Joint Transitional Arrangements for the Handling of Dredged Material in German Federal Coastal Waterways (GÜBAK-WSV)

(between the Federal authorities and the Federal States (Bundesländer) Bremen, Hamburg, Mecklenburg-Western Pomerania, Lower Saxonia, and Schleswig-Holstein)

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1 Preliminary remarks

The objective of the Joint Transitional Arrangement on the Handling of Dredged Material in German Federal Coastal Waterways (GÜBAK-WSV) is to establish common procedures and criteria for the handling of dredged material, to minimise negative effects on the environment and its legitimate uses, and to meet the requirements of the national and European legislation on the protection of waters, the seas, and nature - taking also economic interests like transport and harbour operation as well as tourism and fishery into consideration.

The Joint Transitional Arrangements are preliminary, since regulative and technical developments in the years 2007/2008 made a revision of the directive HABAK-WSV necessary. These developments find their expression in the following documents:

- For the first time, the management plans of the EU-WFD and the action plans were set up on the river-basin scale in December 2008. These draft versions went into the process of public hearing and came into force on 1 January 2010.
- The daughter directive on environmental quality objectives (UQN) for priority substances of the EU-WFD was adopted on 16 December 2008.
- The Marine Strategy Directive of the EU was adopted on 17 June 2008.
- The European Directive on Flood Protection became effective in 2007 (EG-HWRL).

The revision of the former HABAK-WSV guidelines is underway in the German Federal Institute of Hydrology (BfG) on behalf of the Federal Ministry of Transport, Building and Urban Development (BMVBS). After consultations and agreements between the Federal authorities and the affected Federal States (Bundesländer) (Bremen, Hamburg, Mecklenburg-Western Pomerania, Lower Saxonia, Schleswig-Holstein) the present joint transitional arrangement (GÜBAK) shall be replaced by a new directive.

The sediments that are moved in maintenance operations in coastal waters differ strongly and their characteristics depend much on the prevailing hydrodynamic and morphological
situations. The deposition of such material on land will not become practicable beyond the present scale.

Moreover, these sediments may be contaminated in variable degrees - sometimes heavily. There is agreement between the coastal Bundesländer and the Federal authorities that all efforts will be made to reduce such contaminations and to improve the sediment quality. This objective has to be followed furtheron in the national implementation of the EU-WFD, because the dredged material should be retained in the water bodies to sustain their hydromorphologic processes. The Federal authorities and the Bundesländer will seek for solutions for the maintenance of the waterways and represent them in national and international bodies and organizations.

Further objectives are to develop the sediment management concepts with the management plans, the integrated management plans (FFH-RL), and the action plans according to the European Marine Strategy Framework Directive (EU-MSFD).
1. Introduction

1.1 Background

The protection of the seas in issues of dredged-material placement on the high sea, in coastal waters, and in the inner waters are regulated in the following international conventions on the protection of the marine environment that were ratified by the Federal Republic of Germany and are therefore national law:

a) LONDON CONVENTION (1972):
   Specific Guidance for Assessment of Dredged Material
b) OSPAR CONVENTION (1992):
   OSPAR Guidelines for the Management of Dredged Material
c) HELSINKI CONVENTION (von 1992):
   Revised Guidelines for the Disposal of Dredged Spoils

In the framework of these conventions on marine environmental protection, special directives for the ecologically acceptable placement of dredged material in the respective conventions areas have been passed (London 2000, OSPAR 2004, HELSINKI 1992). Such regulations have to be observed in all operations of waterway maintenance, development, and remedial actions.

In accordance with the conventions, the signatory countries are obliged not to place, relocate, or dump dredged material within the convention areas without permits or other arrangements made by the responsible authorities. The following “Joint Arrangements” regulate the application of the three "dredging directives" in the competent authorities of the Federal government and the coastal Bundesländer of Germany.

The guidelines of the international conventions apply only to the placement of dredged material into waters. However, the contracting parties are requested to reduce the negative impacts also during the dredging process. In this regard, the information given in Section 8 (Impact hypothesis) of these Joint Transitional Arrangements (GÜBAK) may serve as working aid.

Further consideration should be given to the protection goals of the nature reserves of the NATURA 2000 network, areas protected under the EU-guideline FFH (Guideline 92/43/EWG)
of 21 May 1992, the Bird Protection Directive (Guideline 79/409/EWG), and further regulations at national and Bundesländer levels.

1.2 Objective and application of the international directives on dredging material

The aim and purpose of these directives is to give contracting parties common rules for investigations, assessments, and placement options of dredged material in the affected waters and thus to prevent contaminations and protect marine species and habitats. Because the guidelines of the LONDON and OSPAR conventions were found to be the most consistent of these regulations, they were chose as the foundation for the application in Germany. Thus, also the requirements of the HELCOM convention are met.

Since these regulations cover only coastal areas of the North Sea and the Baltic Sea to the freshwater limits, they concern only the local authorities that are competent there.

The Joint Transitional Arrangements have to be applied for the placement of dredged material by dumping, relocation, and hydrodynamic dredging techniques.

1.3 Definitions of technical terms

Dredged Material
Dredged material is sediment, soil or excavation material with different portions of mineral or organic components that are moved during the construction of the waterways, their maintenance, and for the preservation of flow discharge or the safety and ease of navigation.

Dredging
Dredging is the technical procedure to grab and lift aquatic sediments or natural subaquatic soils in order to provide the desired channel or fairway profile or to mine sediment or soil material. The type of dredging operation depends on the available equipment and its applicability. These technologies encompass conventional methods and special dredging methods in environmentally sensitive waters.
Placement
These are technical procedures to store dredged material within the water or on land. The material may remain at the placement site forever or for a limited time.

Confined disposal (subaquatic/upland)
A confined disposal facility (CDF) is a technical structure to isolate contaminated dredged material from the environment aiming to have the opportunity to monitor and control potential negative effects in the environment.

Treatment
Treatment is a specific and time-limited procedure to improve the properties of the dredged material and/or to reduce harmful effects to make further beneficial uses or placement possible.

Beneficial use
- Direct utilisation of dredged material without any treatment.
- Utilisation of dredged material after treatment as substitute material in order to save natural resources.

1.4 Scopes of applicability of the conventions
The OSPAR Convention covers formally the North Atlantic, parts of the Arctic Ocean and of the North Sea. Protected zones in the sense of this convention are the High Seas, the area seawards of the coastal sea (exclusive economic zone), the coastal waters seawards of the baseline, and the inner waters landwards from the baseline up to the freshwater limit. The freshwater limit is defined as “the point in a watercourse where at times of low tide or of weak freshwater flow the salt content increases significantly due to the presence of sea water”.
In the North Sea, the freshwater limits of waterways and rivers on the German coast were defined as listed below (Fig. 1):

- River Ems: River-km 25 (Terborg)
- River Jade: Completely (to the mean tidal high water limit-MTHw)
- River Weser: River-km 58 (Nordenham)
- River Elbe: River-km 683 (Freiburg Hafenpriel)
- River Eider: River-km 104 (Schülperneuensiel)

The convention area of the LONDON Convention covers marine waters up to the baseline of the Member States and is thus incorporated in the OSPAR Convention.

Figure 1: German OSPAR Convention area and inner waters on the German North-Sea coast
1 = High Sea (exclusive economic zone)
2 = coastal waters
3 = inner waters
== = fresh water limit
The HELSINKI Convention covers the Baltic Sea region to the baseline and the inner waters. It thus refers to a larger area in the Baltic Sea than the LONDON Convention. In the German Baltic Sea region, the upstream limits of the inner waters are preliminarily taken as the freshwater limits (like in the North Sea) until final definitions will be made (Fig. 2):

Lower Trave: Waterway-km 6 (BWaStr), 19.5 (Konstinkai)
Lower Warnow: River-km 12.5, ship-lock Mühlendamm
Peenestrom: Mouth of the coastal "Peenestrom" including the backwater
Boddens, fjords
and haffs (lagoons): As their water is saline, the placement of dredged material there is subject to the GÜBAK directive.

Figure 2: German HELCOM Convention area and inner waters on the German Baltic-Sea coast

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>High Sea (exclusive economic zone)</td>
</tr>
<tr>
<td>2</td>
<td>coastal waters</td>
</tr>
<tr>
<td>3</td>
<td>inner waters</td>
</tr>
<tr>
<td>===</td>
<td>fresh water limit</td>
</tr>
</tbody>
</table>
The scope of application of the Joint Transitional Arrangement (GÜBAK) covers the territorial waters and the inner waters as shown in Figures 1 and 2.

1.5 Workflow and scope of investigations

The objective of the investigations is the acquisition of information that allows to assess potential ecological effects due to the placement of dredged material in the convention area.

The GÜBAK directive describes a list of investigations that have to be made - sometimes only partly, depending on the prevailing circumstances. The necessary scope and the frequency of the investigations are normally defined by the competent authorities in line with the local conditions. The parameters to be investigated according to the GÜBAK directive are shown in the following scheme (Figure 3). If necessary, chemical and biological investigations may be made simultaneously.

Prior to the placement of dredged material in water bodies, the options of beneficial use - with or without treatment, or the need of confinend disposal have to be reviewed, taking technical, economical and ecological aspects into consideration (Section 7). This check has to be duely documented.

The formal permit is issued by the competent authority together with an expiration date. Data acquired in such investigations remain valid for 5 years unless significant changes occur.

If the placement site is located in the High Sea, the German Federal Maritime and Hydrographic Agency (BSH) is the competent authority regarding the scope of investigations needed and the issue of permits. The High Sea comprises also the Exclusive Economic Zone (EEZ). Here, the “Gesetz zur Ausführung des Protokolls vom 7. November 1996 zum Übereinkommen über die Verhütung der Meeresverschmutzung durch das Einbringen von Abfällen und anderen Stoffen von 1972“ applies.

