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RE-USE OF BORROW PITS: THE DUTCH APPROACH TO STORING (CONTAMINATED) DREDGED MATERIAL

ABSTRACT

In a deltaic country like the Netherlands large volumes of dredged material have to be dealt with in order to keep the ports and inland waterways open for navigation. The majority of the dredged material originates from the North Sea and is relocated in the sea. "Relocation" applies also for the better part to dredged material from inland waters. Some 10 percent of the yearly amount of 30 million cubic metres, however, is contaminated and is therefore stored in (confined) disposal facilities (CDFs). As a result of complex legislation, lack of space and public resistance, cost-effective solutions for dredged material, especially when it is contaminated, are becoming more and more difficult to find.

Re-use of former borrow pits is an attractive option in this respect, in particular when such filling offers opportunities for enhancement of the local environment. A case-specific approach and tailor-made solutions in close communication with all stakeholders are, however, needed to comply with legislation and to safeguard environmental values. This (Dutch) approach may lead to win-win situations with respect to mineral extraction,

recreation, flood management and water management in general. This paper was first presented at PIANC COPEDEC VII, held in Dubai, UAE in February 2008 and is republished here with slight revisions with permission of the PIANC Secretariat in Brussels, Belgium.

INTRODUCTION

The Netherlands is a densely populated and industrialised country located in the Rhine-Meuse delta on the North Sea coast. Frequent dredging is essential to keep seaports, rivers and canals accessible for navigation; other purposes of dredging are drainage, flood protection and remediation of contaminated sites in order to comply with the objectives of the Water Framework Directive. The Netherlands has to deal with large volumes of dredged material, approximately 30 million cubic metres each year.

Above: The re-use of former borrow pits, such as near-shore confined disposal facilities, like De Slufter shown here, are an attractive option for relocating contaminated dredged material, in particular when such filling offers opportunities for enhancement of the local environment (courtesy Port of Rotterdam).

About three-quarters of the dredged material is marine sediment, which has been transported inland by tidal currents. Nearly all of this marine sediment is clean or only lightly contaminated and is relocated at sea if the quality complies with the Dutch action levels.

The majority of dredged material from fresh waters is placed on banks of waterways or relocated in (another part of) the aquatic system. Minor amounts are used for nature development and as building material.

About 10 per cent of the total amount of dredged material is heavily contaminated and is stored in large-scale sub-aquatic confined disposal facilities (CDFs). This is an environmentally sound and efficient solution, because dredged material is contained by dikes and stored for the better part underwater. The near-shore CDF De Slufter, with a remaining storage capacity of 45 Mm³ (see above), is an example of such a facility.

As a result of complex legislation, lack of space and public resistance, finding cost-effective solutions for dredged material, especially when it is contaminated, is becoming more and more difficult.

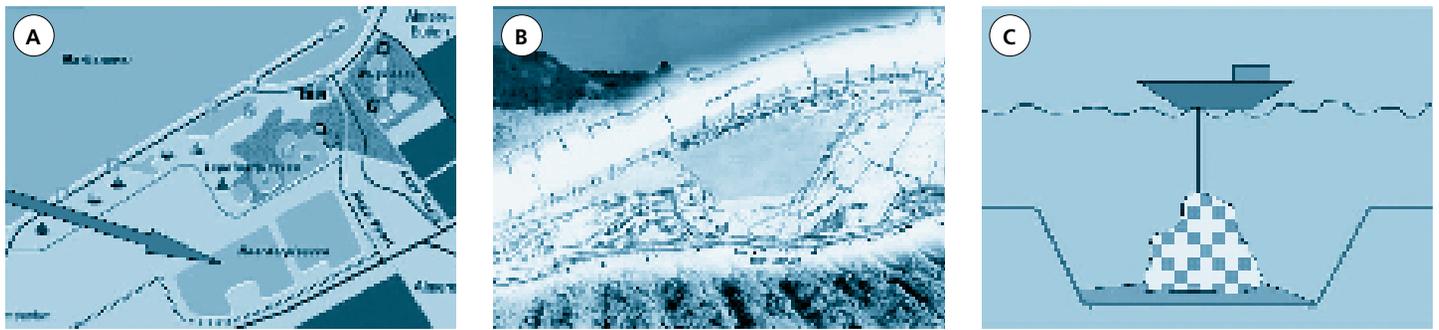


Figure 1. Three types of borrow pits: A) isolated from the surface water; B) partly protected pits (both in time and place); and C) fully open pits.

