

FACT SHEET

BENEFICIAL USE OF DREDGED MATERIAL

WHAT IS BENEFICIAL USE OF DREDGED MATERIAL?

Dredging is essential for the maintenance and development of waterways and ports, as well as navigation, land reclamation, environmental and ecosystem improvement, drainage and flood management. Dredging removes large volumes of sediments that need to be appropriately managed and beneficial use is the preferred way to manage dredged material. It concerns the use of dredged or natural sediment in applications that are beneficial and in harmony with human and natural development (CEDA 2019a).

WHY IS BENEFICIAL USE OF DREDGED MATERIAL NECESSARY?

The best way to manage dredged material sustainably is by using dredged sediments beneficially. The most important principle to consider is that dredged material is a resource instead of waste. It should not be seen in terms of a material that needs to be disposed of. Instead it creates societal, environmental and financial benefits with its reuse. Because large volumes are involved, being able to potentially use dredged material represents a significant sustainability contribution. Nature based solutions are the most sustainable. Dredged material can be used for flood and coastal protection, which may be important to mitigate the effects of climate change (CEDA, 2012) and land subsidence, but also for the improvement of habitats and related ecosystem service functions, and as construction material.

Dredged sediments are an essential component of natural sediment cycles and ecosystems. Therefore, the option of retaining dredged material within the same aquatic system (sustainable relocation) should be considered first (CEDA 2009). Dredged material consists of sedimentary deposits of natural materials such as clay, silt, sand, gravel, rock and organic matter. In general, dredged material can be used beneficially immediately and without treatment. Only a small portion of sediments are contaminated to an

extent that it leads to increased costs in dredged material management. Contamination does not rule out beneficial use. If required, treatment options are available (see CEDA 2019b for further reading).

WHY IS BENEFICIAL USE NOT YET A COMMON PRACTICE?

Generally the public and some National Authorities consider dredged material to be waste and is often in favour of upland confined disposal, thinking this is to contain it. However, this type of disposal disregards its potential value for beneficial use, that is, as a savings on primary resources. Moreover, this type of disposal is usually more expensive.

Other major constraints are the difficulty in finding suitable locations for its use and complex and inconsistent legislation. Because there is often no legislation specifically for dredging or for dredged material management, decision-makers need to deal with a patchwork of different rules, such as regulations to protect the ocean, inland water, residential areas, the environment, nature and for the handling of waste. Many different permits may be required.

HOW CAN BENEFICIAL USE BE IMPLEMENTED IN A DREDGING PROJECT?

Matching supply and demand, taking into account quality, quantity and timing, determines the potential of dredged material for beneficial use. Therefore, beneficial use should be considered in an early stage of a project together with relevant stakeholders, particularly because communicating of project timings and the availability of material can be a determining factor. Legislation, but also its interpretation by regulators, can be a key driver for considering dredged material as a valuable resource, and also in facilitating its use. Important technical criteria in the process are the suitability of the material for use, where and how it was dredged, the opportunities available for its use, the characteristics of the proposed site for use and its environmental and social acceptability (CEDA/IADC 2018).

Above: Sediment from maintenance dredging is used to restore local intertidal mudflat and saltmarsh habitats that have been subject to erosion over recent decades.

To arrive at environmental enhancement through the use of dredged material, an understanding of the natural system is crucial. This will allow for an assessment of both the potential environmental benefits and risks. Environmental and social benefits should be included in a cost-benefit analysis.

As we underline, dredged material should be considered for beneficial use before disposal is considered, and preferably it should be kept within the system (sustainable relocation). The key factors to promote and increase successful beneficial use and instances thereof are as follows (PIANC 2009b):

- Consider the use at an early stage to allow for matching supply and demand;
- Engage stakeholders and partners at an early stage
- Inform the regulatory process about the benefits and potential risks) of using dredged sediments.;
- Analyse comprehensively the social, environmental and economic costs and benefits of a project, taking into account the longer term;
- Make commitments to develop knowledge and further innovation;
- Exchange knowledge in lessons learned from projects.

WHAT TYPES OF BENEFICIAL USES ARE AVAILABLE?

The two main types of beneficial use are **environmental enhancement** and **engineering uses**. Some options belong to both types.