The responsibilities in the different work packages during the application of the GÜBAK directive are defined by the competent authority.
2. Sedimentological investigations
(§ 4.1 LONDON, § 5.4 OSPAR)

The following data should be measured to estimate the physical behaviour of the dredged material:

- Density/specific gravity,
- Solid-matter content (% dry matter) or water content (%),
- Grain-size distribution (% > 63, < 63, < 20 μm),
- Organic matter (as total organic carbon, TOC in % dry matter, fraction < 2 mm).

For the conversion from the volume of dredged material to its mass that is required for reporting to the OSPAR and HELCOM secretariats (cf. Section 11), the following average density values are used:

<table>
<thead>
<tr>
<th>Material</th>
<th>Density [t/m³]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mud/sludge/silt</td>
<td>1.2</td>
</tr>
<tr>
<td>Mixture</td>
<td>1.5</td>
</tr>
<tr>
<td>Sand</td>
<td>1.8</td>
</tr>
</tbody>
</table>

3. Exemptions
(§ 4.2 LONDON, § 5.2 OSPAR)

Sediments at the dredging and the deposition sites can be exempted from additional testing, if one of the following criteria applies:

- The material consists mainly of undisturbed geological material (natural soil).
- The dredged material is composed of more than 90% sand, gravel or rock; or coarse material (fraction >63 μm).

---

1 To ensure that larger organic conglomerates (> 63μm) do not lead to misinterpretations, the TOC is to be analysed in the fraction < 2000 μm. If the TOC concentration exceeds 5 %, chemical testing is obligatory.
Results of earlier analyses (Section 1.5) do not show significant contamination of the dredged material (Section 4.4.2.1, Case 1) and the amount of the dredged material per project is less that 10,000 tonnes (dry mass) per year.

If the above-mentioned criteria are applied, Sections 5.3.2, 5.3.3, 8 (impact hypothesis), and 10 (monitoring programme) have to be taken into account. Further information are essential for assessing the contamination of dredged material to which the above-mentioned criteria cannot be applied.
Figure 3: Flow chart of dredged-material assessment

(from OSPAR-Dredged-material guidelines, 2004)
4. Chemical analyses and assessments

(§ 4.3 – 4.6 LONDON, § 5.4-5.6 and 7.1-7.7 OSPAR)

4.1 General

About dredged material to which the exemptions (Section 3) are not applicable further information is needed for assessing its contamination. Chemical analyses are required to estimate concentrations of contaminants and nutrients. The required extent of sampling and analyses is defined by the competent authorities. Generally, the local characteristics have to be taken into consideration when the frequency and the extent of chemical analyses are determined.

4.2. Sampling

4.2.1 Representativeness of the sediment samples

When the sampling sites and depths are selected, the area and depth of the area to be dredged, the volume of material to be dredged, and the expected changes in the horizontal and vertical patterns of the sediment composition have to be taken into account. The sediment to be analysed should be collected at representative sampling sites.

4.2.2 Number of samples

The following table provides information about the number of individual sampling stations needed in order to ensure representative results, provided that the dredging site is relatively uniform in composition.
Table 1: Recommendations for the number of sampling sites in the area to be dredged.

<table>
<thead>
<tr>
<th>Volume of dredged material [m³] per project</th>
<th>Number of sampling stations</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 25 000</td>
<td>3</td>
</tr>
<tr>
<td>25 000 – 100 000</td>
<td>4 – 6</td>
</tr>
<tr>
<td>100 000 – 500 000</td>
<td>7 – 15</td>
</tr>
<tr>
<td>500 000 – 2 000 000</td>
<td>16 – 30</td>
</tr>
<tr>
<td>&gt; 2 000 000</td>
<td>another 10 per 1 000 000 m³</td>
</tr>
</tbody>
</table>

The number of sampling stations should be adjusted to the conditions for sedimentation in the respective areas, i.e., less stations are needed in open areas (with intensive water exchange) and more stations in partially or completely enclosed areas (e.g. harbour basins).

4.2.3 Individual samples/Composite samples

Normally, the samples from each sampling station are analysed separately.

In case the sediment is homogeneous in regard to its composition (grain-size distribution, organic material) and the expected contamination, samples of two or several neighbouring stations can be pooled into composite samples. This requires, however, that the results provide a representative mean value of the sediment contamination. The original sediment samples should be stored until the dredging project has been approved.

4.2.4 Frequency of sampling

The frequency of sampling should be adjusted to the respective dredging project and the contaminant concentrations.

4.3 Extent, parameters, and methods of chemical analyses

The samples are freeze-dried and sieved > 2 mm.

The fraction (< 2 mm) is referred to as total sample. In this sample organic contaminants and nutrients are analysed. The contents of organic contaminants are re-calculated to the fraction <
63 µm of the total sample, because of the fact that organic contaminants are mainly present in this fraction.

The fraction < 20 µm is separated from the total sample, and the heavy metals are analysed in this fraction. For better estimation of the total heavy-metal contents it is recommended to analyse heavy metals additionally in 10 % - at least in two - of the total samples (< 2 mm, see hereabove).

If local inputs of heavy metals are expected (e.g. at dockyards), the dredged material should be investigated according to the criteria described in Section 3 (if the fraction < 63 µm makes up less than 10 % of the sample). When contaminants like ore, sand-blast particles, or antifouling-paint residues may be present, analyses of the total samples have to be carried out.

The extent of the analyses may be reduced in exceptional cases, but only with the consent of the responsible authorities.

Sediment analyses should be made with the methods and the guiding values given in Annex 3.

Contractor laboratories have to prove their quality-assurance standards. These includes:

• Measurements of blanks and of appropriate certified reference material within the series of sediment samples;
• Participation in intercalibration exercises with sediment samples or periodical intercalibration exercises like QUASIMEME.

Information about the applied quality-assurance procedures is also required by OSPAR with the annual reporting on dredged material.

4.4 Assessment of the analytical results and measures

(Section 5 LONDON, § 5.10-5.13 OSPAR)

Objective, purely scientifically based assessment procedures of analytical dredged-material data exist to date neither in Germany nor elsewhere. To be nevertheless able to make the required assessments of dredged material, an interim assessment procedure is being applied.
4.4.1 Guiding values for assessing contaminants in dredged material

In contrast to the legally binding limit values, the values listed in the following table are to be understood as guiding values. However, if the measurements remain below these guiding values, it does not mean that the dredged-material placement is automatically acceptable, just like exceedance of the guiding values does not imply prohibition of aquatic placement in principle. The guiding values are part of the impact hypothesis (Sections 5.2.1 and 8) and of the subsequent monitoring programme.

The guiding values are derived from the currently known contaminant concentrations in the Wadden Sea and in coastal sediments of the North Sea and the Baltic Sea. They are related to the sediment fraction < 20 µm in assessing heavy metals and to the sediment fraction < 63 µm in assessing organic contaminants.

Because of the currently prevailing contamination, the guiding values cannot be duly observed everywhere and will not be achieved soon. Accordingly, it is necessary to take regional characteristics into consideration within regional sediment-management concepts (e.g. on the tidal Elbe, a concept of river-engineering works and sediment management, the “Strombau- und Sedimentmanagementkonzept für die Tide-Elbe” of 01 June 2008).

In assessing the heavy metals, the values measured in the sediment fraction < 20 µm are compared directly with the guiding values. The assessment of the organic contaminants is based on their concentrations in the sediment fraction < 63 µm that were calculated from the analyses in the total sample and the percentage of the sediment fraction < 63 µm.
Table 2: Guiding values for assessing contaminant and nutrient concentrations in dredged material

Heavy metals: related to the fraction < 20 μm dry mass

Organic contaminants: related to fraction < 63 μm dry mass

TBT: related to the total sample

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>Concentration</th>
<th>North Sea Guiding value RV1</th>
<th>North Sea Guiding value RV2</th>
<th>Baltic Sea Guiding value RV1</th>
<th>Baltic Sea Guiding value RV2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Heavy metals</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arsenic</td>
<td>mg / kg</td>
<td>40</td>
<td>120</td>
<td>20</td>
<td>60</td>
</tr>
<tr>
<td>Lead</td>
<td>mg / kg</td>
<td>90</td>
<td>270</td>
<td>100</td>
<td>300</td>
</tr>
<tr>
<td>Cadmium</td>
<td>mg / kg</td>
<td>1.5</td>
<td>4.5</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Chrome</td>
<td>mg / kg</td>
<td>120</td>
<td>360</td>
<td>90</td>
<td>270</td>
</tr>
<tr>
<td>Copper</td>
<td>mg / kg</td>
<td>30</td>
<td>90</td>
<td>70</td>
<td>210</td>
</tr>
<tr>
<td>Nickel</td>
<td>mg / kg</td>
<td>70</td>
<td>210</td>
<td>70</td>
<td>210</td>
</tr>
<tr>
<td>Mercury</td>
<td>mg / kg</td>
<td>0.7</td>
<td>2.1</td>
<td>0.4</td>
<td>1.2</td>
</tr>
<tr>
<td>Zinc</td>
<td>mg / kg</td>
<td>300</td>
<td>900</td>
<td>250</td>
<td>750</td>
</tr>
<tr>
<td><strong>Organic contaminants</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sum of PCB</td>
<td>μg / kg</td>
<td>13</td>
<td>40</td>
<td>40</td>
<td>120</td>
</tr>
<tr>
<td>α-HCH</td>
<td>μg / kg</td>
<td>0.5</td>
<td>1.5</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>γ-HCH</td>
<td>μg / kg</td>
<td>0.5</td>
<td>1.5</td>
<td>6</td>
<td>18</td>
</tr>
<tr>
<td>Hexachlorobenzene</td>
<td>μg / kg</td>
<td>1.8</td>
<td>5.5</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Pentachlorobenzene</td>
<td>μg / kg</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p,p'-DDT</td>
<td>μg / kg</td>
<td>1</td>
<td>3</td>
<td>7</td>
<td>21</td>
</tr>
<tr>
<td>p,p'-DDE</td>
<td>μg / kg</td>
<td>1</td>
<td>3</td>
<td>8</td>
<td>24</td>
</tr>
<tr>
<td>p,p'-DDD</td>
<td>μg / kg</td>
<td>2</td>
<td>6</td>
<td>7</td>
<td>21</td>
</tr>
<tr>
<td>Hydrocarbons, total</td>
<td>mg/kg</td>
<td>200</td>
<td>600</td>
<td>250</td>
<td>750</td>
</tr>
</tbody>
</table>
4.4.2 Assessments and Actions

4.4.2.1 Assessment of dredged material

The guiding values listed in Table 2 are standardised values which were derived from sometimes very different contamination patterns found in several parts of the North Sea and the Baltic Sea. When they are used, the actual regional contamination, the transport of contaminants and sediment, and other regional characteristics have to be taken into consideration in the impact hypothesis (Section 8).