USE OF DREDGED MATERIAL

Based on the concept that dredged material should be considered as a resource instead of as a waste material, use of dredged material should be encouraged. An example is use of dredged material to fill borrow pits, which is done in several countries such as Japan and the Netherlands (PIANC 2008).

In a number of cases, the filling of pits offers opportunities for the enhancement of the local environment; this can therefore be considered as a beneficial use. Many pits are quite deep and have an anoxic zone, which limits their ecological value. The storage of dredged material makes the pit shallower, which creates attractive conditions for nature development and can have a positive effect on biodiversity. Nature development can also benefit from the creation of habitats in the layer covering the pit.

Site-specific assessments of the environmental and ecological effects of filling borrow pits need to be considered before a decision is taken about the use of a pit for the storage of dredged material. Consultation and involvement of the public and relevant authorities is crucial to gain support for the filling of pits with dredged material. The benefits of dredging (e.g. flood protection) and use (e.g. nature development) and the actual (perceived) risks of the storage of contaminated dredged material should be communicated in order to avoid a NIMBY (Not In My BackYard) attitude, where insufficient information results in public opposition. Storage of "regional" dredged material (i.e. originating from the surrounding area)

is in general more acceptable for the public than storage of contaminated dredged material from all over the country.

LEGISLATION

In the current legislation in the Netherlands the filling of pits can be considered either as the disposal of a waste material (Environmental Management Act) or as a beneficial use, if the quality complies with the standards for building materials (Building Materials Decree). The Environmental Management Act defines criteria for the emission of contaminants to surface and groundwater. New legislation, based on site-specific risk assessment, is in development to encourage use of dredged material. For the application of dredged material, the Building Materials Decree will no longer be applicable, but the Soil Quality Decree instead.

Following this decree, the filling of pits is considered as a beneficial use under the following conditions:

- quality of dredged material is below the standards to consider remediation, in other words below the so-called intervention levels;
- dredged material has to be used in an anaerobic environment to safeguard the restricted mobility of metals;
- dredged material is originating from the surrounding area.

If the filling of pits does not comply with the criteria of the Soil Quality Decree, it has to be considered as disposal, which means that the emission criteria of the Environmental Management Act are applicable.

Another aspect to consider is the Groundwater Directive, a daughter Directive of the European Water Framework Directive, which is in a process of revision.

The filling of pits with dredged material also has to comply with the requirements of the European Bird and Habitat Directives. The filling of pits leads to a reduction of the depth and the underwater area of the side slopes. These changes in bottom topography may reduce habitat diversity and the extent of fish grounds.

USE OF BORROW PITS FOR STORAGE OF DREDGED MATERIAL

Borrow pits in river floodplains, estuaries and near-shore areas formed by extraction of sand and gravel have a large potential for the storage of (contaminated) dredged material. This is the case in particular when the dredged material cannot be used directly in a beneficial way, e.g. as fill material. The feasibility of such storage depends on the quality of the material and the local conditions; especially the potential effects on the environment are essential elements during the planning and decision-making process.

The first step is the selection of suitable locations. Examples of favourable conditions for the protection of groundwater are an upward or stagnant groundwater flow, or an insulating layer of clay underneath the pit.

The second step is to consider appropriate measures to minimise potential effects, such as method of placement, reduction of



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currents (e.g. by construction of bunds) and capping with a clean and erosion-resistant layer. Careful placement of dredged material in the pit is needed to minimise turbidity in the surface water owing to dispersion of fines. A fall pipe or a diffuser may be used for this purpose.