ENVIRONMENTAL ENHANCEMENT

Sustainable relocation

Sustainable relocation of dredged material is the introduction of dredged material into aquatic systems to maintain and/or supplement sediment supply. It is placed there to sustain natural processes. A number of situations exist where regular removal of sediment by dredging from the aquatic system may cause physical problems such as erosion and unacceptable impact to the environment and ecosystems. In these cases, recycling the sediment within the natural sediment transport system may provide a solution.

Habitat creation and improvement

Dredged material can be used in various ways to create or maintain marine wildlife habitats. These include the following types: intertidal mudflats, salt marshes and wetlands. These habitats can be for birds (upland habitats and nesting islands) and aquatic habitats can be for fish and benthic organisms including aqua culture. It is important to note that mudflat nourishment and marsh recharge may also contribute to flood protection. Extensive

shallow fore-shores are created by placing fine-grained dredged material in intertidal areas to restore or extend estuarine mudflats. This technology has been most extensively developed in the USA. In Europe, mainly small-scale projects are being undertaken, including in the UK and the Netherlands. It should be noted that the creation of any new habitat means replacing an existing one. A full environmental cost-benefit study is always necessary before making a decision and any scheme will inevitably mean some losses as well as gains.



Agriculture

Dredged material from mainly rivers and inland waterways has been used in agriculture, horticulture and forestry. Its primary drawbacks are possible contaminants including salt (in the case of marine sediments), and regulatory constraints.



Recreation

This involves the creation of amenities, for example hiking trails, through marshlands, or access to constructed or existing waterways. It should be noted that habitat creation and enhancement areas as well as beach nourishment for flood protection could also create significant recreational benefits which may not have been their primary purpose.

Amenity in this context means the improvement or provision of facilities that are designed for recreation. It includes the regeneration of derelict land, landfill, landscaping and the creation of recreation areas.



Clean dredged sediment is used to cover and landscape the upland CDF of dredged harbour silts (Hamburg, Germany).

Rehabilitation of borrow pits

Artificial depressions, such as borrow pits from the extraction of sand and gravel, in and near river, estuarine and marine systems, are potentially very useful locations to place dredged materials. Filling pits can offer opportunities for environmental improvement. Many pits are quite deep which leads to the development of a stagnant, anoxic zone with negative effects for the ecosystem. Dredged material can be used to make the pits shallower and thus eliminate anoxia and improve ecological conditions.



Cliffe Pools, UK: a win-win for river dredging and nature.

ENGINEERING USES

Flood and coastal protection

There are several ways in which dredged material can be used in flood and coastal protection schemes. Examples are as follows:

- Beach nourishment and the direct replacement of eroded beach material. This is now an accepted form of 'soft' coastal defence. In the past, it was usually required that the beach be nourished with similar material to what had eroded. Research has led to the creation nowadays of a more stable beach with a different profile.

- Development of unenforced coastlines (managed retreat). This approach is suitable for muddy coasts backed with low-value land. The objective is to create a buffer zone by setting back the defence works and breaching the existing wall.
- Mudflat nourishment and marsh recharge. By placing fine dredged material in intertidal areas for restoration or to extend estuarine mudflats, the extensive shallow foreshores also contribute to flood protection.
- The formation of offshore berms designed to modify the wave climate. These berms may be hard (rock) designed to withstand wave energy, or soft (sand) designed to absorb wave energy. It is also possible to form sacrificial feeder berms supplying the sediment intended to move onshore.
- The placement of dredged material on the banks of waterways and upland. To gain elevation and use of dredged material for dyke, dam or dune construction for flood protection.



Using dredged sediment for coastal defence and habitat restoration, Horsey Island 2009 (Jim Pullen UAV Surveys, April 2017).

Construction

In the construction industry, dredged material may be used for the following purposes:

- Construction material and reclamation. Dredged material such as sand, clay and gravel can be used as an alternative for some primary resources. These may be used as construction material for many applications such as land or mine reclamation, replacement fill, land-fill cover, road foundations and noise barriers.
- Land reclamation. Dredged material may be used to construct islands and other man-made land. In the case of traditional land reclamation, the material is excavated specifically for this purpose.
- Land development. Dredged material may be used to develop commercial sites (e.g., rehabilitating of brownfield sites, agriculture land and recreational sites).
- The production of aggregates and mudcrete (mud stabilised with cement). The sand and gravel component of dredged material arising from capital dredging and the maintenance of a certain site may be used to make concrete. Logistics and economics are the biggest issues.