This applies, on the one hand, to areas of significantly higher contamination (e.g. the Elbe estuary) and, on the other hand, to areas where contamination is significantly lower (e.g. national parks and other legally protected areas) where the ecological status must not be deteriorated lastingly.

The GÜBAK defines the following cases to describe the contamination in dredged material:

Case 1  $c \leq RV1$

- The mean concentration $c$ of each individual contaminant is below or equals the basic guiding values $RV1$
- The contamination of this material corresponds to the contamination near the coast.

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2 An RW2 of 100 μg/kg is valid in the national park "Wadden Sea", while outside of this area the RW2 is 300 μg/kg.

3 Phosphorus and nitrogen see Section 5.4.4.
Case 2  $ RV1 < c \leq RV2$

The mean concentration $c$ of at least one contaminant exceeds the guiding values $RV1$, but not the values $RV2$.

This material is considered to be moderately more contaminated than coastal sediments.

Case 3  $c > RV2$

The mean concentration $c$ of at least one contaminant exceeds the guiding values $RV2$.

This material is considered to be significantly more contaminated than coastal sediments.

4.4.2.2  Actions to be taken during the placement of dredged material

Depending on the contamination concentrations (cases 1-3), the following actions have to be taken.

Case 1:  **Contamination in dredged material $<$ RV1**

1. Examination of the possibility of beneficial use of the dredged material according to Section 7.

2. Placement of the dredged material under consideration of the physical and biological effects (Impact hypothesis, Section 8.2).

3. Issue of a permit (see Section 9)

Case 2:  **Contamination in dredged material $>$ RV1, $<$ RV2**

1. Examination of the possibility of beneficial use of the dredged material according to Section 7.

2. Formulation of an impact hypothesis (Section 8.2) and a monitoring programme when appropriate (Section 10).

3. Checking options to reduce negative impacts during the extraction and the placement of the dredged material (Section 8.3).

4. If the impact hypothesis identifies significant or long-lasting impairments of environmental assets to be protected (*Schützgüter*) (Section 8.2.1) or if significant or lasting accumulation of contaminants or nutrients accumulation in the sediment is to be expected, actions like those of Case 3 should be taken.

5. Issue of a permit (see Section 9)
Case 3: Contamination in dredged material > RV2

1. Actions as in Case 2, plus:

2. Search for the source of the contamination and initiatives to close it, e.g. by reporting it to the local authorities.

3. Reviewing options of technical pre-treatment of the dredged material to keep the impact of its placement on the marine environment as weak as possible (separation of most contaminated fractions and their disposal on land, or treatment and beneficial use) or use or placement of less contaminated or treated fractions in waters.

4. Weighting placement in waters versus landfill:

   • Examination and assessment of options for confined disposal in surface waters (e.g. capping or artificial islands) considering technical, ecological and economic aspects.

   • Examination whether suitable areas on land are available for safe placement regarding the following aspects:
     - Risks to human health
     - Environmental risks from landfill sites (leaking of contaminants, loss of options for certain future land uses, land consumption)
     - Risks during transport and placement on land
     - Economic aspects (costs of transport, energy, landfill operation)

   Comparative assessment of options for dredged-material placement in water and on land.

In the High Sea and the exclusive economic zone (EEZ) the regulations of the “Gesetz zur Ausführung des Protokolls vom 7.11.1996 zum Übereinkommen über die Verhütung der Meeresverschmutzung durch das Einbringen von Abfällen und anderen Stoffen von 1972” (Hohe-See-Einbringungsgesetz, BGBl. 1998 I, S.2455) is applicable.

5. Biological investigations and assessments

(Section 4.7-4.10 LONDON, § 5.7-5.9 OSPAR)

5.1. General

The placement of dredged material in waters may have impacts on flora and fauna (see Section 8):

   • Adverse effects on biocoenoses in water bodies and at the seafloor caused by hazardous chemical substances in dredged material.
Physically induced impairments of flora and fauna by turbidity and/or covering.
- Oxygen depletion and release of nutrients.

Biological investigations provide information about integrated, short-term and long-term effects of dredged material that cannot be acquired by chemical analyses alone. Biological studies thus are a necessary supplementation to chemical and physical investigations:

- Ecotoxicological investigations provide information about acute and chronic effects of contaminants on organisms and about the accumulation of contaminants in organisms (bioaccumulation). An ecotoxicological risk assessment should be made with each dredging project, although it is not mandatory in any case. It may be sufficient to explain plausibly that ecological hazards can be ruled out (e.g. when there are no contamination sources). Ecotoxicologic tests are obligatory if Case 3 of chemical analyses applies.

- Biological benthos studies establish species inventories of macrophytes and macrozoobenthos at dredged-material placement sites and identify potential effects.

- Fish-biological investigations help to estimate impacts of turbidity, covering by dredged material, and oxygen depletion on fish populations in the placement area.

5.2 Scope of investigations

5.2.1 Investigations for the impact hypothesis (prior to dredging)

Investigations for ecotoxicological assessments have to be carried out at the dredging sites. If Case 3 of the chemical analyses applies, such investigations are obligatory (see 4.4.2.2). They usually comprise tests to detect acute and chronic ecotoxicity.

The examinations of existing placement sites and of planned sites vary in scope. In the first case available information about observed impacts has to be considered and assessed, while in the latter case an impact hypothesis has to be formulated (Chapter 8). The study plans must be set up accordingly.
Flora and fauna at the placement site and in its surroundings must be examined as to whether covering, sedimentation, or increased turbidity pose threats. The minimum test programme considers the macrozoobenthos, the macrophytes, and the fish populations. Additionally, it should be seen whether there is a possibility of endangering other highly-valued species such as eelgrass, birds, seals. A basis for this can be a comparison of data on populations of protected species listed in catalogues, such as the Nature Conservation Act (BnatSchG), the FFH Directive, the Bird Protection Directive, and other red lists (see Section 5.3.2). The scope of the studies has to be widened accordingly.

Examinations and assessments of flora and fauna should be made in line with generally accepted scientific methods.

The macrozoobenthos (invertebrates indigenous to the sediments of the water body, generally larger than 1 mm up to several decimetres in body size, e.g. mussels, snails, crustacea, worms) and the macrophytes are important indicators of biotope-characterising factors (like grain-size distribution, salinity, oxygen, turbidity). These organisms are the nutritional basis for many types of fish and waterfowl. The analysis of their populations allows to estimate the potential vulnerability of the benthic community and of organisms at the higher levels of the foodweb.

Analyses of the fish fauna can provide information on the impact on spawning grounds, young-fish habitats, and on the habitats of fish species living preferentially near the seafloor or river bottom (e.g., flat fish). Possible impacts on migration routes of fish and crustacea and on commercial and sport fishing grounds should be assessed as well.

Plankton and periphyton organisms (microepifauna, microepiflora) generally have short generation cycles (days to weeks). Thus, losses that occur as a consequence of dredged-material placement are quickly compensated. Therefore, separate analyses are generally not required.

5.2.2 Investigations during the monitoring programme
Extent and frequency of the investigations for monitoring are determined – like those for chemical analyses – in dependence on the impact hypothesis on a case-by-case basis (see Section 10).
5.2.3. **Sequence of investigations**

The sequence of biological investigations is similar to that of chemical analyses; one distinguishes in principle:

- Investigations at the dredging and the placement sites including the surrounding areas.
- Investigation prior to, and if appropriate during the dredging operation in the context of the impact hypothesis (see Section 8) and after the completion of the project in the monitoring programme (see Section 10).

5.3. **Methods of the investigations**

5.3.1. **Ecotoxicologic testing**

Currently the following standardised test for estimation of toxic effects on brackish and marine sediments are available:

- Marine algae test modified for brackish/marine water (DIN EN ISO 10253)
  
  This test is made with sediment eluate.

- Luminescent-bacteria test modified for brackish/marine water (DIN EN ISO 11348-1-3)
  
  This test is made with sediment eluate.

Acute amphipod test (ISO DIN 16712 draft)

The test is made in sediment.

Within one test battery, these tests are considered equally important, i.e. the worst test result defines the assessment.

5.3.2 **Benthos studies**

The benthos studies consider the species inventory, abundances, and biomass values at the dredged-material placement site in order to acquire information about the protection status of species, populations, zoocoenoses, and the size of the populations. Assessment aids are given in the German Federal Nature-conservation Act (*BnatSchG*), the FFH Directive, the Bird Protection Directive, and red lists of species and habitats. The time of the inventory has to be chosen according to seasonal aspects to achieve realistic risk assessments (seasonal variations). Accepted standard procedures (ICES, TMAP) have to be applied.
Investigations of flora and fauna require a separate sampling concept. Its scope depends on the dredging project under consideration, so that general recommendations cannot be given here. Beyond single studies, repeated inventories may be required, e.g. in different seasons.

No additional investigation are needed, if the effects at the placement site can be sufficiently estimated from the data of the species inventory on abundances and biomass.

5.3.3 Fish-biological studies
An inventory of the fish fauna at the placement site may be made by evaluation of data from the fishery authorities, from literature research, or from own investigations (species inventory, abundances, biomass). The relevance of the area as a preferred feeding area of the fish fauna can be derived from the abundances and biomass of fish-food species. Inventories have to be made, if effects are likely in spatially limited habitats, spawning grounds, and fry habitats. Moreover, it should be examined whether important fishing grounds of commercial high-sea and coastal fisheries are affected.