Three different types of former borrow pits for the storage of dredged material are shown in Figure 1 A, B and C (AKWA 2004):

- The first type (A) is an inland aquatic borrow pit, where the surface water is not connected to the surrounding surface water – horizontally isolated.
- The next type – also in the sense of degree of insulation from the surrounding environment – is a former borrow pit in the floodplain of a river (B); only during extreme conditions the surface water may be affected slightly by the run-off of the river.
- The third type (C in Figure 1) is a fully open pit, which means that both during fill operations and later on the hydraulic conditions may influence the water quality, because of the possible exchange of suspended solids and the possible erosion of the upper layer of the stored material close to the upper part of the pit.

Six former sandpits are now in use in the Netherlands for the storage of contaminated dredged material with capacities up to 10 million cubic metres. Figure 2 shows one example of such former borrow pits in

the floodplain of the river Waal, the main branch of the lower reach of the river Rhine. For the storage of relatively clean dredged material numerous smaller pits are in use.

Another example of storage of dredged material in a former borrow pit is shown in Figure 3, at Tryehus, an inland aquatic storage site in the province of Friesland.

To provide better protection against floods, the discharge capacity of the rivers Rhine and Meuse and the storage capacity in their floodplains will be enlarged. The resulting dredged materials that cannot be used as construction material will be used to fill sand and gravel pits. Heavily contaminated dredged material from so-called “hot spots” will be stored in existing large-scale aquatic confined disposal facilities.

PROTECTION AGAINST EROSION

In particular during filling operations (Figure 4), measures must be taken to ensure that erosion of stored material and subsequent transport by (tidal) currents of suspended material to the surrounding surface water is minimised. An appropriate measure is a bund a few metres high built around (part of) the pit; due account should be taken of shipping requirements. Materials suitable for such bunds are not only sand, clay, gravel and armourstone, but also recycled and secondary materials

Figure 2. The filling of the former borrow pit Kaliwaal using a fall pipe. After filling, the site will be transformed into a nature reserve area, a project supported by the World Wildlife Fund.





Figure 3. The Tryehus storage site in Friesland, a northern province of the Netherlands.

and combinations such as sand with an erosion-resistant cover layer.

The hydraulic conditions – waves or currents or a combination of both – determine the design of these current-reducing near-bed structures. This applies to both the cross-section and the extent (or layout). In the case of unilateral flow (in the floodplains of rivers), building a bund at the upper boundary of the pit may be sufficient. However, in the case of estuaries and coastal sites, a submerged (or near-bed) ring dike may be necessary to provide appropriate protection. An example of the first situation is the former borrow pit “Cromstrijen”, located in one of the lower reaches of the Rhine-Meuse delta (see Figures 4 and 5 and van der Sluijs *et al.* 2007).

CONCLUSIONS

Finding destinations for dredged material, especially when it is contaminated, is a problem in densely populated countries such as the Netherlands. New Dutch legislation based on site-specific risk assessment is enabling more uses of dredged material.



Figure 5. Schematic drawing of the former borrow pit “Cromstrijen”, with a capacity of 10 Mm³, which was provided with an underwater bund at the upper boundary.

Borrow pits, both near-shore and inland, have a large potential to store dredged material, which can be beneficial to the environment. Although a case-specific approach and tailor-made solution are necessary for each borrow pit to comply with legislation and to safeguard environmental values, the storage of dredged material in pits can lead to win-win situations with respect to mineral extraction, recreation, flood management and water management in general.

This solution is in general less expensive than confined disposal, because less facilities are required and dredged material can be more easily unloaded, e.g. by split barges. The use of borrow pits for storage of dredged material can be a very practical

Figure 4. Unloading dredged material to fill the former borrow pit at Cromstrijen in the lower reaches of the Rhine-Meuse delta.

and cost-effective approach. Depending on local conditions this approach can also be feasible in developing countries and countries in transition.

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