DESIGN FEATURES OF CONFINED DISPOSAL FACILITIES (CDFs) FOR CONTAMINATED SEDIMENTS

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ABSTRACT

Confined disposal facilities (CDFs) are one of the most widely used options for placement of contaminated sediments. These facilities must be designed to retain the suspended solids and contaminants during pumping and provide adequate storage during hydraulic placement of dredged sediments. Following placement, the finer sediments consolidate and dewater. Containment features such as liners, surface covers, and low permeability dike materials, cores, or cutoff walls can be considered as control measures for contaminated sediments. These features may serve to improve the effectiveness of CDFs in retaining contaminants and reducing the potential for contaminant losses to surface water, ground water, air, plants, and animals. This paper describes the major design considerations for containment features for CDFs.

INTRODUCTION

Improved methods for design, construction, and management of confined disposal facilities (CDFs) for placement of contaminated sediments are being developed under the U.S. Army Corps of Engineers (USACE) Dredging Operations and Environmental Research (DOER) program. CDFs are one of the most widely used technologies for disposing of contaminated sediments. CDFs are diked areas designed to provide retention and storage of dredged material. A CDF may be constructed as an upland site, a nearshore site with one or more sides constructed in the water, or as an island containment area. Contaminant loss pathways for a CDF include effluent during filling operations, surface runoff following precipitation, leachate to groundwater, volatilization to air, and direct uptake by plants or animals colonizing the site. If applicable environmental standards or guidelines are not met for one or more of these pathways, contaminant control measures can be considered to reduce impacts to acceptable levels.

CDF CONTAINMENT

Containment in a CDF may be defined as an operational approach or engineered feature intended to function as a contaminant control measure to reduce the migration or transport of contaminants via one of the pathways. Containment refers to the ability of the site with associated features to hold the contaminants within the site as opposed to treatment approaches intended to destroy or degrade contaminants or immobilize the contaminants within the sediment. Contaminant measures may include operational modification, selective placement of dredged material, and engineered site controls or containment features, such as liners, surface covers, and lateral cutoffs. Information is available for a number of foreign and domestic case studies for design and construction of engineered containment features and application of operational controls for containment (Palermo and Averett 2000).

Operational Controls. Site operations can be used as a control measure for CDFs to reduce the loss of contaminants through the surface water, volatilization, and groundwater pathways. Operational controls may include selective placement of layers of clean and contaminated material to provide for attenuation or containment of contaminants (sandwiching); taking advantage of the fine-grained nature of dredged material, which yields low permeability when subjected to consolidation in a CDF (self-sealing or self-lining); placing cleaner dredged material with suitable chemical and physical properties as the final layer in a CDF (defacto surface covers); placement of drainage layers to enhance dewatering and consolidation; and control of ponded water to reduce hydrostatic head or maintain a negative hydraulic gradient (conditions causing seepage flow into the CDF as opposed to flow from the CDF). Selective placement configurations with respect to water levels are possible for nearshore and in-water CDFs. Selective placement below the groundwater or surface water elevation keeps that portion of the CDF fill anaerobic, which reduces the potential for release of some classes of contaminants of concern (especially metals) to the dissolved phase. Selective placement can also take the form of configuring the CDF fill with a greater depth and smaller surface area. This reduces the "footprint" of the site subject to erosion, plant and animal uptake, and surface runoff.

Engineered Containment Features. Operational approaches as discussed above should be considered as a "first line of defense" for projects in which containment is needed to control pathways. However, if such measures will not meet requirements, engineered control measures may be needed. Engineered CDF containment features or control measures are specifically designed and constructed to enhance containment of the dredged material and control potential contaminant release pathways. Containment features are not widely practiced for dredged material management because simply retaining sediment solids in a CDF has adequately met regulatory requirements for most navigation dredging projects. However, CDFs are often recommended and have been required for some sites receiving highly contaminated material or for sites located in environmentally sensitive areas. For these CDFs engineered features may be needed. The major categories of engineered containment features include bottom and sideliners (with and without leachate collection) surface covers, dike cores, and cutoff walls.

Liners And Leachate Collection Systems. Liners consist of a layer of clay, conditioned dredged material or synthetic material placed across the bottom and sides of a CDF to control leachate. Leachate collection systems, consisting of drainage layers and piping to collect leachate for treatment or disposal are sometimes used in conjunction with liners. Only a few dredged material sites worldwide have been constructed with liners.

Surface Covers. Surface covers consist of a layer of material placed on top of contaminated sediment. Covers provide several potential benefits for contaminant control by providing a clean layer exposed to surface runoff, isolating the underlying dredged material from access by plants and animals, and reducing infiltration of precipitation into the fill, thereby reducing leachate volume. Surface cover construction for CDFs can be problematic due to the soft nature of newly placed dredged material, especially material that has been hydraulically placed in the CDF.

Lateral Containment. Lateral containment features are used for containment of lateral seepage from the CDF, either directly through the dikes or in foundation soil layers beneath the CDF. Possible lateral containment options include dikes constructed using a layer or core of material

that reduces permeability to contain seepage (dike cores), liners or mattresses placed on the inside face of dikes, or installation of a cutoff wall to reduce lateral flow from the CDF or to divert groundwater around the CDF (e.g., a slurry wall or sheet-pile, placed either within the dike cross section or outside the dike perimeter in foundation layers).

CONCLUSIONS

The number of CDFs where operational controls for containment or engineered containment features have been implemented is limited. Most of these sites are associated with sediment remediation projects, which involve more highly contaminated sediments than normally associated with navigation projects. Design of these containment features has been on a case-by-case basis with little commonality from site to site. Reports on effectiveness or criteria for evaluation of the measures is also poorly documented in the open literature. Further, there are no specific design or construction guidelines for engineered containment measures tailored to the conditions normally encountered with contaminated dredged material in CDFs (Palermo and Averett 2000).

Additional design and construction guidance for CDF containment features is being developed under the USACE DOER program. Information on design approaches or field experiences is welcomed (email contacts averetd@wes.army.mil or palermm@wes.army.mil) and will be used in developing the DOER technical guidance.

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REFERENCE

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