5.3.4 Mass balances
5.3.4.1 Investigation scope and methods
Oxygen depletion and nutrient levels should be measured, if the material to be dredged consists mainly of fine-grained material:

- Oxygen consumption of the dredged material in mg/kg DS,
- Total phosphorus content ($P_{ges}$) in mg/kg DS
- Total nitrogen content ($N_{ges}$) in mg/kg DS

If dredged material with high nutrient contents is to be deposited in areas where fine-grained fractions dominate, nutrient contents in the interstitial water and/or the eluate of the sediments has also to be determined at the deposition site.
5.4. Assesment of the analytical results

5.4.1 Ecotoxicologic data
An objective and scientifically based assessment method of ecotoxicological effects caused by dredged material is currently not available in Germany. Nevertheless, to make the necessary assessments of the integrated contaminant effects in the dredged material, an interim test (test with eluates, luminescent bacteria, algae) is applied for the time being. The interpretation of the results of the amphipod tests in the whole sediment requires experienced experts.

The toxicity class of dredged material is defined by the pT-value (power of toxicology) of the most sensitive organism within a range of biotests of equal priority and rank. The grouping in toxicity classes always refers to the undiluted eluate.

The evaluation of the ecotoxicologic test results follows the sediment categorisation presented in Table 3.

Table 3: Sediment toxicity classes for dredged-material handling. The ecotoxicologic test are made with eluate.

<table>
<thead>
<tr>
<th>Highest dilution factor without effect</th>
<th>pT value of the individual test</th>
<th>Toxicity classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original sample</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1:2</td>
<td>1</td>
<td>I</td>
</tr>
<tr>
<td>1:4</td>
<td>2</td>
<td>II</td>
</tr>
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<td>1:8</td>
<td>3</td>
<td>III</td>
</tr>
<tr>
<td>1:16</td>
<td>4</td>
<td>IV</td>
</tr>
<tr>
<td>1:32</td>
<td>5</td>
<td>V</td>
</tr>
<tr>
<td>&lt; 1:64</td>
<td>&gt; 6</td>
<td>VI</td>
</tr>
</tbody>
</table>

In contrast to chemical analyses, ecotoxicological test are not suitable for quantitative or qualitative identification of individual substances or compounds but help to estimate the effects and potential hazards caused by dredged material. They have to be considered, along with other criteria, in decisions on permits for dredged-material placement in waters.
Effects grouped in Toxicity classes 0 to II are currently rated as harmless, above Class II they are seen to be critical in dependence on the causes of increased toxicity and must be examined in the impact hypothesis. In such cases the causes of increased toxicity have to be identified.

5.4.2 Assessment of the findings of flora and fauna inventories
If a significant deterioration of protected species and communities has to be expected in terms of nature conservation, another placement site must be sought (see Section 9).

5.4.3 Oxygen depletion
Currently there are no generally accepted guiding values for the oxygen consumption of sediments. The oxygen consumption measured in the dredged material should be taken as an argumentation in the assessment of potential effects caused by the nutrients in the material. The chosen dredging and dumping techniques have to be integrated into this assessment. When sediments have high portions of fine-grained material, the potential consumption of the oxygen-depleting substances has to be measured. Under consideration of the prevailing hydrological conditions, quantitative calculations can find out whether oxygen deficits may occur.

5.4.4 Nutrients
It is not necessary to make a distinction between the guiding values RV 1 and RV 2 regarding nutrients in the context of dredged-material placement, because the restrictions imposed in Section 8.3 are sufficient to minimise negative effects on the environment when nutrient levels are increased.

The unified guiding values for phosphorus and nitrogen in solid matter and eluates, as shown in Table 2, will be applied (according to the Dredged-material Concept of Schleswig-Holstein, 1996).
6. Identification of contaminant sources
(Section 2 LONDON, Section 6 OSPAR)

The prevention of contamination in dredged material or its reduction are of high importance. The developer of the dredging project is usually not the polluter. If significant contamination is found in dredged material, it is necessary to identify the sources of contamination and to take efforts to minimise the contaminant inputs in the river basin by means of management plans for the national implementation of the EU-WFD (see Section 12).

7. Alternatives to dredged-material placement in waters
(Section 3 LONDON, Section 8 OSPAR)

Alternatives to dredged-material placement in water bodies may be:

- Use as construction material (coastal defences, backfill material for potholes and for beach nourishment, new shore and harbour areas, land- and biotope reclamation, protection of subaquatic embankments or river-training structures).
- Use as soil material on agricultural areas.
- Utilisation on land, after treatment (e.g. for coastal defences or road construction, landscaping, sealing layers in waste landfills, recultivation of historic waste dumps and industrial sites, or as additive in building materials).
- Confined disposal in waters.
- Confined disposal on land, after treatment.

(Links to relevant literature in Appendix 4.)

8. Impact hypothesis
(Section 7 LONDON, Section 10 OSPAR)

8.1 Tasks

The most essential element of the international directives is the development of an impact hypothesis for each dredged-material placement project in the convention area. This prediction has to be submitted by the project developer for the final assessment of the effects on the environment before the permit is issued (see Section 9). If an environmental impact study or a
comparable study on the proposed project is available, this may be used in place of the impact hypothesis.

An impact hypothesis consists in a description of expected physical, chemical, and biological effects on the environment and covers temporal and spatial dimensions of potential effects. It may be necessary to provide a baseline study describing the placement site. The development and use of computer-based transport models may also be needed. The assessment should be as comprehensive as possible.

Impacts to be expected are described regarding the affected habitats, physical processes, species of plants and animals, life communities, and uses in the area so that a monitoring programme of the area after dredged-material placement can be derived.

8.2. Elements of the impact hypothesis

In the following, the topics are listed that have to be considered in the impact hypothesis according to the pertinent international directives. Their relevance in the respective case is dependent on local conditions of the dredged-material placement operation.

8.2.1 Protected assets and uses in the placement area

The following assets and uses may be impaired by the placement of dredged material and have to be taken into consideration in the impact hypothesis:

Humans:
- human health, recreation, tourism (e.g. regarding contaminants, nutrients, algae, noise)
- navigation (e.g., shallow waters)
- fishery (e.g. damage to fish and mussel cultures, breeding-, spawning-, and feeding grounds)
- technical facilities (e.g. pipelines, desalination plants)
- costal protection (e.g. changes in the hydrographic situation)
- extractive industry
- other legitimate uses of the marine environment.
Animals and plants:

- health (e.g. regarding contaminants, covering with dredged material, oxygen depletion, changes in sediment composition)
- nature reserves, areas under special protection status, national parks
- inventory of rare or vulnerable species
- migration of fish, breeding-, spawning-, and feeding grounds

8.2.2 Possible impacts caused by dredged-material placement in costal waters

Physical impacts

- changes in hydromorphological conditions (e.g., shallow waters, change of channel cross sections)
- turbidity, temporal increases in suspended matter content,
- change in the stability of sediments (increased fine-grained fractions)
- changes in the structure of the seafloor (levelling, ripples)
- transport of dredged material by currents or influences of tides or waves

Chemical impacts

- deterioration of water quality (oxygen, contaminants, and nutrients) during the placement operation
- release of contaminants and nutrients from the dredged material
- accumulation of contaminants and nutrients in sediments
- comparison of the loads of contaminants and nutrients due to handling of dredged material with the existing loads at the placement site
- short- and long-range transport of contaminants and nutrients.

Biological impacts

- blanketing of bottom-dwelling flora and fauna at the placement site
- impairment of habitats or flora and fauna in the water and changes in the biocoenosis.

8.3 Measures for minimisation of impacts and search for alternative placement sites

The search for alternatives dredged-material placement procedes from the findings of the impact hypothesis. Ecological advantages of the alternatives are weighed against economic benefits and drawbacks. The following options exist:


- shift to an alternative time of the placement operation (e.g. winter time)
- shift to alternative dredging techniques
- shift to alternative placement techniques (e.g. use of special aprons to avoid spreading of silt)
- shift to alternative sites (e.g. biologically dead zones)

9 Permits

(Section 9 LONDON, Section 11 OSPAR)

The international directives on dredging demand permitting procedures for the placement of dredged material in waters. The background is the licensing requirement for the dumping of materials at sea in the convention areas. In Germany, these principles are implemented in national law by the “Gesetz zu dem Übereinkommen vom 15. Februar 1972 und 29. Dezember 1972 zur Verhütung der Meeresverschmutzung durch das Einbringen von Abfällen durch Schiffe und Luftfahrzeuge vom 11. Februar 1977” (BGBl II S. 165) that delegates the responsibility to the Federal Maritime and Hydrographic Agency (BSH). For the coastal sea and tidal rivers upstream to the freshwater limit there are no specific legal regulations. According to German law, the regulations of the respective Federal states (Bundesländer) have to be applied.

As far as the state-specific laws demand it, the authorities of Bundesländer grant permits for projects of thirds parties to handle dredged material pursuant to the Federal Water Act (§ 3, §7 WHG) which correspond to the permit mentioned in the directives. A permit under nature-conservation legislation is required if significant interferences with nature and landscape occur (§18 BNatSchG).

In cases of significant impairments of biotopes having legal protection status (cf. especially §30 Abs. 1 Nr. 6 BNatSchG) or if bans on certain activities in protected areas exist, placement of dredged-material from third-party projects in the coastal sea requires an exemption by the competent nature-conservation authority pursuant to the legislation of the respective Federal state (Bundesland).

Pursuant to §7 of the Federal Waterway Act (WaStrG), the maintenance of Federal waterways is a task under the sovereignty of the Federal government and does not require any permit, approval or concession under legislation on water and nature-conservation. Pursuant to § 4 WaStrG, the requirements of nature conservation as well as those of landscape and water-
resources management have to be observed in agreement with the Federal states. Moreover, pursuant to § 48 *WaStrG*, the Federal Waterways and Shipping Administration (*WSV*) has the obligation to ensure in its own rights the safety and order, what - according to established case law - includes also the observation of regulations on nature conservation.

