health criteria.
INVIAS	Instituto Nacional de Vías	Colombian national institute managing transport infrastructure, including ports and waterways.
MER	Milieu Effect Rapportage	Dutch Environmental Impact Report, comparable but broader than standard EIA.
MinAmbiente	Ministerio de Ambiente y Desarrollo Sostenible	Colombian Ministry of Environment, responsible for setting sediment reuse guidelines.
MinTransporte	Ministerio de Transporte	Colombian Ministry of Transport, stakeholder in port and dredging regulation.
MKBA	Maatschappelijke Kosten-Baten Analyse	Dutch cost-benefit analysis that quantifies social and environmental impacts in monetary terms.
MKI	Milieukostenindicator	Environmental cost index that quantifies ecological impact for use in procurement and evaluation.
NbS	Nature-based Solutions	Strategies using natural processes and ecosystems for infrastructure and environmental management.

OSPAR	–	North-East Atlantic regional agreement to protect marine ecosystems (Netherlands is a party).
PNDM	Plan Nacional de Dragados Marítimos	Colombia's 2017 National Maritime Dredging Plan with strategic goals for reuse and regulation.
PFAS	Per- and polyfluoroalkyl substances	Group of persistent industrial chemicals regulated due to toxicity and environmental risk.
PFOA	Perfluorooctanoic acid	A type of PFAS banned or limited due to high persistence and toxicity.
RAW	Rationalisatie en Automatisering Grond-, Weg- en Waterbouw	Dutch system for standardizing technical specifications in civil and dredging contracts.
RIVM	Rijksinstituut voor Volksgezondheid en Milieu	Dutch National Institute for Public Health and the Environment, supporting environmental threshold research.
RWS	Rijkswaterstaat	Dutch agency managing national waterways, enforcing dredging and environmental regulations.
RVO	Rijksdienst voor Ondernemend Nederland	Dutch agency granting permits and supporting economic/environmental initiatives (e.g., in EEZ dredging).
SEDIAS	Sediment Assessment Assistant	Dutch software tool for assessing impact of contaminated sediments on water quality.
SIKB	Stichting Infrastructuur Kwaliteitsborging Bodembeheer	Foundation responsible for protocols and certification in Dutch soil/sediment quality control.
SIKB Protocol 1001	–	Field sampling protocol for collecting soil or dredged material samples for batch classification.
SIKB Protocol 3000 / AP04	–	Dutch laboratory analysis standard for determining chemical contamination in soils and sediments.
ZBT	Zoute Baggertoets	Saltwater dredging test to evaluate sediment suitability for spreading at sea.

Appendix K – Overview of dredging monitoring systems used globally

System Type	Parameter Measured	Example Devices/Systems	Protocols & Methods	Availability/Use in Colombia
In-situ turbidity sensors	Turbidity (NTU/FNU)	YSI EXO2, Seapoint Turbidity Sensor, Eureka Manta+, Hydrolab DS5	Continuous logging; calibrated per ISO 7027 or USEPA 180.1; placed upstream/downstream; readings every 15 mins	Used by INVEMAR, port authorities; available via local distributors
Multiparameter sondes	Turbidity, DO, pH, salinity, temp	YSI EXO2, Eureka Manta+, OTT Hydrolab	Field deployment with vertical profiles; quality assurance with duplicates and calibration	Common in baseline studies; used by consultants in Cartagena, Barranquilla
Acoustic Doppler Current Profilers (ADCP)	Current velocity/direction, sediment transport	Teledyne RDI Workhorse, Nortek Aquadopp	Installed on pontoons or bottom-mounted; data every 15–30 mins; supports plume dispersion modeling	Used in hydrographic and dredging surveys; operated by DIMAR, private contractors
Remote turbidity buoys	Surface turbidity (real-time)	YSI EMM68, SmartBuoy by Cefas, Campbell Scientific CR300	Continuous logging + telemetry (GPRS); alarms on threshold exceedance; solar powered	Deployed in ports and sensitive habitats; telemetry integration with monitoring platforms
Drone-based sensors	Surface turbidity (spatial)	DJI drones with MicaSense RedEdge, Parrot Sequoia	Image acquisition + reflectance-based turbidity estimation; calibrated with field data	Used by consulting firms for shallow plume mapping
Satellite-based monitoring	Surface turbidity (regional scale)	Sentinel-2, Landsat-8	Image processing (e.g., band ratios); validation with in-situ measurements	Used by IDEAM, universities for plume tracking in Magdalena delta and Pacific coast
Plume modeling systems	Predicted sediment spread	Delft3D, MIKE21, TELEMAC	Driven by ADCP, bathymetry, sediment loads; used for adaptive dredging control	Used in major port projects (e.g., Cartagena); often integrated into EIAs
AIS (Automatic Identification System)	Dredger location & movement	MarineTraffic, Vesper Cortex AIS, dredger onboard AIS	Position tracking for compliance & correlation with plume data	Standard for contractor vessels; regulated by DIMAR
Water sampling (manual)	Total Suspended Solids (mg/L)	Van Dorn bottles, Niskin samplers, GF/F filters	Lab analysis; TSS vs. turbidity calibration curve; done during spot checks	Used for regulatory compliance and calibration of sensors

Colophon

POLICY- AND TECHNICAL ADVICE ON THE BENEFICIAL USES OF MARINE DREDGED SEDIMENTS IN COLOMBIA, INCLUDING NATURE-BASED SOLUTIONS
INFORMATION, EXPERIENCES, AND LESSONS LEARNED IN THE LICENSING, OPERATION, MONITORING AND CONTROL OF MARITIME DREDGING ACTIVITIES IN THE NETHERLANDS, AS WELL AS IN THE DETERMINATION OF REQUIREMENTS TO APPROVE IN THIS COUNTRY THE USES OF MARINE DREDGED SEDIMENTS

The project "Policy and Technical Advice on the Beneficial Uses of Marine Dredged Sediments in Colombia, including Nature-Based Solutions" is part of the collaboration between the Government of the Netherlands, through the Partners for Water program, and the Colombian Ministry of Environment, the National Planning Department (DNP) and the Ministry of Transport. The project was carried out by a consortium consisting of Arcadis, Fundación Herencia Ambiental Caribe, JESyCA, and Netics, together with government entities from both Colombia and the Netherlands.

AUTHORS
Jip Koster, NETICS B.V.
Thijs Verhoeven, NETICS B.V.
Hugo Ekkelenkamp, NETICS B.V.

OUR REFERENCE
:1

DATE
23rd January 2026

STATUS
Final

CHECKED BY

Martijn Onderwater
Technical Manager, Arcadis B.V

Juan David Carranza
Soil scientist

RELEASED BY

Jeroen Klooster
Project Manager, Arcadis B.V