- Filling geotextile containers. These include sandbags, geotextile tubes and geotextile containers. Existing and possible uses for geotextile containers include dyke construction, groynes, breakwaters, sand dune stabilisation, stabilisation of banks of waterways and wetland stabilisation.



Geotubes for bank stabilisation.

- The manufacture of synthetic building materials. Several methods have been developed to re-use dredged sediments to manufacture synthetic building materials such as bricks and artificial gravel. Economic feasibility is a major constraint for these uses.

SEDIMENT MANAGEMENT TECHNIQUES

This is a different category that does not directly deal with the use of dredged material but with the management of on-site sediments. The aim is to create benefits such as reducing the volumes to be dredged using engineering techniques. Another example is landscaping the sea- or riverbed to restore the ecology of the underwater landscape sand and gravel have been extracted.

The analyses of numerous case studies in CEDA 2019a and CEDA 2019b demonstrate that there is significant technical knowledge on and experience with the beneficial use of sediment. The case studies can be found on the [CEDA website](#).

IS THE FUTURE OF USING DREDGED MATERIAL BENEFICIALLY?

Global and regional conventions on dredged material management have recently led to the publication of recently published guidelines that acknowledge the origin and specific properties of dredged material and actively promote beneficial use of dredged material (LC/LP, 2013; OSPAR 2014), stating:

'Sediment is an essential component of fresh water, estuarine and marine ecosystems. Sediment processes play important roles in determining the structures and functions of aquatic systems. Therefore, management processes applied to sediment, in relation to human activities, should recognise that sediment is an important natural resource.'

In addition, in many countries disposal is becoming increasingly difficult owing to the lack of space and to environmental concerns. Because of this, there is a growing interest the potential of dredged material as a resource.

Good communication is essential to gain support from the public, regulators and other stakeholders. Good communication is needed for dredged material to be viewed as a valuable resource and prevent it being stigmatised as waste.

Several international programs and initiatives centred on the sustainable and nature-based development of hydraulic and civil infrastructures seek to support the sustainable development of infrastructure through a better alignment of engineering and natural systems and their integration. The beneficial use of sediment is a key, constant theme across these programmes.

WHAT IS RELEVANT LITERATURE?

The various management options are discussed in-depth in the publications below.

Aarninkhof, Stefan, Laboyrie, Polite & van Koningsveld, Mark, 2018. [Dredging for Sustainable Infrastructure](#). (CEDA/IADC).

CEDA, 2010. ['Dredged Material as a Resource: Options and Restraints'](#). A CEDA information paper.

CEDA.-- 2012. ['Climate Change Adaptation as it Affects the Dredging Community'](#). A CEDA position paper.

CEDA 2019a. [Sustainable Management of the Beneficial use of sediments](#). A CEDA information paper.

CEDA 2019b. ['Assessing the Benefits of Using Contaminated Sediments'](#). A CEDA position paper.

IADC, 2009. ['Facts about Dredged Material as a Resource'](#). An IADC technical report.

LC/LP, 2013. [Revised Guidelines for Assessment of Dredged Material](#).

OSPAR, 2014. [OSPAR Guidelines for the Management of Dredged Material at Sea](#).

PIANC, 2009a. ['Dredging Management Practices for the Environment: A Structured Selection Approach'](#). PIANC EnviCom: Report 100, a technical report.

PIANC, 2009b. ['Dredged Material as a Resource'](#). PIANC EnviCom: Report 104, a technical report.

THIS FACT SHEET IS BASED ON THE BOOK *DREDGING FOR SUSTAINABLE INFRASTRUCTURE*

The book *Dredging for Sustainable Infrastructure* gives state-of-the-art guidance on how to design, implement and manage a water infrastructure project with a dredging component to project owners, regulators, consultants, designers and contractors.

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