Neither is a permit under nature-conservation legislation necessary if - due to fundamental changes in the waterway-maintenance methods or the resumption of maintenance work after a very long period - the placement of dredged material within the Federal waterways may cause significant impairments of the functionality and efficiency of the ecosystem. In such cases, the Federal Waterways and Shipping Administration will ask for a comment by the competent nature-conservation authority. If the Federal administration intends to deviate from this comment, the decision will be made by the competent authority of the Federal government in agreement (i.e. after inviting a comment) from the highest authority for nature conservation and landscape management of the Federal state (*Bundesland*) concerned (cf. § 20 Abs. 3 *BNatSchG*).

Projects that may lead to a significant impairment of elements of Natura-2000 areas that are essential for the intended preservation objectives (*Erhaltungsziele*) must be reviewed for their compatibility with these intended preservation objectives prior to project implementation. In case of non-compatibility, these projects are admissible only under the conditions listed in § 34 Abs. 3 and 4 *BNatSchG*.

10 Monitoring programme for the dredged-material placement site

(Section 8 LONDON, Section 12 OSPAR, Part B HELCOM)

10.1 General

Monitoring of the dredged-material placement site is an essential element of the whole dredging project. Definitions, objectives, and strategies are described in detail in the international directives. The extent of monitoring required is based on the impact hypothesis (see Section 8). The developer of the project is in charge of the monitoring programme.
The effects of dredged material are similar in many regards, so that it is not necessary to monitor all placement sites, particularly those, where only small amounts of dredged material were dumped. Detailed investigations should be made at selected (typical) placements sites.

The impact hypothesis and, derived therefrom, the monitoring programme are preconditions for dredging-project permits (see Section 9). The following section gives general guidance.

10.2. Monitoring programme

The dumping of dredged material affects primarily the seafloor, so that monitoring can normally be restricted to the sediments and sediment-dwelling organisms at the placement site.

The extent of investigations within and outside the placement site is defined on a case-by-case basis. The dimensions of the site as described in the permit document have to be checked as well.

Spatial extent
The spatial extent of the area to be examined has to take into consideration the size of the planned placement site and all areas, where dredged material may be unintentionally dumped, as well as possible drift of deposited dredged material (direction and extent of sediment transport).

To assess the effects it is necessary to compare the physical and chemical properties and the habitats of the placement site with an unaffected reference area. A suitable reference area must be named in the monitoring programme.

Frequency of monitoring
The frequency of monitoring at the placement site depends on several factors.
In cases when the dredged-material placement operation has lasted for several years, repetitive inspections have to be conducted every 3 to 5 years. Repeated testing is only necessary if changes have occurred in the material (amount and type of the dredged material, placement technique).
If the regeneration of a placement site that is no longer in use should be monitored, more frequent measurements and analyses may be required.
11 Obligatory reporting on dredged material placement

(Section 13 OSPAR, HELCOM MONAS 3/2001, 5/1)

Supply of input data
The above-described testing scheme provides primarily information for the purpose of issuing permits (see Section 9). At the same time, it gives the most accurate estimate of the total input of contaminants into waters through dredged-material placement (gross figures). For this reason, the quantities of dredged material placed and the analyses made have to be reported on standardised form-sheet to the OSPAR and HELCOM secretariats (see Annex 1).

It is assumed hereby that dredged material that is exempted from analyses according to Section 2 does not contain relevant inputs of contaminants. In such cases it is only required to report the quantities of dredged material but not their contaminant concentrations.

Monitoring
Short reports about monitoring activities have to be provided by the holder of the permit for dredged-material placement (see Section 9). They should include details and findings of the investigations and show whether the monitoring aims have been reached (verification of effects on the environment).

Reporting
The international reporting of the quantities and the quality of the dredged material placed in the seas and about the monitoring activities is made by the Federal Institute of Hydrology (BfG) in cooperation with the German Federal Maritime and Hydrographic Agency (BSH). The Federal Institute of Hydrology submits the reports annually to the OSPAR Secretariat via the Federal Ministry of the Environment (BMU) with the request to forward them also to the LONDON Convention Secretariat, and every three years to the HELCOM Secretariat.
12 Updating


Sediment-management practices have to be developed further with view to the development of the sediment regime. Following the successful reduction of contaminant loads in the Middle and Upper Elbe River, the guiding values for contaminants may be adjusted to the changed situation.

Because of the current contamination situation, it will not be possible in the medium-term perspective to adhere to the guiding values (Section 4.4) everywhere or to reach them in the short term. Thus, it is necessary to take such regional peculiarities into account in the context of regional sediment management concepts. The previous sediment-management concepts and those to be developed further constitute, on the basis of the current system understanding, an important and generally accepted maintenance practice. They establish the further development and optimization of the maintenance practice and indicate possibilities to influence the improvement of the sediment quality. The aim is to further develop these sediment management concepts with the management plans pursuant to EU-WFD, the integrated management plans pursuant to the FFH Directive and the programmes of actions pursuant to EU-MSFD.
### Annex 1

siehe [degree] [miles] [Major type of deposited material]

**Reporting form for dredged material to the OSPAR and HELSINKI Commissions**

Annual reporting of the dredged material deposited in the convention areas and the associated contamination loads

| **Authority:** |  |
| **Reporting year:** |  |
| **Removal region:** |  |

### 1. Deposition site

| a) Name of the deposition site |  |
| b) Location | Waters: Inner waters (yes / no) |
| | Coordinates (WGS 84): Nord |
| | East |
| c) Depth under KN [m] |
| d) Distance to coast [miles] |
| e) Tide/current | Main direction [degree] |
| | Maximum velocity [m/s] |
| f) Major type of deposited material ( % silt, % sand) |
| g) Year of the permit [a] |
| h) Total amount of the deposited sediments [m³] |
| i) Total amount of the dredged material permitted [m³] |
| j) Monitoring authority |
| k) Existing of monitoring programms (yes / no) |
| | If yes: Type* |
| | If yes: Frequency of investigations |
| l) Further important information |

to j) if reports of monitoring activities are available, please add

### 2. Characterisation of the origin and the amount of the dredged material

| a) Location | Waters: Inner waters (yes / no) |
| | Coordinates (WGS 84): Nord |
| | East |
| b) Area of dredging (harbour, estuary, ocean) |
| c) Type of dredging project (constructions of waterways, maintenance) |
| d) Type of deposition |
| e) Total amount of dredged material (wet material) [m³] |
| | Silt with density = 1,2 t/m³ (wet material) [t] |
| | mixture with density = 1,5 t/m³ (wet material) [t] |
| | sand with density = 1,8 t/m³ (wet material) [t] |
| f) Density kg/l |
| g) Water content (on average) [%] |

### 3. Characterisation of the contaminants and nutrients in the dredged material

<p>| a) Analytical results of single samples |
| | Total amount of organic material, delivered as TOC [% TS] |
| | Grain size fractions |
| | &gt; 63 µm (sand) [% TS] |
| | &lt; 63 µm [% TS] |
| | &lt; 20 µm [% TS] |
| | Heavy metals in &lt; 20 µm fraction (resp. in the total) |
| | Cadmium [mg/kg TS] |
| | Mercury [mg/kg TS] |
| | Chrome [mg/kg TS] |</p>
<table>
<thead>
<tr>
<th>Compound</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td>Copper</td>
<td>mg/kg TS</td>
</tr>
<tr>
<td>Lead</td>
<td>mg/kg TS</td>
</tr>
<tr>
<td>Nickel</td>
<td>mg/kg TS</td>
</tr>
<tr>
<td>Zink</td>
<td>mg/kg TS</td>
</tr>
<tr>
<td>Arsenic</td>
<td>mg/kg TS</td>
</tr>
<tr>
<td>Sample &lt; 2mm</td>
<td></td>
</tr>
<tr>
<td>Organic compounds (in the total sample &lt; 2mm)</td>
<td></td>
</tr>
<tr>
<td>PCB 28</td>
<td>µg/kg TS</td>
</tr>
<tr>
<td>PCB 52</td>
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<td>µg/kg TS</td>
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<tr>
<td>a-Hexachlorocyclohexane</td>
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<td>g-Hexachlorocyclohexane</td>
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<tr>
<td>Hexachlorobutadiene</td>
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<tr>
<td>p,p DDT</td>
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</tr>
<tr>
<td>p,p DDE</td>
<td>µg/kg TS</td>
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<tr>
<td>p,p DDD</td>
<td>µg/kg TS</td>
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<tr>
<td>Naphthalene</td>
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<td>Fluorene</td>
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<td>Anthracene</td>
<td>mg/kg TS</td>
</tr>
<tr>
<td>Fluoranthene</td>
<td>mg/kg TS</td>
</tr>
<tr>
<td>Pyrene</td>
<td>mg/kg TS</td>
</tr>
<tr>
<td>Benzo(a)antracene</td>
<td>mg/kg TS</td>
</tr>
<tr>
<td>Chrysene</td>
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</tr>
<tr>
<td>Benzo(b)fluoranthene</td>
<td>mg/kg TS</td>
</tr>
<tr>
<td>Benzo(k)fluoranthene</td>
<td>mg/kg TS</td>
</tr>
<tr>
<td>Benzo(a)pyrene</td>
<td>mg/kg TS</td>
</tr>
<tr>
<td>Dibenz(ah)anthracene</td>
<td>mg/kg TS</td>
</tr>
<tr>
<td>Benzo(ghi)perylene</td>
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<td>Indeno(1,2,3-cd)pyrene</td>
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<td>Tetrabutyltin</td>
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<tr>
<td>Nutrients</td>
<td>Total N</td>
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<td>----------------</td>
<td>--------------</td>
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<td></td>
<td>Total P</td>
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</tr>
<tr>
<td></td>
<td>Total -P in eluate</td>
</tr>
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<td>Oxygen consumption</td>
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<tr>
<td>Toxicity</td>
<td>Characterisation of toxicity of individual samples, if available</td>
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</tbody>
</table>

b) Further important information
Annex 2

Deriving chemical reference values to assess contaminant levels in dredged material in coastal waters

1 Introduction

The international dredged-material directives of the LONDON Convention (LC) and OSPAR Convention propose to introduce two concentration levels (i.e. three quality levels) for contaminant assessments. This is a purely verbal statement to which no concentration levels are assigned and no basis for its derivation and application is given.

For this reason it was necessary to formulate for Section 4 of the "GÜBAK" a chapter on "Fundamentals of the derivation of guiding values and for the evaluation of analytical data and measures" within the context of the current scientific, national or international state-of-the art.

The following section presents these fundamentals and the subsequent concept for the definition of guiding values.

2 Definitions

Natural background value
The natural background value indicates concentrations of substances that result exclusively from the local geogenic influences without interferences by human activities. On the coasts of the North Sea and the Baltic Sea, such natural background values can be found only locally, for instance in deeper sediment layers or in polders that have been closed for a long time.
Regional contamination level

The regional contamination level is the current contaminant concentration in sediments that results from the interactions of the natural background value with the diffuse contamination load from anthropogenic activities in the considered region, i.e. without point sources of contamination like large settlements, industries, mining, and port operations. This level may differ from region to region. Illustrative examples of this differentiation are the German Wadden Sea, the tidal reaches of the rivers Elbe, Weser, and Ems as well as the boddens and bays on the coast of the Baltic-Sea.

Protection target

In general the dumping of dredged material in coastal waters accelerates the transport of contaminants in the direction towards the North Sea and the Baltic Sea. As these contaminants preferentially settle in the coastal waters, these were selected as the target area of protection. In the North Sea this is the German Wadden Sea, in the Baltic Sea - the sedimentation areas in coastal waters and in the western Baltic Sea.

Regional validity

The guiding values "RV1" are based exclusively on the current contamination status of the sediments in the German coastal waters of the North Sea and the Baltic Sea. In addition to these, the regional contamination levels in the area of deposition of dredged material have to be taken into consideration.

3. Classification scheme

The detailed examination of the possibilities to derive guiding values on the basis of ecological studies found that no generally accepted procedure exists - neither nationally nor internationally. For this reason, similar to the previous practice, the guiding values were derived from contaminant concentrations in the sediments of the coastal waters of the North Sea and the Baltic Sea, taking the following aspects into account:
3.1 Contaminant levels in coastal sediments

The availability of data on contaminant levels in coastal water is as follows:

3.1.1. North Sea
3.1.1.1 Data basis

- The joint measuring programme of the Federal authorities and those of the Federal states in the North Sea [1] [2] [3]
- GKSS, Geesthacht [4]
- German Federal Institute of Hydrology (BfG), Koblenz
- German Federal Maritime and Hydrographic Agency (BSH), Hamburg,
- State Agency of Ecology, Lower Saxony
- State Agency of the Environment and Nature, Schleswig-Holstein

3.1.1.2 Data evaluation

- Most of the data found consideration already in 1997 in the "Joint recommendations of Federal authorities and coastal Federal states" ("Gemeinsamen Empfehlungen von Bund und Küstenländern" [5]) when guiding values were derived.
- New data originate mostly from the coastal monitoring programmes of the Federal states or from single sediment analyses by the BfG.
- Current, large-scale studies in the Wadden Sea are not available. There remains still an urgent need for research.

It was agreed on this basis to use the R1-values of the "Joint recommendations" as in 1997 for the necessary data updating during a transition period. However, here the organic contaminants were standardised to the fraction < 63 µm.

3.1.2. Baltic Sea
3.1.2.1 Data basis

- German Federal Institute of Hydrology (BfG), Koblenz
- State Agency of the Environment and Nature, Schleswig-Holstein
- State Agency of the Environment, Nature and Geology, Mecklenburg-Western Pomerania
3.1.2.1. Data evaluation

On the above-mentioned data basis, guiding values for heavy metals in the Baltic Sea were developed for the first time in 1997. Because no reliable data archive on organic contaminants existed at this time, the proposed guiding values from the North Sea were preliminarily adopted. On the basis of analyses, of the subsequent years, of the data stock up to 2004, it was then possible to derive reliable specific guiding values for the Baltic Sea.

3.2. Procedure of deriving guiding values

The described data were treated as follows:

* In order to correct the "grain-size effect" (i.e. the influence of different grain-size compositions) in heavy metal analyses and thus to improve the comparability of the data [6], the heavy-metal concentrations were measured in the separated fraction < 20 µm. Sediments with a fine-grain portion of < 10 % were not taken into consideration.
  The concentrations of organic contaminants were measured in the whole sample < 2mm and then standardised by computation to the respective fraction < 63 µm.

* The standardised values were sorted according to increasing contaminant contents irrespective of the geographic position of the sampling stations.

The 90-percentil value c (90) was calculated from the concentration series of every compound. The rounded results are defined as "current regional contamination load" or as RW 1.

3.3 Guiding values and classification

The guiding values RV1 (Table 1 in Section 4.4.1) provide the starting point for the classification scale.

The separation in two concentration levels (= three quality classes) as demanded by the London Convention and OSPAR Convention is provided by defining a second guiding value RV2. A factor was chosen that allows for sufficient differentiation in the dredged material, on the one hand, and ensures that no lasting change in the sediment condition has to be feared when all described demands were observed, on the other hand. On the basis of chemical analyses of dredged material in waterways and ports, this demand can be met with the following factors:

\[ \text{Factor } f = 3 \text{ for heavy metals}, \]
Factor $f = 3$ for organic contaminants.

By multiplying the guiding values $RV1$ with this factor, one consequently finds the guiding value $R2$ (see Table 1).

Depending on the concentration $c_x$ of a contaminant $x$ the following three assessment classes result:

Class 1: $c_x \leq RV1$: The dredged material meets the current contamination status in near-coastal waters,

Class 2: $RV1 < c_x < RV2$: The dredged material is moderately more contaminated than sediments in near-coastal waters,

Class 3: $c_x > RV2$: The dredged material is significantly more contaminated than sediments in near-coastal waters.

References

## Annex 3

### List of parameters to be analysed in dredged material and remarks on the methodology

Overview of parameters and limits of determination

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Units</th>
<th>North Sea</th>
<th>Baltic Sea</th>
<th>Limit of determination</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical properties</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density</td>
<td>%</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Contents of solids or water</td>
<td>%</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Grain-size fractions (&gt;63, &lt; 63, &lt; 20µm)</td>
<td>%</td>
<td>x</td>
<td>x</td>
<td>0.1</td>
</tr>
<tr>
<td>Organic material (TOC)</td>
<td>%</td>
<td>x</td>
<td>x</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Nutrients</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total-P in total sediment &lt; 2mm</td>
<td>mg/kg</td>
<td>x</td>
<td>x</td>
<td>5</td>
</tr>
<tr>
<td>Total-N in total sediment &lt; 2mm</td>
<td>mg/kg</td>
<td>x</td>
<td>x</td>
<td>200</td>
</tr>
<tr>
<td>Total-P in eluate</td>
<td>mg/l</td>
<td>x</td>
<td>x</td>
<td>0.02</td>
</tr>
<tr>
<td>Total-N in eluate</td>
<td>mg/l</td>
<td>x</td>
<td>x</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Heavy metals in &lt; 20µm (&lt; 2mm)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arsenic</td>
<td>mg/kg</td>
<td>x</td>
<td>x</td>
<td>1</td>
</tr>
<tr>
<td>Lead</td>
<td>mg/kg</td>
<td>x</td>
<td>x</td>
<td>10</td>
</tr>
<tr>
<td>Cadmium</td>
<td>mg/kg</td>
<td>x</td>
<td>x</td>
<td>0.1</td>
</tr>
<tr>
<td>Chrome</td>
<td>mg/kg</td>
<td>x</td>
<td>(x)</td>
<td>10</td>
</tr>
<tr>
<td>Copper</td>
<td>mg/kg</td>
<td>x</td>
<td>x</td>
<td>10</td>
</tr>
<tr>
<td>Nickel</td>
<td>mg/kg</td>
<td>x</td>
<td>(x)</td>
<td>10</td>
</tr>
<tr>
<td>Mercury</td>
<td>mg/kg</td>
<td>x</td>
<td>x</td>
<td>0.1</td>
</tr>
<tr>
<td>Zink</td>
<td>mg/kg</td>
<td>x</td>
<td>x</td>
<td>10</td>
</tr>
<tr>
<td><strong>Organic contaminants in total sediment &lt; 2mm</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrocarbons, total</td>
<td>mg/kg</td>
<td>x</td>
<td>x</td>
<td>20</td>
</tr>
<tr>
<td>Hydrocarbons, chain length up to C20</td>
<td>mg/kg</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Hydrocarbons, chain length C21 to C40</td>
<td>mg/kg</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Sum of PCB, calculated from following congeners: PCB- Nr. 28, 52,101,118, 138,153,180</td>
<td>µg/kg</td>
<td>x</td>
<td>x</td>
<td>0.1 for each individual compound</td>
</tr>
<tr>
<td>p,p'-DDT</td>
<td>µg/kg</td>
<td>x</td>
<td>x</td>
<td>0.1</td>
</tr>
<tr>
<td>p,p'-DDE</td>
<td>µg/kg</td>
<td>x</td>
<td>x</td>
<td>0.1</td>
</tr>
<tr>
<td>p,p'-DDD</td>
<td>µg/kg</td>
<td>x</td>
<td>x</td>
<td>0.1</td>
</tr>
<tr>
<td>Hexachlorobenzene</td>
<td>µg/kg</td>
<td>x</td>
<td>x</td>
<td>0.1</td>
</tr>
<tr>
<td>gamma-HCH (lindane)</td>
<td>µg/kg</td>
<td>x</td>
<td>x</td>
<td>0.05</td>
</tr>
<tr>
<td>Tributyltin</td>
<td>µg/kg</td>
<td>x</td>
<td>x</td>
<td>1</td>
</tr>
<tr>
<td>Dibutyltin</td>
<td>µg/kg</td>
<td>x</td>
<td>x</td>
<td>1</td>
</tr>
<tr>
<td>Monobutyltin</td>
<td>µg/kg</td>
<td>x</td>
<td>x</td>
<td>1</td>
</tr>
<tr>
<td>Triphenyltin</td>
<td>µg/kg</td>
<td>x</td>
<td>x</td>
<td>1</td>
</tr>
<tr>
<td>Tetrabutyltin</td>
<td>µg/kg</td>
<td>(x)</td>
<td>(x)</td>
<td>1</td>
</tr>
<tr>
<td>alpha-HCH</td>
<td>µg/kg</td>
<td>(x)</td>
<td>(x)</td>
<td>0.05</td>
</tr>
<tr>
<td>Hexachlorobutadiene</td>
<td>µg/kg</td>
<td>(x)</td>
<td>(x)</td>
<td>0.1</td>
</tr>
</tbody>
</table>
Pentachlorobenzene | µg/kg | x | 0.1  
Sum of 16 PAH, calculated from the following components (US-EPA list): Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Anthracene, Benzo[a]anthracene, Fluorantheine, Pyrene, Phenanthrene, Chrysene, Benzo[b]fluoranthene, Benzo[k]fluoranthene, Benzo[a]pyrene, Indeno[1,2,3-cd]pyrene, Benzo[ghi]perylene, Dibenzo[ah]anthracene | mg/kg | x | x | 0.01 for each individual compound

Parameters in brackets need be analysed only if contamination is expected.

Overview of parameters and analytical methods

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freeze drying</td>
<td>DIN 38414-S 22</td>
</tr>
<tr>
<td>Drying at 105 °C</td>
<td>DIN/ISO 12880</td>
</tr>
<tr>
<td>Density</td>
<td>Gravimetrie</td>
</tr>
<tr>
<td>Dry residue</td>
<td>DIN 38414-S22 oder DIN/ISO 12880</td>
</tr>
<tr>
<td>Water content</td>
<td>DIN/ISO 12880</td>
</tr>
<tr>
<td>Grain-size fractions (&gt;63, &lt; 63, &lt; 20µm)</td>
<td>Siebg. nach BfG-Methode</td>
</tr>
<tr>
<td>Organic material (TOC)</td>
<td>EN 13137, DIN 38409-H3, ISO 10694</td>
</tr>
<tr>
<td>Total-P in total sediment &lt; 2mm</td>
<td>DIN 38414-S12, EN ISO 11885-E22</td>
</tr>
<tr>
<td>Total-N in total sediment &lt; 2mm</td>
<td>DIN 19684-T4, DIN ISO 11261</td>
</tr>
<tr>
<td>Preparation of eluates</td>
<td>DIN 38414-S4</td>
</tr>
<tr>
<td>Total-P in eluate</td>
<td>DIN 38405-D11-4, DIN EN 1189</td>
</tr>
<tr>
<td>Total-N in eluate</td>
<td>DIN EN ISO 11905-1, DIN ENV 12260, DIN 38409-H27</td>
</tr>
<tr>
<td>Oxygen consumption /3h</td>
<td>TV-W/I 1994</td>
</tr>
<tr>
<td>Separating the fine grain fraction &lt; 20 µm</td>
<td>BfG-Methode</td>
</tr>
<tr>
<td>Digestion for heavy metal determination</td>
<td>DIN 38414-S7</td>
</tr>
<tr>
<td>Arsenic</td>
<td>DIN EN ISO 11969-D18, DIN 38406-E29</td>
</tr>
<tr>
<td>Lead</td>
<td>DIN 38406-E6, DIN EN ISO 11885, DIN 38406-E29</td>
</tr>
<tr>
<td>Cadmium</td>
<td>DIN EN 5961-E19, DIN 38406-E29</td>
</tr>
<tr>
<td>Chrome</td>
<td>DIN EN 1233, DIN EN ISO 11885, DIN 38406-E29</td>
</tr>
<tr>
<td>Copper</td>
<td>DIN 38406-E7, DIN EN ISO 11885, DIN 38406-E29</td>
</tr>
<tr>
<td>Nickel</td>
<td>DIN 38406-E11, DIN EN ISO 11885, DIN 38406-E29</td>
</tr>
<tr>
<td>Mercury</td>
<td>DIN EN 1483, EN 12338-E31</td>
</tr>
<tr>
<td>Zinc</td>
<td>DIN 38406-E8, DIN EN ISO 11885, DIN 38406-E29</td>
</tr>
<tr>
<td>Hydrocarbons, total</td>
<td>z.B. ISO/DIS 16703 oder LAGA-Merkblatt MKW/04</td>
</tr>
<tr>
<td>Hydrocarbons, chain length up to C20</td>
<td></td>
</tr>
<tr>
<td>Hydrocarbons, chain length C21 to C40</td>
<td></td>
</tr>
<tr>
<td>Sum of PCB, calculated from the following congeners:</td>
<td>PCB- Nr. 28, 52,101,118, 138,153,180 p,p'-DDT p,p'-DDE p,p'-DDD Hexachlorobenzene gamma-HCH (lindane) alpha-HCH Hexachlorobutadiene Pentachlorobenzene</td>
</tr>
<tr>
<td>Tributyltin</td>
<td>Dibutyltin</td>
</tr>
<tr>
<td>Sum of 16 PAH, calculated from the following components (US-EPA- list):</td>
<td>Naphthalene, Acenaphthylene, Acenaphtene, Fluorene, Anthracene, Benzo[a]anthracene, Fluoranthene, Pyrene, Phenanthrene, Chrysene, Benzo[b]fluoranthene, Benzo[k]-fluoranthene, Benzo[a]pyrene, Indeno[1,2,3-cd]pyrene, Benzo[ghi]perylenne, Dibenz[a,h]anthracene</td>
</tr>
<tr>
<td>Marine algae test</td>
<td>Luminescent bacteria test</td>
</tr>
</tbody>
</table>
Recommendations for chemical analyses

Annex 3.1: Sample preparation

Upon delivery to the laboratory, wet sediment samples may require the following preparatory treatments:

- Preparation of composite samples
- Splitting the samples in sub-quantities (DIN 38402-A30)
- Homogenising the samples (DIN 38402-A30)
- Drying of samples
- Crushing or milling of dried samples

Usually, the customer will specify the required treatment steps.

Annex 3.2: Measuring the dry residue

The dry residue of wet sediment samples may be determined by the following methods:

Freeze-drying (DIN 38414-S22):  
In freeze-drying sediment samples, care must be taken not to exceed the temperature of 25 °C (possible loss of Hg and organic substances). The layer of the drying samples should not exceed 2 cm thickness to keep the drying time within 2-3 days. Particular attention should be given to avoid cross-contamination during drying. Especially heavily Hg contaminated samples must not be dried together with sediment samples with low Hg contents. Contamination may be spread also by Hg transfer from the previous drying of heavily contaminated samples.

Drying at 105 °C (DIN/ISO 12880)  
Drying at 105 °C takes place in heating cabinets with variable aeration gates as described in DIN 12880 Part 1. Evaporation dishes of porcelain or drying plates of stainless steel or aluminium should be used. The drying process has to be finished when the weight remains constant.
Deviations from this procedure must be approved by the customer.
The customer must receive the following documentation after the completion of each job:

- A complete report on the analyses that informs about the measured results of the analysed parameters and mentions possible irregularities.

**Annex 3.3: Drying of sediments and suspended solids**

Samples of wet sediments and/or suspended solids are freeze-dried prior to the analyses for heavy metals and organic contaminants (DIN 38414-S22).

cf. Recommendations in Annex 3.2: Freeze-drying

**Annex 3.4: Determination of the grain-size distribution in sediments by ultrasonic sieving in order to collect separate fractions ("BfG method")**

The following method developed in the German Federal Institute of Hydrology (BfG), Koblenz is to be applied:

**Ultrasonic sieving of all fractions:**

- **Drying:** The deep-frozen original sediment sample is freeze-dried, (about 60 to 80 ml, layer thickness about 2 cm, duration of drying 2-3 days, $T_{\text{max}} = 25^\circ\text{C}$).
- **Ultrasonic sieving:** Sieving in the ultrasonic bath with 2000 µm-, 630 µm-, 200 µm-, 63 µm- and 20 µm- sieves.

Representative aliquots: 10 to 30 g (or more, if very coarse and sandy samples are concerned) of the dried original sample are applied to the 2000 µm sieve that stands in a 600 ml beaker in the ultrasonic bath together with sieving aids (several balls of agate or zirconium of about 10 mm diameter).
About 30 - 50 ml distilled water are added and ultrasonic treatment is applied for 1 - 2 min. Then the beaker is shaken by hand and the sievings are given with several agate balls onto the 630 µm sieve.

After 1 - 2 min ultrasonic treatment, the passing material from the 630 µm sieve is given onto the 200 µm sieve and sieved in the ultrasonic bath. This procedure is repeated accordingly with the 63 µm- and the 20 µm-sieves.

The passing material of the 20 µm-sieve is filled into a 300 ml-centrifuge cup.

These steps are repeated several times, so that finally nearly 300 ml of water with the overwhelming part (>95%) of the "fraction <20 µm" are in the centrifuge cup. After 10 - 15 min centrifugation at 2,000 - 3,000 g the supernatant is carefully poured off. The residue is freeze-dried (overnight at T_max 25°C). Then the "fraction <20 µm" is available for contaminant analyses.

The residues on the 2000-, 630-, 200-, 63-, and 20 µm-sieves consist mostly of mineral material, mainly quartz (heavy-weight fraction). The still present darker organic components that have much less specific weight (light-weight fraction) may now - as required - be nearly completely transferred into the 200-µm fraction by repeated and sometimes prolonged sieving in the ultrasonic bath (see above). A good separation of the light-weight fraction may also be achieved by giving the sieving residues into 50 ml beakers for repeated suspending and settling (settling times: fraction 20 - 63 µm: 90 sec, fraction 63 - 200 µm: 10 sec, with about 40 ml per filling), followed by careful decanting.

**Calculating the grain-size distribution:**
The sieving residues are dried in a drying cabinet and weighed.

The percentage of the "<20 µm-fraction" is calculated as the difference of the weighed-in quantity of the dried original sediment and the sum of all dried sieving residues. This is done under the assumption that no relevant losses in weight occur during the sieving process. Losses should be kept at a minimum. A check can be made by weighing the portions of the fraction <20 µm after freeze-drying. The measurements are rounded up to integer percentages.

**Remarks**
Ultrasonic sieving separates the mineral components >20 µm, which contain low contaminant concentrations, from the more contaminated fine-grain fraction < 20 µm. Agglomerates as well as organic material, like residues of leaves, flocs etc. are mostly crushed.

If the fraction < 20 µm is separated only for the purpose of contaminant analyses and no determination of the grain-size spectrum is required it is not necessary to separate this fine-grain fraction completely (> 99%), because the contaminant concentration in this fraction do not depend significantly on the completeness of the separation. In such cases the fraction < 20 µm may be extracted directly from the wet original sample without prior use of all the coarser sieves. However, clogging of the sieves may cause problems.

Conversely, if also the coarser mineral fractions (20-63 µm, 63-200 µm etc.) shall be analysed for contaminants, the present organic components, which show usually much higher contaminant concentrations, have to be separated thoroughly. The organic portions that remain after several sieving and settling processes usually do not play a significant role for the determination of the weight percentages of the sieving residues 20-63 µm and 63-200 µm.

Desorption of heavy metals from the fraction < 20 µm was not observed with this sieving method. Neither were losses of organic contaminants or contaminations noted.

The sieves for ultrasonic sieving may be produced in the laboratory from acrylic-glass tubes and fabric that is used in industrial mills (e.g. Fa. Verseidag in 47608 Geldern). More detailed information may be obtained from the German Federal Institute of Hydrology (BfG), Koblenz. It is recommended to check the sieve fabric regularly (e.g. after 10 to 30 applications) for holes or ruptures by means of a magnifying glass.

The customer must receive after the completion of each job the following information:

- The data of the portions of the grain-size fractions [in %].
- Information about irregularities during the measurements.
Annex 3.5: Extraction of the fine-grain fraction < 20µm in suspended solids or sediments by ultrasonic sieving for heavy-metal analyses ("BfG method")


The assessment of the heavy-metal concentration in suspended solids and in sediments often requires the isolation of the fraction < 20 µm from the un- or less-contaminated coarser mineral fractions (coarse silt, sand). This < 20 µm fraction that is usually highly enriched with contaminants (the so-called contaminant-carrier fraction) has to be analysed separately. This may be achieved effectively by ultrasonic sieving without significant distortion of the coarser (> 20 µm) mineral fractions.

Because the fraction < 20 µm is needed only for heavy-metal analyses, it is not necessary to extract this fine-grain portion completely from the original samples.

The < 20 µm fraction may be extracted by the following method that was developed by the German Federal Institute of Hydrology (BfG):

The fraction < 20 µm can be extracted directly from the wet original sample or from the freeze-dried original sample.

Depending on the grain-size distribution of the original sample and the desired amount of the < 20 µm fraction, 5 to 20 g of the sample material is given with several balls of agate or zirconium oxide (about 10 mm in diameter) into the 20-µm sieve that stands in a 600-ml beaker in the ultrasonic bath.

The sieves for ultrasonic sieving may be produced in the laboratory from acrylic-glass tubes and fabric that is used in industrial mills (e.g. Fa. Verseidag in 47608 Geldern). More detailed information may be obtained from the German Federal Institute of Hydrology (BfG), Koblenz. It is recommended to check the fabric of the sieves regularly (e.g. after 10 to 30 applications) for holes or ruptures by means of a magnifying glass. Damaged sieves have to be replaced.

If samples contain much sand (> 50%), an initial sieving using a 63 or 200 µm-sieve in the ultrasonic bath is recommended. Otherwise, the greater amount of input that is needed in case of
sandy material would cover and clog the < 20µm sieve and thus hinder the particles to pass the sieve in a reasonable period of time.

About 30 to 50 ml of distilled water are added to the sample in the sieve/beaker and ultrasonic treatment is applied for 1 - 2 min. Then the beaker is shaken by hand and the passing material, i.e. the "fraction < 20µm" is given into a 300-ml centrifuge beaker.

The aforementioned step is repeated until the quantity of the "fraction < 20µm" in the centrifuge beaker is sufficient for the heavy-metal analysis.

The passing material is centrifuged for 10 - 15 min at 2000 - 3000 g. The supernatant is carefully poured off and discarded, the residue is freeze-dried (over night at T_{max} = 25 °C). The „fraction < 20 µm“ is then ready for heavy-metal analysis.
**Annex 3.6: Eluate analyses**

Chemical analyses of eluate are performed according to LAGA TR (of November 1997).

Aqueous eluates are prepared from the original (non-dried) samples (DIN 38414-S4) and examined for the parameters listed in the table. Prior to the analyses, the eluates are filtered through a membrane filter (pore size 0.45 µm).

The customer must receive after the completion of each job the following information:

- A complete report that informs about the measured parameters and about possible irregularities during the measurements.

- A documentation of the analytical quality assurance during the analyses.
Annex 3.7: TOC determination

Total carbon (TC) and total organic carbon (TOC) are determined according to EN 13137 and DIN 38409-H3.

Deviations from these methods should be agreed with the customer.

- The following quality-assurance methods should be applied in the analyses of the samples and mentioned in the test report:

  - Blanks must be determined for all devices, instruments, and reagents used. If necessary, it should be taken into considerations during the evaluation of the measured data.

  - Analyses of at least one suitable (see below) reference sediment (internal laboratory standard or certified reference material) using the same methods applied for the samples under consideration. The actual values measured in the reference sediment and the respective mean values/target values should be mentioned in the test report. The relative simple standard deviations of the values from the mean/target values of the reference materials must not exceed 10%. A suitable reference sediment shows a TOC concentration from 1 to 10 % (related to dry mass) and should have a similar matrix in respect to the analysed samples (here: marine sediment or river-sediment) e.g. NIST-1941b or - after approval by the customer - a reference material of suitable concentration and matrix.

- The limits of determination of 0.1 % related to dry mass have to be observed. Deviations towards higher values are particularly defined by the customer in single cases. When analysing sandy samples (more than 50 % sand), the amount of input material has to be increased accordingly.

- TOC measurements should be made at least twice with every sample. The difference between these two measurements should be $< 10$ % of the mean value. If this result is not
matched, at least one more measurement is necessary, and the variation coefficient should then be < 10%. If this cannot be achieved, the variation coefficient has to be reported with the results.

➢ Results are reported as % TOC or % TC related to dry mass.

The customer must receive after the completion of each job the following information:

• A complete report that informs about the measured parameters and about possible irregularities during the measurements.

• A documentation of the analytical quality assurance during the analyses (e.g. control charts of the reference material and recovery rates).
Annex 4

General recommendations for literature on the handling of dredged material

1  **International agreements**

   (via [www.bafg.de/Baggergut](http://www.bafg.de/Baggergut) or [www.htg-baggergut.de](http://www.htg-baggergut.de))


2  **PIANC International Navigation Association**

   ([www.pianc-aipcn.org/](http://www.pianc-aipcn.org/))


Working Group ENVICOM 8: “Generic Biological Assessment Guidance for Dredged Material” (in preparation.)
3 CEDA / IADC Environmental Aspects of Dredging

(www.iadc-dredging.com)

Guide 4: Machines, Methods and Mitigation (1998)
Guide 5: Reuse, Recycle or Relocate (1998)

4 Hafenbautechnische Gesellschaft (HTG) -Fachausschuss Baggergut

(German Port Technology Association - Technical Committee on Dredging)

(www.htg-baggergut.de)

(Handling of dredged material against the background of legal regulations: Definitions (2002))

5 Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall, ATV-DVWK

(German Association for Water, Wastewater and Waste)

(www.atv.de)

(Handling of dredged material, information sheet, Parts 1, 2, and 3)

6 Deutsch-Niederländischer Austausch über Baggergut

(Dutch-German Exchange on dredged material)

(via www.htg-baggergut.de)

Teil 2: "Treatment and Confined Disposal of Dredged Material" (2002)

Literature recommendations on Chapter 4 „Chemical analyses and assessments“

(Joint measuring programme of Federal institutions and Federal states on the North Sea - Joint water-quality measurements in coastal waters of the Federal Republic of Germany)


OSPAR (1997): JAMP Guidelines for Monitoring Contaminants in Sediment

QUASIMEME: Quality Assurance of Information for the Marine Environmental Monitoring, QUASIMEME Project Office, Marine Laboratory, PO Box 101, 375 Victoria Road, Aberdeen AB11 9DB, UK (www.quasimeme.marlab.ac.uk)
**Annex 5**

**List of acronyms and abbreviations**

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>BNatSchG</td>
<td><em>Bundesnaturschutzgesetz</em> - German Federal Nature Conservation Act</td>
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<tr>
<td>DS</td>
<td>dry substance</td>
</tr>
<tr>
<td>EEZ</td>
<td>exclusive economic zone</td>
</tr>
<tr>
<td>EG-HWRL</td>
<td>European Directive for Flood Protection/EG-Hochwasser Richtlinie</td>
</tr>
<tr>
<td>EU-WFD</td>
<td>European Water Framework Directive</td>
</tr>
<tr>
<td>EU-MSFD</td>
<td>European Marine Strategy Framework Directive</td>
</tr>
<tr>
<td>FFH-RL</td>
<td>Flora-Fauna-Habitat Directive</td>
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<tr>
<td>ICES</td>
<td>International Council for the Exploration of the Sea</td>
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<tr>
<td>LC</td>
<td>London Convention</td>
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<tr>
<td>OSPAR</td>
<td>Oslo-Paris Convention</td>
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<tr>
<td>TMAP</td>
<td>Trilateral Monitoring and Assessment Program</td>
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<tr>
<td>TOC</td>
<td>Total Organic Carbon</td>
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